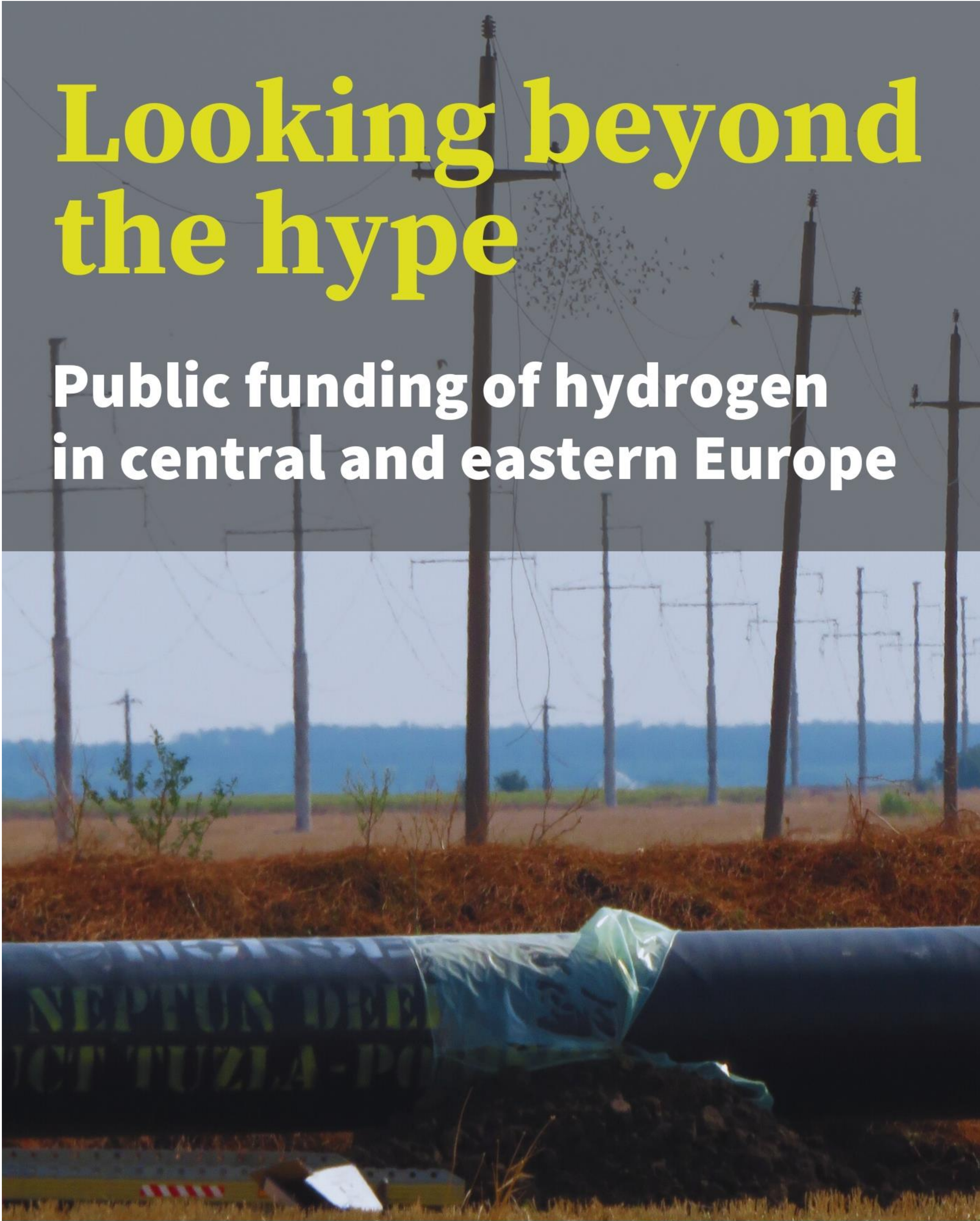
Looking beyond the hype

Public funding of hydrogen in central and eastern Europe



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Cover photo: The Tuzla-Podisor pipeline in Romania under construction, CEE Bankwatch Network

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Table of contents

Introduction 4

Hydrogen in the EU: what kind and for what purpose? 5

Funding for renewable hydrogen in the EU 8

Country overviews 10

- Hungary 10
- Poland 16
- Romania 21
- Tuzla-Podisor pipeline 24
- 'Hydrogen-ready' CHPs 24

Key challenges 27

Recommendations 29

Introduction

In recent years, hydrogen has become a household name in the context of the green transition, chiefly due to its omnipresence on the EU policy landscape. It has the potential to support decarbonisation efforts in hard-to-abate sectors, where electrification is too costly and inefficient, and the EU has made efforts to create the necessary legislative and regulatory frameworks. It has also unlocked billions in public funds to support the creation of a hydrogen market in Europe.

Since the European Commission published its Hydrogen Strategy in 2020,[1] many Member States have followed suit by developing their own national hydrogen strategies to determine what role this energy carrier has in their decarbonisation process.

But evidence is mounting that the Commission may have been too optimistic about hydrogen's contribution.

This briefing explains this issue and shows that similar over-optimism about hydrogen's role is prevalent in the central and eastern European EU Member States. It covers three central and eastern European countries – Hungary, Poland and Romania – based on analysis of their national hydrogen strategies and national energy and climate plans (NECPs).

Focusing on the targeted sectors, types of hydrogen considered, current demand and production and publicly funded hydrogen projects, it finds that they are unfocused and risk wasting significant amounts of public funding on fossil fuels and/or hydrogen use in inefficient applications. Hydrogen is treated as an all-around solution rather than developing it in limited applications where it can support the decarbonisation efforts.

We conclude that public financing in the EU must be restricted and targeted at the most needed end-use applications, primarily for the replacement of current fossil-based hydrogen applications, and in energy-intensive industrial processes and long-distance transport that are difficult to electrify. It should not be available for solutions outside of that scope.

[1] European Commission, A hydrogen strategy for a climate-neutral Europe, *EUR-Lex*, 8 July 2020.

Hydrogen in the EU: what kind and for what purpose?

The European Commission's vision is outlined in the EU Hydrogen Strategy of 2020,[2] REPowerEU plan of 2022,[3] Renewable Energy Directive (RED) delegated acts adopted in 2023,[4, 5] and hydrogen and gas decarbonisation package adopted in 2024,[6] to name a few.

According to the Hydrogen Strategy,[7] this energy carrier is needed to decarbonise carbon-intensive industries such as steel, chemicals, and cement, and heavy-duty transport, shipping, and aviation where electrification is not an efficient solution. The role of hydrogen in energy storage, grid balancing and ammonia production for fertilizers is also highlighted.

The plan is to start by replacing the current uses of fossil hydrogen in refineries and ammonia and methanol production, specific parts of the rail network, and heavy-duty road vehicles which are difficult or not feasible to electrify.

The EU's policy priority is the production of renewable, or 'green' hydrogen, as it has the most significant greenhouse gas emissions reduction potential.[8] Unlike fossil-based 'grey' (without carbon capture) or 'blue' (with carbon capture) hydrogen, which can play no useful role in decarbonisation, as both are associated with high carbon dioxide and methane emissions[9], renewable hydrogen does have a – limited – role in climate policy, as it is needed in the decarbonisation efforts of hard-to-abate sectors.

To accelerate the energy transition, the Hydrogen Strategy and REPowerEU plan set a renewable hydrogen production target of 10 million tonnes. The REPowerEU plan also added an import target of 10 million tonnes by 2030. These targets aim to reduce the EU's dependence on fossil gas more quickly than planned before 2022, as hydrogen is planned to replace some of the current applications of fossil gas in industry.

