CESEC's region potential for renewable and low-carbon gas deployment in the context of infrastructure development

Energy & resources

October 2024

Executive Summary

Background and objectives

In order to meet the European Green Deal and REPowerEU objectives, the CESEC region needs to step up the efforts for renewable energy deployment, including renewable and low-carbon gases. In order to do so, an adequate network of infrastructure, alongside a fit-for-purpose regulatory framework, needs to be developed. In this context, DG ENER has commissioned a study to Grant Thornton in association with AF Mercados EMI (ENER/C4/2021-444 | CESEC's region potential for renewable and low-carbon gas deployment in the context of infrastructure development) aiming at exploring the potential for the production and deployment of renewable and low-carbon gases (renewable hydrogen and biomethane specifically), as well as their integration in the CESEC region.

In accordance with the increasing importance of hydrogen and biomethane in Europe, the 2013 TEN-E Regulation (REGULATION (EU) No 347/2013) has been revised to introduce new infrastructure categories and end policy and financial support to cross-border natural gas infrastructure. The new infrastructure categories include electrolysers, hydrogen transport, storage facilities, and receiving terminals, as well as smart gas grids for integrating renewable and low-carbon gases (such as biomethane and renewable hydrogen) into the existing networks. In addition, for the first time, Projects of Mutual Interest (PMI) are also introduced in the revised TEN-E Regulation (Regulation (EU) 2022/869). The 1st PCI/PMI list under the revised TEN-E Regulation was published in November 2023 and came into force in May 2024. Moreover, the Council and the Parliament reached a provisional political agreement[1] on a regulation that establishes common internal market rules for renewable and natural gases and hydrogen. The Energy Community countries also adopted and adapted the revised TEN-E Regulation with Ministerial Council Decisions 2023/02/MC-EnC and 2023/03/MC-EnC in December 2023. Upon its entry into force, it will repeal the old regulation on 31 December 2024[2].

[1] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the internal markets for renewable and natural gases and for hydrogen (recast) - pdf (europa.eu)
[2] Implementing the new TEN-E Regulation - Energy Community Homepage (energy-community.org)

Methodological Approach

The study commences with a presentation of the most significant advancements in the EU policy environment concerning renewable and low-carbon gases. Onwards, the analysis focuses on the assessment of the production and consumption patterns of renewable hydrogen and biomethane in the CESEC region. In addition, the levelised costs of renewable hydrogen and biomethane production (LCOH and LCOB, respectively) are estimated, including an estimation on how those are expected to differentiate from one country to another and also across the years in the 2030-2050 timeframe. It is noted that despite the fact that simulations have been conducted until 2050, they are presented only until 2045 in Chapter 3, due to the fact that the timeframe of 2050 entails large uncertainty.

With regards to infrastructure, an assessment of its readiness to accommodate renewable hydrogen and biomethane in the region is conducted with a focus on its current status (i.e., transmission and distribution networks and storage sites). The activities and plans of the Operators regarding testing of their existing infrastructure, construction of new and repurposing of actual infrastructure are also presented. To this end, a high-level overview of the national investment plans on TSO- and, to the extent possible, on DSO- level, concerning renewable hydrogen and biomethane deployment is provided. The analysis focuses on the main infrastructure bottlenecks, and the infrastructure adaptation needs for pure hydrogen transportation, reception and storage. Finally, findings from interaction with key stakeholders coupled with the modelling analysis highlight the potential hydrogen flows to be facilitated by hydrogen pipelines. This is a response to meeting the hydrogen demand in the region.