The RED delegated acts classify renewable hydrogen as one of the 'renewable fuels of non-biological origin' (RFNBO) and outline the definition of renewable hydrogen. Renewable, or RFNBO, hydrogen is produced by electrolysis (splitting water into hydrogen and oxygen), while the process itself is powered by electricity

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[2] Ibid.

[3] European Commission, REPowerEU Plan, *EUR-Lex*, 18 May 2022.

[4] European Commission, Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin, *EUR-Lex,* 10 February 2023.

[5] European Commission, Commission Delegated Regulation (EU) 2023/1185 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels, *EUR-Lex*, 10 February 2023.

[6] European Commission, Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC, *EUR-Lex,* 13 June 2024.

[7] European Commission, A hydrogen strategy for a climate-neutral Europe, *EUR-Lex*, 8 July 2020.

[8] Ibid.

[9] Robert W. Howarth, Mark Z. Jacobson, How green is blue hydrogen?, *Energy Science & Engineering*, *9*(10), 1676-1687, 2021.

from renewable sources such as wind and solar. Renewable hydrogen, if produced at the site of consumption, can also reduce dependence on imported fuels.

However, renewable hydrogen is not without its challenges. In 2023, only 0.1 to 0.2 per cent of hydrogen produced globally was renewable, with the majority produced from unabated fossil gas.[10] This is because producing renewable hydrogen is currently 1.5 to 6 times more costly than unabated fossil-based production.[11] While the cost-effectiveness of renewable hydrogen is expected to increase as renewable energy and electrolyser production are scaled up, the efficiency problem is an insurmountable physical barrier to reducing the cost.

The ‘hydrogen economy’, when considering the entire value chain from production, transportation to end uses for hydrogen, is inefficient due to highly energy-intensive production and energy losses along the supply chain.

When renewable electricity is converted into hydrogen, approximately 20-30 per cent of the energy is lost during the production process.[12] Additionally, storing and compressing the produced hydrogen requires an extra 10-15 per cent of the energy.[13] Furthermore, when hydrogen is converted back into usable energy, either through combustion or in fuel cells, there is an additional efficiency loss ranging from 20 to 60 per cent, depending on the technology used for conversion.[14] Production of synthetic fuels from hydrogen, such as ammonia and methanol, also involves additional energy losses.

Due to these efficiency losses, direct electrification of end uses must be prioritised, while hydrogen as a comparatively inefficient decarbonisation tool should only be used where other options are not available.

These issues of efficiency and price have not helped the EU achieve the overly ambitious goals set by the Commission in 2020. The strategic objective for 2024 was to install at least six gigawatts (GW) of renewable hydrogen electrolysers, and produce up to one million tonnes of renewable hydrogen. In September 2023, the capacity of renewable hydrogen electrolysers was 0.23 GW, amounting to a slim four per cent of the intended strategic objective of 6 GW, while production was around 0.03 million tonnes.[15] Based on these figures, the EU’s renewable hydrogen production would have to increase 200-fold in the next five years to reach the goal of 10 million tonnes by 2030.

The lack of connection between policy objectives and reality reflects a perception of hydrogen as a magic bullet on the political level, while it has shown only a fraction of its claimed usefulness in practice.

Moreover, as countries struggle to scale up their renewable energy capacity at a sufficient pace to ensure the electrification of heat, cooling, transport and some industrial sectors, utilising renewables for inefficient

[10] International Energy Agency, Global Hydrogen Review 2024, *International Energy Agency,* October 2024.

[11] Ibid.

[12] IRENA, Green Hydrogen Cost Reduction: Scaling up Electrolysers to Meet the 1.50C Climate Goal, *International Renewable Energy Agency,* 2020.

[13] EECA, Green Hydrogen, *Energy Efficiency and Conservation Authority of New Zealand,* accessed 28 October 2024.

[14] Ibid.

[15] Hydrogen Europe, Clean Hydrogen Monitor 2023, *Hydrogen Europe*, October 2023.

hydrogen production threatens to compete with direct use of electricity. Therefore, renewable hydrogen should only be manufactured using additional renewable power, e.g. produced when demand is lower.

Overall, while renewable hydrogen is still a necessary part of decarbonising certain sectors, its price and efficiency challenges will make it a relatively scarce resource which will need to be targeted to decarbonise processes where it is needed the most and where there is no better alternative.

There are signs that the European Commission has started to understand this. In February 2024, in its impact assessment for a 2040 climate target for the EU, the Commission assumed total production of just over three million tonnes of hydrogen by the end of the decade, far below the Hydrogen Strategy and REPowerEU targets.[16]

Indeed, a July 2024 European Court of Auditors (ECA) report[17] on the EU's renewable hydrogen industrial policy warns the Commission that it is 'time for a reality check' regarding the EU's hydrogen production and import targets for 2030, calling them unrealistic and overly ambitious. The ECA further criticises the Commission for failing to do proper analyses before setting the targets, highlighting the wider issue of a lack of evidence-based decision-making on hydrogen.

[16] European Commission, Commission Staff Working Document, Impact assessment report part 3 accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Securing our future: Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society, *EUR-lex*, 6 February 2024.

[17] European Court of Auditors, The EU's industrial policy on renewable hydrogen – Legal framework has been mostly adopted – time for a reality check, *European Court of Auditors,* 16 July 2024.

Funding for renewable hydrogen in the EU

The EU Hydrogen Strategy's targets and plans are supported by various financing mechanisms from different funding streams. An estimate of the funding available, covering both technology-neutral funds for which hydrogen projects may apply and those targeted only at hydrogen, amounts to USD 137.7 billion (around EUR 126.8 billion) in the EU and its Member States, of which USD 67.9 billion (around EUR 62.5 billion) is EU funding.[18] However, most of this funding is not targeted only at renewable hydrogen but includes low carbon hydrogen in almost all funds.[19]

Funding estimates also differ significantly among sources. The European Court of Auditors report[20] estimates that in reality there is EUR 18.8 billion available for hydrogen projects in EU funding programmes until 2027, and most of it is derived from the Recovery and Resilience Facility.

Table 1. EU funding sources for hydrogen, 2021-2027[21]

Fund	Type of hydrogen	Funds available (EUR million)	Details
Connecting Europe Facility – Transport	Renewable Low carbon[22]	250 (committed)	Refuelling stations, production and storage facilities
Connecting Europe Facility – Energy	Renewable Low carbon	3.4 (committed)	Networks and storage
Innovation Fund – European Hydrogen Bank	Renewable	800 (committed)	Domestic production and import of renewable hydrogen
Innovation Fund – Projects	Renewable Low carbon	2 202 (committed)	Production and use of hydrogen and electrolyser manufacture

[18] The Oxford Institute for Energy Studies, 2024 State of the European Hydrogen Market Report, *Oxford Institute for Energy Studies*, June 2024.

[19] Ibid.

[20] European Court of Auditors, The EU's industrial policy on renewable hydrogen – Legal framework has been mostly adopted – time for a reality check, *European Court of Auditors,* 16 July 2024.

[21] Ibid.

[22] According to Directive (EU) 2024/1788 on common rules for the internal markets for renewable gas, natural gas and hydrogen, ''low-carbon hydrogen' means hydrogen the energy content of which is derived from non-renewable sources, which meets the greenhouse gas emission reduction threshold of 70 % compared to the fossil fuel comparator for renewable fuels of non-biological origin set out in the methodology for assessing greenhouse gas emissions savings from renewable fuels of non-biological origin and from recycled carbon fuels, adopted pursuant to Article 29a(3) of Directive (EU) 2018/2001.' In practice, this means mostly nuclear-derived hydrogen and fossil gas-derived hydrogen with carbon capture and storage or usage. As any new nuclear plants would be built much too late to have a positive impact on the climate emergency, and the problem of long-term safe storage of radioactive waste remains unresolved, and as carbon capture is far from being commercially viable, low carbon hydrogen should not be supported with public funds in our view.

Horizon Europe - Clean Hydrogen Joint Undertaking	Renewable Low carbon	1 200 (allocated)	Research and innovation projects
Recovery and Resilience Facility (including REPowerEU)	Renewable Low carbon	13 628 (allocated)	All types of projects across the value chain
European Regional Development Fund, Cohesion Funds, Just Transition Fund	Renewable Low carbon	Unknown	All types of projects across the value chain
InvestEU + LIFE	Renewable Low carbon	799 (committed)	Production, supply and on-site storage projects
Modernisation Fund	Renewable Low carbon	Unknown	All types of projects across the value chain
European Investment Bank	Renewable Low carbon	Unknown	All types of projects across the value chain

Source: European Court of Auditors, Special report 11/2024: The EU's industrial policy on renewable hydrogen – Legal framework has been mostly adopted – time for a reality check, *European Court of Auditors*, 17 July 2024.

Country overviews

Hungary

Background

The National Hydrogen Strategy of Hungary[23] was adopted in 2021 and is scheduled to be reviewed in 2025. Its vision is to develop '*potent competencies with regard to the key elements of the hydrogen value chain, which, supplemented through targeted RDI and economic development activities, will serve to promote the shift towards a carbon-free society and to maintain the competitiveness of the Hungarian economy.*'

The Strategy mentions different types of hydrogen: green, blue, turquoise, grey; 'low-carbon' and 'carbon-free', but does not clearly define them, obscuring their potential climate impacts.

Renewable hydrogen, produced primarily from solar energy, is stated as the long-term focus. However, no dedicated renewable hydrogen target is set, only targets for 'green and other carbon-free' hydrogen, which includes nuclear and possibly biomass, whose carbon neutrality is hotly debated.[24]

The Strategy argues for the use of fossil hydrogen with carbon capture and storage (CCS) in the short and medium-term to establish a viable hydrogen market, but it is part of consumption scenarios even in 2050. Modelling for the country's updated NECP (2024) includes hydrogen without specifying the source or production method.

In 2020, according to the Strategy, Hungary consumed 160,000 tonnes of fossil hydrogen, which was driven by fertiliser production (115,000 tonnes), oil refining (25,000 tonnes), and the chemical industry (20,000 tonnes).

But in the future, the Hungarian government expects the main demand for hydrogen to come from industry and transport sectors. The targeted industries are ammonia production, iron and steel (from 2040), chemicals, and, to a lesser extent, refineries and cement. Renewable or nuclear hydrogen might be used in heating and cooling and power generation after 2040.

According to the Hungarian NECP's trajectories,[25] hydrogen is expected to support the decarbonisation of the transport sector (heavy duty vehicles, buses) in Hungary, starting from 2026. The WAM (With Additional Measures) scenario of the NECP projects that the contribution of hydrogen could reach up to a quarter of the energy use levels in transport by 2050.[26]

The Strategy includes direct investments such as the Green Bus Programme which includes piloting the use of hydrogen in public transport, and the Green Truck Programme, as well as the introduction of hydrogen

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[23] Government of Hungary, Hungary's National Hydrogen Strategy, *Government of Hungary*, May 2021.

[24] World Wide Fund For Nature, Scientist Letter to Biden, von der Leyen, Michel, Suga & Moon Re. Forest Biomass, *World Wide Fund For Nature*, 11 February, 2021.

[25] Government of Hungary, National Energy and Climate Plan 2024 update, *Government of Hungary*, 2024.

[26] Ibid., 242.

as a means of seasonal electricity storage. Priority projects include CO_2 transportation and storage, system integration, and carbon capture and utilisation in petrochemistry.

Out of 162,000 tonnes of estimated domestic hydrogen production by 2030, the Strategy aims to produce 20,000 tonnes per year of 'low carbon' fossil gas-based hydrogen with carbon capture and 16,000 tonnes per year of 'green and other carbon-free' hydrogen, with 240 MW of electrolyser capacity installed. Additional renewable production needs for hydrogen production are not covered in the Strategy or the NECP. The rest of the hydrogen will be produced from fossil gas.

Although it expects a significant decrease in fossil hydrogen production between 2030 and 2040 and increased production of renewable and nuclear hydrogen between 2040 and 2050, the Strategy still foresees a key role for fossil gas. Reaching 1.5-fold growth of domestic hydrogen production by 2050 compared to 2020, it envisages that fossil-based hydrogen with carbon capture will make up 43 per cent of production – more than 100,000 tonnes – feeding fossil gas dependency.

The Strategy does not reveal any plans to import or export hydrogen until 2030. In the first few years, even domestic transportation of hydrogen remains limited as production and consumption are geographically linked. However, the NECP indicates that after 2030, the higher RFNBO targets of the RED Directive would be partially covered by imports and underlines the importance of security of hydrogen supply in the future. Hungary plans to join hydrogen corridors and participate in the European Hydrogen Backbone by 2030, as well as establishing a regional transit function, implying future cross-border trade.

According to the Strategy, at least two per cent of hydrogen is to be blended with fossil gas in the existing fossil gas transmission system by 2030, followed by building dedicated hydrogen pipelines. Some would be conversions of existing pipelines, and some would be built from scratch, depending on demand. Conversion of the existing gas pipelines and compressor stations is already being studied. The calls for tender for the new combined cycle gas turbine (CCGT) units of the Matra and Tisza II power plants mention at least five per cent and up to 30 per cent hydrogen blending respectively.

Hungary is exploring the possibility of converting some gas storage capacities into hydrogen storage. MFGT (Hungarian Gas Storage Ltd) is carrying out a pilot project entitled 'Aquamarine', which aims to test underground gas storage facilities for hydrogen compatibility. The country is also looking to adapt its gas storage facilities to shift from east-west transport routes to a more south-north-west direction and make them hydrogen-compatible, but without describing specific measures in this regard.

The Strategy outlines plans for two hydrogen valleys: the Transdanubian one, linked to the Paks nuclear plant, and the Northeastern Hydrogen Valley, which may be linked to the new planned CCGT plant at the site of the current Matra coal power plant.

The NECP refers to further expansion of Hungary's cross-border fossil gas capacities in a general manner, mentions the gas TSO's network development plan and makes a concrete reference to a new fossil gas interconnection with Slovenia, which is to be fully hydrogen compatible. According to the NECP, this would provide Slovenia with direct access to Hungary's fossil gas storage capacity, while Hungary would have an alternative sourcing route for LNG and future hydrogen imports via northern Italy.

The gas TSO's draft 10-year network development plan[27] also describes projects (to be implemented in 4-10 years) further examining the transformation of gas pipelines, and proposes hydrogen corridors with new (SI, SK, RO) and repurposed (UA) pipelines in order to prepare for import/export and injection needs. Hungary also plans to initiate combination pilot programmes (co-firing of fossil gas and hydrogen) for CCGT.

Financing

A few priority projects of the Hydrogen Strategy have cost estimates with possible funding sources (operational programmes for EU funds, the Modernisation Fund, national budget). However, there is no estimate of the overall costs necessary to achieve targets set by the Strategy.

The revised NECP provides information on financing hydrogen from the REPowerEU and the Hungarian Environmental and Energy Efficiency Operational Programme Plus[28] (EEEOP Plus), financed by the Cohesion Fund/European Regional Development Fund (ERDF).

The national Recovery and Resilience Plan and REPowerEU plan[29] includes measures for hydrogen production, hydrogen trucks, buses, and refuelling stations. The REPowerEU chapter[30] allocates EUR 180 million to renewable hydrogen production (30 MW electrolyser capacity) and utilization for transport (hydrogen vehicles and filling stations), aiming to contribute to the goals of the Hydrogen Strategy.[31]

EEEOP Plus allocates EUR 140 million to promote the widespread use of hydrogen, including non-renewable hydrogen. Although no hydrogen-related EEEOP Plus calls for proposals have been published yet, the project types that may be supported include hydrogen production, storage, use and hydrogen transportation. The OP declares that the scheme also aims to support carbon capture technologies for 'low carbon' hydrogen production and the upgrading of existing gas infrastructure to blend hydrogen.

The Just Transition Fund may also finance a small hydrogen pilot project under the innovative energy storage measure.

Regarding national funds, revenues from the EU Emissions Trading System have been a notable source of funding for hydrogen with allocations of about EUR 50 million spent on various planning, pilot and demonstration projects on hydrogen production, storage and transport.[32]

The Hydrogen Strategy does not include assessments about the social impacts of Hungary's hydrogen plans such as costs for end users.

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[27] FGSZ, National Ten-Year Development Proposal of the Integrated Natural Gas System, *FGSZ*, August 2024.

[28] Government of Hungary: Környezeti és Energiahatékonysági Operatív Program Plusz, *Government of Hungary,* 2023.

[29] Government of Hungary, Magyarország Helyreállítási és Ellenállóképességi Terve, *Government of Hungary*, 2023.

[30] Government of Hungary, REPowerEU Terv, *Government of Hungary,* accessed 28 October 2024.

[31] Government of Hungary, Updated National Energy and Climate Plan 2024, *European Commission,* Policies and Measures Annex I.

[32] Hungarian State Treasury, OTR Treasury Monitoring System, *Hungarian State Treasury,* accessed 28 August 2024.

Table 2. Hungarian Hydrogen Strategy funding needs estimates

Project	Fund (2021-2027)	Estimated cost (EUR million)	Type of hydrogen	Description
Green Truck Programme	CF/ERDF	95-110	Not defined	Building a charging network, developing supporting and service industries for hydrogen-powered trucks, procurement of vehicles
Green Bus Programme Plus	National budget CF/ERDF	28-55	Not defined	300 electric and hydrogen-powered buses by 2025, deployment of charging points
Establishment of hydrogen valleys in Hungary	CF/ERDF	28-42	Renewable Nuclear Fossil gas with CCS	2 hydrogen valleys to be established by 2030: Transdanubian hydrogen ecosystem (involving Paks nuclear plant) and North-eastern hydrogen valley (possible link to Matra CCGT)
Hydrogen Highway project	CF/ERDF MF	55-83	Renewable Nuclear	Assessment and repurposing of existing gas transmission and storage infrastructure
Blue Hydrogen project for industrial hydrogen usage	CF/ERDF MF	55	Fossil gas with CCS	CCS technology deployment, CCU research, pyrolysis pilot project, developing background industry and services
Hydrogen research, development and innovation	CF/ERDF MF	28	N/A	RDI, education

Source: Government of Hungary, Hungary's National Hydrogen Strategy, *Government of Hungary*, 2021.

Table 3. **Allocations for hydrogen-related schemes in Hungary**

Project	Fund	Allocation (EUR million)	Type of hydrogen	Description
Promotion of the use of hydrogen	ERDF State budget	140	Renewable Nuclear Fossil gas with CCS	Hydrogen production, use, transport, storage Hydrogen charging stations Establishing industry clusters Blending hydrogen into gas infrastructure
Hydrogen investments – H2 production pillar	RRF/REPowerEU	135	Renewable	30 MW electrolyser capacity
Hydrogen investments – H2 utilization pillar	RRF/REPowerEU	45	Not mentioned	47 hydrogen-powered vehicles, 5 hydrogen filling stations

Source: Government of Hungary, Final updated NECP 2021-2030 (submitted in 2024), (Annex I. Policies and Measures no. 93-95)

Table 4. **Hydrogen-related projects that have received public funding in Hungary**

Project	Fund	Allocation (EUR million)	Type of hydrogen	Description
Establishment of National Hydrogen Technology Laboratory[33]	RRF	15.7	N/A	RE and Hydrogen Laboratory financed together Hydrogen technologies & carbon capture and use
Aquamarine project[34]	State budget Private	13	Not mentioned	2.5 MW electrolyser, testing underground gas storage facilities for hydrogen compatibility
Hydrogen blending in the gas transmission	State budget	6	Not mentioned	Pilot project to build and test system elements for transporting max. 10 per

[33] HUN-REN Hungarian Research Network, Megújuló Energiák Nemzeti Laboratórium – HUN-REN TTK, *HUN-REN Hungarian Research Network,* accessed 28 October 2024.

[34] MFGT Hungarian Gas Storage Ltd., Akvamarin, *Hungarian Gas Storage Ltd,* accessed 28 October 2024.

system (Flumen project)[35,36]				cent hydrogen in the gas transmission system
Power-to-gas hydrogen storage[37]	State budget	3	Renewable	Hydrogen storage system using renewable energy produced from the Bükkábrány solar power plant
Hydrogen production, storage and transport[38,39]	State budget	5.2	Renewable	Technology demonstration and establishing business case for commercial scale
Small-scale water transport[40]	ERDF	0.2	Not mentioned	Development of prototype hydrogen fuel cell for small ships on Lake Balaton and rivers

[35] Miskolc University, FLUMEN Projekt (1. fázis), *Miskolci Egyetem,* accessed 28 October 2024.

[36] Miskolc University, FLUMEN Projekt (2. fázis), *Miskolci Egyetem,* accessed 28 October 2024.

[37] Bükkábrány Energy Park, Mérföldkövek, *Bükkábrányi Energiapark,* accessed 28 October 2024

[38] Hungarian Hydrogen and Fuel Cell Association, Hydrogen newsletter 2021/1, *Hungarian Hydrogen and Fuel Cell Association,* 6, April 2021.

[39] National Research, Development and Innovation Office, Karbonmentes, többlet villamos energia innovatív technológia által gázenergiává (hidrogén, biometán) történő alakítását célzó fejlesztések megvalósítása (2020-3.1.2-ZFR-KVG), támogatott projektek, *NKFIH,* accessed 28 October 2024.

[40] Kontakt-Elektro Ltd., GINOP-2.1.2, *Kontakt-Elektro Ltd.,* accessed 28 October 2024.

Poland

Background

Poland is the third largest hydrogen producer in the EU. In 2023, Poland produced and consumed 0.729 million tonnes of fossil-based hydrogen, produced almost exclusively by steam methane reforming (SMR). Currently there are virtually no commercially functioning electrolysers for renewable hydrogen production in the country. The role of international hydrogen trade in Poland is negligible (151 tonnes imported, 230 tonnes exported in 2023).[41]

Currently, hydrogen is used primarily as a feedstock in the chemical, petrochemical and refining industries, the fertilizer sector being the single largest consumer.

The Polish Hydrogen Strategy until 2030 with an outlook to 2040[42] was adopted in November 2021. It builds on two other strategic documents: the Energy Policy of Poland until 2040 adopted earlier in 2021 and the National Climate and Energy Plan for the years 2021-2030 (NECP) of 2019. A comprehensive update of the Energy Policy is expected in early 2025. As the Hydrogen Strategy is based on assumptions from the outdated NECP and Energy Strategy, it does not reflect the current state of the energy sector or current EU climate policy accurately. However, the updated draft NECP (under public consultation until 15 November 2024) upholds the Hydrogen Strategy's targets.

The overarching goal of the Strategy is to create a hydrogen economy in Poland by developing the entire value chain for electricity, heat, transport and industry, while decarbonisation remains a secondary priority.

By 2025, the Strategy expects 50 MW installed capacity of 'low carbon' hydrogen production facilities and by 2030, 2 GW; and it foresees at least five hydrogen valleys established by 2030 out of a total of 11 potential valleys identified; 100-250 hydrogen buses in use by 2025 and 800-1000 by 2030; and a minimum of 32 hydrogen filling stations by 2025.

The Strategy adopts a technology-neutral approach to hydrogen. Three types of hydrogen are defined based on the level of CO_2 emissions from their production rather than a specific technology:

- conventional hydrogen (fossil hydrogen without carbon capture and storage (CCS));
- 'low carbon' hydrogen (including nuclear hydrogen and fossil gas hydrogen with CCS, produced from renewable or non-renewable energy sources with a carbon footprint of less than 5.8 kg CO_2 eq/kg H2);
- renewable hydrogen (CO_2 emissions below 1kg CO_2 eq/kg H2).

No projections of future total hydrogen demand or targets related to hydrogen production by different technologies are provided. Meeting the Strategy's indicators is expected to create demand for 193,634

[41] European Hydrogen Observatory, Hydrogen demand: Poland, *European Hydrogen Observatory*, 2024.

[42] Ministry of Climate and Environment of Poland, Polish Hydrogen Strategy until 2030 with an outlook until 2040, *Ministry of Climate and Environment*, 2021.

tonnes of hydrogen by 2030, to be covered by domestic production of 'low carbon' hydrogen, which is prioritised.

In the 'transition period' until 2030, fossil hydrogen from SMR is expected to dominate the market due to its lower costs and insufficient renewable hydrogen capacity. Although governmental support is limited to 'emission-free' technologies, most of the 'low carbon' hydrogen production methods cause significant GHG emissions, for example gas with CCS, in which the CCS may never materialise. This creates a serious risk of funding hydrogen production from fossil fuels and missing the country's decarbonisation goals.

According to the Strategy, use of 'low carbon' hydrogen will significantly reduce the greenhouse gas emissions in energy, heating and transport. However, even the Strategy's Annex concludes that its implementation will not yield significant reductions in either 2030 or 2040, with the avoided CO_2 emissions contributing to only 3.08 per cent of estimated national greenhouse gas emission reductions by 2030.

The Strategy is dominated by an 'all of the above' approach – there is no clear prioritisation for hydrogen applications. The long-term plans include almost every use of hydrogen and technology in development, with little consideration of technical feasibility, economic rationale, and the availability of hydrogen to cover this demand. Hydrogen is treated as a universal replacement for coal and fossil gas in the energy sector and of liquid fuels in transportation, yet its energy efficiency or cost-effectiveness compared to alternatives is not addressed.

The decarbonisation of existing demand for fossil hydrogen in industry is given less focus, with the chemical and oil industry as the main beneficiaries. Decarbonisation of steel manufacturing is given least priority although it generates 22 per cent of the CO_2 emissions in industry. The Strategy, unwisely, also includes future hydrogen use in heating and cooling, with the updated NECP highlighting potential large investments in heating and cooling infrastructure to blend hydrogen with fossil gas.

Transport as one of the priority objectives has a strong emphasis in the Strategy, with plans to use hydrogen in all modes of transport, focusing on urban transport (local buses) and heavy and long-haul transport.

The Strategy plans local renewable and 'low carbon' hydrogen production to meet domestic demand, however it only accounts for the new demand generated by carrying out the planned new projects and not the existing hydrogen demand, currently covered by fossil hydrogen. Therefore, the planned renewable hydrogen production capacity falls short when the total domestic demand is considered. The updated NECP targets for 2030 will require imports of approximately 113,000 tonnes of hydrogen.

Poland intends to stimulate investments in gas infrastructure by retrofitting existing gas infrastructure to achieve 10 per cent blending of biomethane and hydrogen by 2030 to (barely, if at all) lower the carbon emissions from fossil gas.

According to the Strategy, hydrogen production as close as possible to energy sources and demand centres is considered optimal. At first, hydrogen will be transported primarily using road and rail transport. A feasibility study for a Hydrogen Highway – a north-south hydrogen pipeline – is mentioned, as well as participation in the European Hydrogen Initiative and European Hydrogen Backbone. In 2023, PCI status was granted to a Hydrogen interconnector between Finland, Estonia, Latvia, Lithuania, Poland and Germany (Nordic-Baltic Hydrogen Corridor). No projects related to electrolysers in Poland were submitted.

However, hydrogen production sites in Poland will in many cases be located far away from the end use locations, which requires developing infrastructure for the transfer and distribution of hydrogen, ammonia or their derivatives (new pipelines and transshipment terminals). Poland is, according to the Strategy, expected to play an important role as a transit country between the Baltic Sea region and Germany and in coordinating the hydrogen trade throughout central and eastern Europe, including with Ukraine.

Although the draft NECP update[43] upholds the Hydrogen Strategy's targets, they are put in the context of the RED RFNBO goals and explicitly refer to hydrogen as 'green hydrogen' only. According to the draft, Poland will need approximately 315,000 tonnes of RFNBO hydrogen in 2030 (16.7 TWh of renewable electricity), 91,700 tonnes for transport and 270,000 tonnes for industrial processes (with approximately 225,000 tonnes consumed by the ammonia industry to sustain fertilizer production). The maximum domestic production is expected to reach 156,000 tonnes, and the remaining 113,000 tonnes would need to be imported either as hydrogen or green ammonia.

According to the NECP WAM scenario,[44] in 2040 more heat and cooling is generated from hydrogen than from geothermal energy and photovoltaics combined. Only part of the 'green hydrogen' produced would be directed to the transport, industry and heating sectors, with the rest to be burnt in gas turbines and CCGT units (all of which are assumed to be 'hydrogen ready'). In 2040, 17.8 TWh or 6 per cent of electricity is to be produced from hydrogen. All of this seems highly unlikely in view of renewable hydrogen's high costs and limited availability.

According to the draft NECP, providing RFNBO hydrogen for industry and transport to meet the goals of the RED will be at the core of the update of the Hydrogen Strategy. It will be focused on deciding whether it is more beneficial to produce RFNBO hydrogen domestically or to rely on imports, and on construction of infrastructure for hydrogen transmission and distribution. Support for the initiative to build a Nordic-Baltic Hydrogen Corridor is stressed. Although no assessment of total hydrogen demand in industry, transport and energy sector is provided in the draft NECP, it is highly unlikely that it could be met by renewable hydrogen only.

Financing

According to the Hydrogen Strategy, the early stage of development of hydrogen technologies and lack of in-depth analyses allows only a limited estimate of the costs necessary to reach the goals. The capital expenditures in public transport and hydrogen production until 2030 will amount to about EUR 2.8 billion, with low- and zero-emission hydrogen production facilities costing EUR 2.2 billion, and the rest is allocated to purchasing hydrogen buses (EUR 540 million) and building hydrogen refuelling stations (EUR 60 million).[45] At least EUR 280 million will be provided from national funds, with the rest to be sourced from the EU.

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43 Ministry for Climate and Environment of Poland, Projekt Krajowego Planu w dziedzinie Energii i Klimatu do 2030 r. – wersja do konsultacji publicznych z 10.2024 r., Government of Poland, October 2024.

44 Ibid.

45 Approximate calculated costs in EUR are based on the original costs in PLN in the Hydrogen Strategy: PLN 12 billion (low-and zero-emission hydrogen production facilities costing PLN 9.2 billion; purchasing hydrogen buses PLN 2.3 billion; building hydrogen refuelling stations PLN 0.25 billion).

Table 5: **Hydrogen-related projects that have received public funding in Poland**

Project	Fund (2021-2027)	Allocation (EUR million)	Type of hydrogen	Description
Cogeneration for energy and industry[46]	MF	444 (0-444)	All types	Allows for a mixture of 'low emission gases' like synthetic gas and hydrogen, which can include fossil gas and fossil-based hydrogen
Hydrogen manufacturing, storage and transport[47]	RRF	800	All types	25 hydrogen refuelling stations and 320 facilities, including electrolysers
H2 Silesia,[48] construction of a large-scale renewable hydrogen production facility	IPCEI Hy2Infra	218	Renewable	105 MW production capacity
Hydrogen production from electrolysis to blend with fossil gas[49]	ERDF	2.9	Renewable Supports fossil gas	Hydrogen for blending, supports fossil gas consumption
Hydrogen mobility[50]	CEF Transport	12.8	All types	Construction of five hydrogen refuelling stations, including stationary hydrogen storage facilities

[46] Modernisation Fund, EIB confirmation of priority investment, *Modernisation Fund*, 2021.

[47] European Commission, Poland's recovery and resilience plan, *European Commission*, 2023.

[48] Polenergia, NOTIFICATION DECISION OF THE EUROPEAN COMMISSION CONCERNING STATE AID TO H2SILESIA UNDER IPCEI, *Polenergia,* 15 February 2024.

[49] Ministry of Development Funds and Regional Policy of Poland, Opracowanie systemu produkcji zielonego wodoru metodą elektrolizy, zasilanego z odnawialnych źródeł energii i łączącego wytworzony wodór z gazem ziemnym w elektronicznie kontrolowany i bezpieczny sposób, *Ministry of Development Funds and Regional Policy*, 2023.

[50] European Commission, Clean cities – hydrogen mobility in Poland (phase II), *European Commission,* 2022.

Hydrogen mobility along TEN-T road networks[51]	CEF Transport	62.3	Renewable	Construction of 16 refuelling stations and 1 hydrogen production plant
Oświęcim - Tworzeń gas pipeline[52]	ERDF	49.1	N/A	Pipeline will be adapted for the transport of mixtures of gas with small amount of hydrogen
Rembelszczyzna-Mory gas pipeline[53]	ERDF	62.2	N/A	Pipeline will be adapted for the transport of mixtures of gas with small amount of hydrogen

[51] European Commission, Clean cities – hydrogen mobility in Poland (phase III), *European Commission,* 2023.

[52] Ministry of Development Funds and Regional Policy of Poland, Budowa gazociągu Oświęcim-Tworzeń, *Ministry of Development Funds and Regional Policy*, 2023.

[53] Ministry of Development Funds and Regional Policy of Poland, Budowa gazociągu Rembelszczyzna-Mory, *Ministry of Development Funds and Regional Policy*, 2023.

Romania

Background

According to its Hydrogen Strategy,[54] Romania produced around 194,000 tonnes of hydrogen in 2021. Almost all of it is domestically produced from gas and oil by catalytic reforming and steam methane reforming and only 1.5 per cent by electrolysis. Hydrogen is used in oil refining (55.6 per cent), fertilizers (42.7 per cent), and other chemical industries (1.5 per cent).

The Romanian National Hydrogen Strategy and Action Plan were developed in 2023 but have not been officially adopted. Hydrogen is also part of the National Energy and Climate Plan,[55] but the targets are not as ambitious as in the Strategy. The government has taken some steps to develop a regulatory and financial framework for hydrogen, such as adopting a law to integrate renewable and low-carbon hydrogen in industry and transport in 2023,[56] which set mandatory targets for hydrogen use, and creating a Recovery Fund financing scheme for renewable hydrogen production. However, according to the Strategy, more legislation is needed to build the entire production chain and the market.

The Strategy outlines Romania's aim to develop a hydrogen economy by 2030 '*to decarbonise the economy by using renewable hydrogen in existing industry and expand its use to steelmaking and transport.*'

It also highlights the need to develop renewable hydrogen, and to a lesser extent so-called 'low carbon' hydrogen (meaning nuclear-based hydrogen in this case). Targets are set only for renewable hydrogen production to 2030: up to 153 kilotonnes (kt)/year of hydrogen produced, with 2 GW of electrolysers installed. In the NECP, Romania reduced its overly ambitious targets for hydrogen to 336 MW of electrolysers by 2030 – still very ambitious compared to the progress so far (see below).[57]

No specific targets are set for after 2030, when hydrogen is foreseen to be used in additional sectors such as cement production, power, heat, and storage. The Strategy mentions the production of so-called 'turquoise hydrogen' made via fossil gas pyrolysis with solid carbon as a by-product in 2030-2035 and nuclear-based hydrogen in 2035-2050.

The government's immediate priority is to replace current applications of fossil-based hydrogen with renewable hydrogen. It is expected that existing industry (excluding refineries) will use up to 135 kilotonnes (kt)/year of hydrogen in 2030, an increase of 67 per cent due to higher demand for fertilizers, of which 56.9 kt must be renewable, in order to comply with the RED requirements (at least 42 per cent of hydrogen used in industry should be RNFBO).

23.7 kt/year will be for additional applications in the steel industry and 72.9 kt/year for transport (which also includes refineries) such as heavy duty and light duty vehicles, buses, passenger cars but also trains.

[54] Energy Ministry of Romania, National Hydrogen Strategy and Action Plan 2023-2030, *Energy Ministry,* 8 November 2023.

[55] Energy Ministry of Romania, Integrated National Energy and Climate Plan of Romania, 2025-2030 update, *European Commission*, 16 October 2024.

[56] Government of Romania, Law 237/ 19.07.2023 to integrate renewable and low-carbon hydrogen in industry and transport sector, *Official Journal no. 669/20,* July 2023.

[57] Energy Ministry of Romania, Integrated National Energy and Climate Plan of Romania, 2025-2030 update, *European Commission*, 16 October 2024.

Although most of these plans go in the right direction, as they address hard-to-abate industry, electrifying lightweight vehicles and trains is much more efficient, cost-effective and easier than using hydrogen.

Romania's current production of fossil-based hydrogen is 194 kt/year, while the estimated target for renewable hydrogen is 153 kt/year by 2030. At least 41 kt of fossil-gas-based hydrogen will therefore still be used. Not all demand in existing industries will be met, yet some of the hydrogen is still planned for abatable sectors.

The government plans to develop fossil gas networks adapted to hydrogen transmission, but no targets are set for 2030. These networks will be rather local, in areas of industrial production.

By 2035, industries such as cement and electricity and heat production are expected to consume hydrogen, by cofiring 50 to 100 per cent hydrogen in gas power plants (combined cycle gas turbine (CCGT) and combined heat and power (CHP) and blending at least 20 per cent in the fossil gas transmission and distribution systems. There are also plans for seasonal storage of hydrogen.

The amount of hydrogen needed to replace fossil gas for these purposes is not estimated, but the numbers will be huge, since Romania uses around 10 billion cubic metres (bcm) of gas per year. Blending hydrogen with fossil gas results in low efficiency and will have a negative impact on fuel and energy pricing, while emissions will not be significantly reduced.[58]

By 2045, the Strategy states that most of the gas transmission system will be adapted to so-called green gases, while hydrogen will be expanded to other sectors such as chemicals production, construction products and metallurgy. It also predicts that renewable hydrogen will be also used to produce other fuels such as methanol, diesel, kerosene, ammonia.

In its Strategy, Romania is planning to produce all the necessary renewable hydrogen domestically by 2030. It is expected that 4261 MW of dedicated installed capacity in solar and wind and 2130 MW installed capacity in electrolysis is needed to meet the demand. Yet so far, Romania has two schemes for renewable hydrogen production for about 200 MW. One is financed through the Recovery and Resilience Facility to support the development of 100 MW electrolysis capacity.[59] In addition, the government launched a new state aid scheme in August 2024 for an additional 100 MW of electrolysis, aiming to draw funds from the Modernisation Fund.[60]

Romania currently has about 6 GW installed capacity of wind and solar. The aim set in the updated NECP is to reach 15.9 GW installed capacity by 2030, so an additional 10 GW is needed. However, it is not clear if this also includes dedicated capacity for hydrogen production.

There is no specific reference in the Strategy to hydrogen import/export capacity by 2030. However, cross-border transmission connections such as the Hydrogen Backbone and the HI-East corridor, that would facilitate imports from North Africa and the Middle East through Bulgaria and Greece, are mentioned.

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[58] Gniewomir Flis, 12 Insights on Hydrogen, *Agora Energiewende*, 23, January 2022.

[59] European Commission, State aid: Commission approves €149 million Romanian scheme under Recovery and Resilience Facility to support renewable hydrogen production, 8 August 2022.

[60] Energy Ministry of Romania, Key programme 4: Investments in renewable hydrogen production, *Energy Ministry*, 9 August 2024.

By 2035, Romania aims to develop international agreements for the cross-border trade of hydrogen and to connect the local hydrogen systems to the European Hydrogen Backbone where economically feasible.

For industry, production and storage will be localized to specific consumption sites. In the transport sector, the distribution of hydrogen to refuelling stations (39 by 2030) will be ensured by road or train, until a better solution is identified.

Transgaz has identified eleven gas transmission pipelines that could be integrated into the European Hydrogen Backbone after 2040, but it is not specified how much hydrogen they could carry. The Romanian government is expecting to use existing fossil gas infrastructure for the transport of hydrogen. The Strategy's Action Plan sets 2030 as a deadline for blending two per cent hydrogen with fossil gas, and expects 20 per cent by 2035, with a further transition to renewable gases by 2045. However, no additional explanation is provided for how to achieve this.

E.On Romania, a subsidiary of the German electric utility company E.On, is currently testing the potential for blending 20 per cent hydrogen in existing distribution networks, to find out if pipelines and home appliances function. This pilot project has also gained governmental support.[61]

Financing

Regarding non-refundable funding, the strategy and the NECP identify relevant EU and national grants, however, they do not mention how much funding from these programmes could go into hydrogen development.

The hydrogen projects that received funding under the Recovery and Resilience Plan[62] consist of construction of 60 MW of electrolysis by 2025 (the target for electrolysers was revised in 2023, initially it was 100 MW according to the NRRP),[63] for which EUR 150 million is allocated; the acquisition of 12 hydrogen trains and construction of one refuelling station (both cancelled due to lack of offers), while plans for a fossil gas distribution system adapted for hydrogen were also cancelled, due to the reduction of RRP funding for Romania. EUR 500 million has been allocated from the Modernisation Fund for 100 MW of electrolysis.[64]

Although cofiring of hydrogen in fossil gas power plants and the transmission network is planned to happen only after 2035, already a series of Romanian fossil gas projects which have received EU funding are promising to adapt to 'green' gases in the future. Two power plants amounting to around 1300 MW received EUR 420 million from the Modernisation Fund and the National Recovery and Resilience plan includes a EUR 300 million scheme for '*hydrogen-ready highly efficient combined heat and power plants*'. A similar scheme was approved also via Modernisation Fund, which has also supported two gas pipeline projects with EUR 93 million, claiming they will carry a fossil gas-hydrogen blend in the future.

[61] Energy Ministry of Romania, Delgaz Grid: Proiectul 20HyGrid a fost finalizat cu succes, concluziile fiind prezentate, *Energy Ministry*, 28 March 2024.

[62] Council of the European Union, Anexă la Decizia de punere în aplicare a Consiliului de modificare a Deciziei de punere în aplicare din 29 octombrie 2021 de aprobare a evaluării planului de redresare şi rezilienţă al României, *Council of the European Union*, 22 November 2023.

[63] European Commission, COMMISSION STAFF WORKING DOCUMENT Analysis of the recovery and resilience plan of Romania, 21 November 2023.

[64] Energy Ministry of Romania, Key programme 4: Investments in renewable hydrogen production, *Energy Ministry*, 9 August 2024.

Problematic EU-financed hydrogen projects

Tuzla-Podisor pipeline

Tuzla-Podisor is a 308-km pipeline project to bring Black Sea gas to the national gas grid. The pipeline has received **EUR 85 million in financing from the Modernisation Fund.** [65] One of the objectives of the proposal was that it 'is creating the conditions to transport the natural gas – hydrogen mix to reduce greenhouse gas emissions.' [66] But the project documents do not stipulate any hydrogen components or provisions for hydrogen transport. This was expected as the Tuzla-Podisor pipeline's purpose is to transport the extracted gas from the Black Sea. If built, the pipeline will enable the transport and consumption of around 8 bcm/year of fossil gas starting from 2027 until at least 2043, according to promoters.

'Hydrogen-ready' CHPs

Similarly, fossil gas-based CHPs that will be supposedly 'hydrogen-ready' have already been financed with **EUR 300 million from the Recovery and Resilience Facility**. The main motivation was allegedly to replace coal, and one of the commitments in the NECP is to make a full switch to renewable gases by 2036.

However, one such project is a 52 MW (160 MWt) gas CHP in the city of Constanta, replacing an existing gas heating power plant of 150 MW. The project mentions 'hydrogen readiness' in the EIA documentation,[67] but the project promoter confirmed though a public information request[68] that the current investment does not include hydrogen components for production, utilisation or storage. In its response, the city of Constanta representatives also say that the current project can include 20 per cent hydrogen in the mix and will be upgraded once the technology advances, but no date is provided. So, the power plant will continue to run on fossil gas for an unspecified period. Until now four such CHP projects have been financed and more are expected in the Modernisation Fund, as DG COMP approved an additional state aid scheme worth EUR 360 million in March 2024.[69]

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[65] European Commission, COMMISSION DECISION of 30.05.2023 on disbursement of revenues of the Modernisation Fund under Directive 2003_87_EC of the European Parliament and of the Council (Annex), *modernisationfund.eu,* 30 May 2023.

[66] Modernisation Fund Investment Committee, IC Recommendation on Non-Priority Proposal MF 2023-1 RO 1-001 - Gas Transmission Pipeline Black Sea-Podisor, *modernisationfund.eu*, June 2023.

[67] Environmental Protection Agency, Draft Screening decision, 29 June 2023.

[68] Answer of Constanta Municipality received 08.06.2023 to public information request formulated by Bankwatch Romania on 29 May 2023.

[69] European Commission, Commission approves prolongation and amendment of Romanian State aid scheme to support high-efficiency cogeneration of electricity and heat, *European Commission*, 6 March 2024.

Table 6. **Romanian NECP funding estimates for hydrogen projects**

Project	Fund	Estimated cost (EUR million)	Type of hydrogen	Description
Electric and Hydrogen public transport vehicles	CF RRF SCF Local budget	2 400	Not mentioned	Electric and hydrogen financed together, but the target is to have 1280 hydrogen buses by 2030
Electric and hydrogen cargo trucks	Environmental Fund SCF Private	9 200	Renewable	Electric and hydrogen financed together, but the target is to have 123.000 hydrogen trucks by 2030
'Hydrogen ready' gas transmission system	MF CEF Energy State budget	3 337	Renewable	This measure also includes the projects mentioned above which are already financed; 9 projects in total. The idea is to integrate hydrogen by 2035–2042
Introducing hydrogen in the power system	MF CF FTJ Innovation Fund Private	N/A	Renewable	50 per cent renewable hydrogen in 2600 MW of gas CCGT and CHPs by 2036. These gas facilities are already financed from EU funding. The estimation for upgrades to integrate 50 per cent H2 are not presented.
Hydrogen electrolysers	MF PTJ RRF Innovation Fund Private	N/A	Renewable	336 MW, of which 160 MW are already financed. The target is way below the Strategy.

Source: European Commission, Integrated National Energy and Climate Plan of Romania 2025-2030 Update, *European Commission*, October 2024.

Table 7. **Hydrogen-related projects and schemes that have received public funding in Romania**

Projects By 2024	Fund (2021-2027)	Allocation (EUR million)	Type of hydrogen	Description
Gas transmission pipelines, 'hydrogen ready'	MF[70]	93.5	Not mentioned	Two gas transmission pipelines Black Sea-Podisor and Gercesti-Jitaru that are 'creating the conditions to transport a natural gas - hydrogen mix
Fossil gas CHPs 'hydrogen ready'	RRF/REPower EU[71] MF	300 362	Renewable Low carbon	At least 500 MW
Electrolysis for hydrogen production	RRF[72] MF	150 500	Renewable	At least 160 MW
Hydrogen production in fertilizers industry	JTF[73]	21	Renewable	

[70] European Commission, Annex to the Commission Decision on the disbursement of revenues from the Modernisation Fund under Directive 2003/87/EC of the European Parliament and the Council - First biannual disbursement cycle of 2023, *Modernisation Fund,* 30 May 2023.

[71] Council of the European Union, Annex to the Council Implementing Decision amending Implementing Decision of 29 October 2021 on the approval of the assessment of the recovery and resilience plan for Romania, *Council of the European Union*, 22 November 2023; European Commission, Commission Staff Working Document, Analysis of the recovery and resilience plan of Romania, *European Commission*, 21 November 2023.

[72] Council of the European Union, Annex to the Council Implementing Decision amending Implementing Decision of 29 October 2021 on the approval of the assessment of the recovery and resilience plan for Romania, *Council of the European Union*, 159, 22 November 2023.

[73] Ministry of European Investments and Projects, The Just Transition Programme, *Ministry of European Investments and Projects*, 114, 2 December 2022.

Key challenges

Central and eastern European (CEE) governments are expecting hydrogen to play a significant part in their decarbonisation strategies, judging by the examples of Hungary, Poland and Romania. Despite the EU's focus on renewable hydrogen, the CEE countries are not so fast to bet on it and are weighing up their options across the whole hydrogen rainbow.

Whilst recognising the need to ramp up renewable hydrogen production, the countries have worrying plans to increase use of non-renewable hydrogen. None of the three countries' hydrogen strategies rule out the need for fossil-based hydrogen, not even after 2030.

Hungary and Poland also choose to use more 'technology neutral' definitions of hydrogen production technologies. Hungary lumps water electrolysis in with nuclear hydrogen under the blanket term 'green and other carbon-free hydrogen', while Poland classifies fossil gas with CCS, nuclear, and biomass-based hydrogen all as 'low-carbon' along with renewable hydrogen.

All three countries agree with the EU's priority sectors for hydrogen use: decarbonising industry and other hard-to-abate sectors. However, they do not stop there, treating hydrogen as a solution to every sector which needs decarbonising.

The unfocused nature of their hydrogen strategies and plans means that limited funding is not sufficiently targeted for the sectors most in need of renewable hydrogen. EU funds therefore risk being used to support fossil fuels and other high-risk and uneconomic alternatives such as nuclear.

One of the key issues in hydrogen strategies in Hungary, Poland and Romania is their affinity for blending hydrogen with fossil gas under the pretence that it will reduce carbon emissions. In Hungary, hydrogen is planned to be blended into the existing fossil gas transmission system, while new gas power plants plan to include a 5-30 per cent hydrogen blend. In Poland, retrofitted gas infrastructure is expected to accommodate a 10 per cent blend. In Hungary and Romania, the governments plan to initially blend two per cent hydrogen into the distribution network, with Romania aiming to reach 20 per cent and having invested EU funds for this purpose. Even assuming that renewable hydrogen will be used in all these cases – which is far from certain – the ultimate emissions savings would be marginal and represent a waste of a limited resource.

Perhaps the most obviously unsuitable application for hydrogen use has somehow also made its way into the strategies of all countries – the heating and cooling sector. Scientific findings[74] suggest that hydrogen is not a cost-optimal solution for decarbonising the heating sector, compared to electrification's higher efficiency and lower costs. Despite this evidence, Poland has included future large investments in heating and cooling infrastructure to introduce a hydrogen-fossil gas blend, while Romania plans to use hydrogen in heating after 2030, and Hungary potentially after 2040.

The countries have also failed to analyse the pace of deployment of additional renewable production needed to reach their renewable hydrogen production targets by 2030. The pace and scale of targets both within the EU and in those countries is unrealistic, bordering on impossible. This is also not reflected in

[74] Jan Rosenow, A meta-review of 54 studies on hydrogen heating. *Cell Reports Sustainability*, 2023.

hydrogen projects receiving public funding – Romania is the only country among these three allocating a relatively significant amount of funding for electrolysers, and even that is negligible compared to the intended renewable hydrogen consumption levels. None of the countries target the issue of necessary additional renewable capacity in their hydrogen strategies. Therefore, a massive funding and planning gap stands between the expected renewable hydrogen production capacity by 2030 and the reality of countries lacking funded electrolyser and renewables projects.

The importance of hydrogen in decarbonising the transport sector is also overinflated and problematic in all the countries, considering electrification, a more efficient and competitive alternative is available for local transport and passenger cars. A considerable amount of funding is allocated to purchasing unnecessary hydrogen buses and other vehicles in both Hungary and Poland.

All the countries are investing in hydrogen transmission, both by retrofitting gas transmission networks and developing cross-border projects and brand-new hydrogen pipelines, which is disproportionate to the scale of development of renewable hydrogen production capacities.

Lastly, there is a complete lack of consideration of the misuse of public funds or the social impact of the future renewable hydrogen price in the 'all-of-the-above' hydrogen applications approach that the countries are using. While many hydrogen projects proposed today will remain only dreams of fossil fuel companies, funding the wrong projects could still do a lot of damage. The public is at risk of footing a hefty bill.

Unfocused, unrealistic and unaffordable – these three adjectives summarise what the hydrogen strategies of Hungary, Poland and Romania have in common. They all provide unverified plans for their envisaged hydrogen economies.

Recommendations

Renewable hydrogen is scarce, expensive and the most useful solution only in a few select cases. Public financing in the EU should be restricted and targeted at those most needed end-use applications, and not be available for solutions outside of that scope.

- Remove support for projects that support the development or use of non-renewable hydrogen. Subsidisation of fossil hydrogen should not be permitted.
- Funding allocations should be based on independent, realistic, scientific assessments and projections of the future of renewable hydrogen, including costs to end users. Investments should be grounded in reality.
- Investments in demand-side projects should be directly related to and keep pace with the capacity and investments in supply-side projects to avoid a mismatch.
- Prioritise funding for production of renewable hydrogen near to point of consumption and high-efficiency hydrogen use in 'hard-to-abate' sectors over less efficient and no-go applications. Local public transport or passenger vehicles should not be seen as appropriate sectors for public support for hydrogen, and under no circumstances allow funding for developing the least efficient end-uses of hydrogen, such as heating and cooling.
- Remove funding for projects which blend hydrogen with fossil gas.
- Introduce other hydrogen use efficiency criteria based on life-cycle emissions savings, cost-effectiveness, energy efficiency, and comparison to viable alternatives that must be met before funding is allocated to hydrogen projects.
- Revise national strategies and plans for hydrogen based on the above-mentioned recommendations.