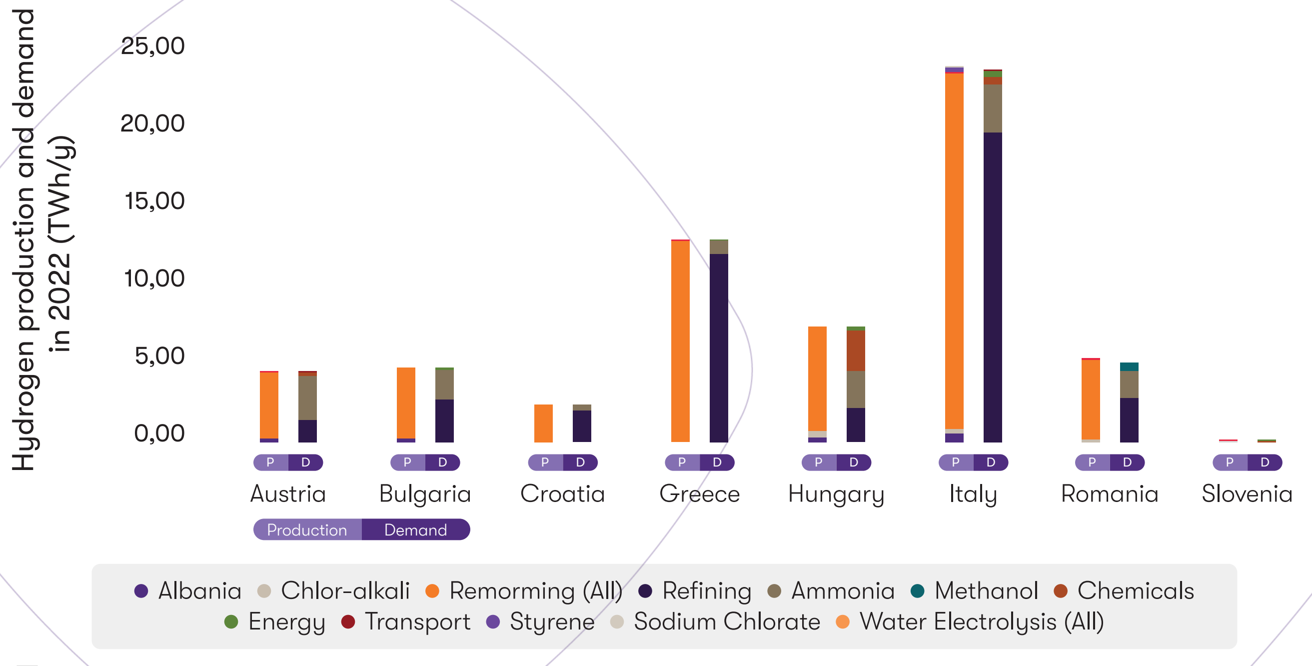
The approach followed for the implementation of the study relies on a combination of tools, such as analysis of publicly available data, studies and policy documents, elaboration of a full-fledged survey, initiation of complementary interviews with key stakeholders, organization of a stakeholders' workshop and the conduct of a regional modelling analysis. More specifically, desktop research is conducted to source the latest available data on production and consumption of renewable hydrogen and biomethane, the relevant targets set by each of the countries in the CESEC region, the planned production plants and infrastructure, as well as the infrastructure costs and the production cost drivers. In this context, the National Energy and Climate Plans (NECP) of the CESEC countries, as well as the National Hydrogen Strategies (NHS) - wherever available -, the Union-wide Ten-Year Network Development Plan (TYNDP), the Network Development Plans (NDP) of the Transmission System Operators (TSO) and of the Distribution System Operators (DSO), the 1st PCI/PMI list, the Hydrogen Project Visualisation Platform of ENTSOG, and the Hydrogen Infrastructure Map have been assessed. Moreover, an online survey based on questionnaires that differentiate depending on the type of key stakeholder (i.e., TSO, DSO, National Regulatory Agencies (NRAs), etc.) was launched. Finally, interviews with targeted stakeholders have been conducted in order to facilitate the information flow, as well as when clarifications on the responses in the survey are needed. In order to assess the potential future cross-border flows of renewable hydrogen between EU Member States and Energy Community Contracting Parties, a modelling exercise is implemented utilising PLEXOS software.

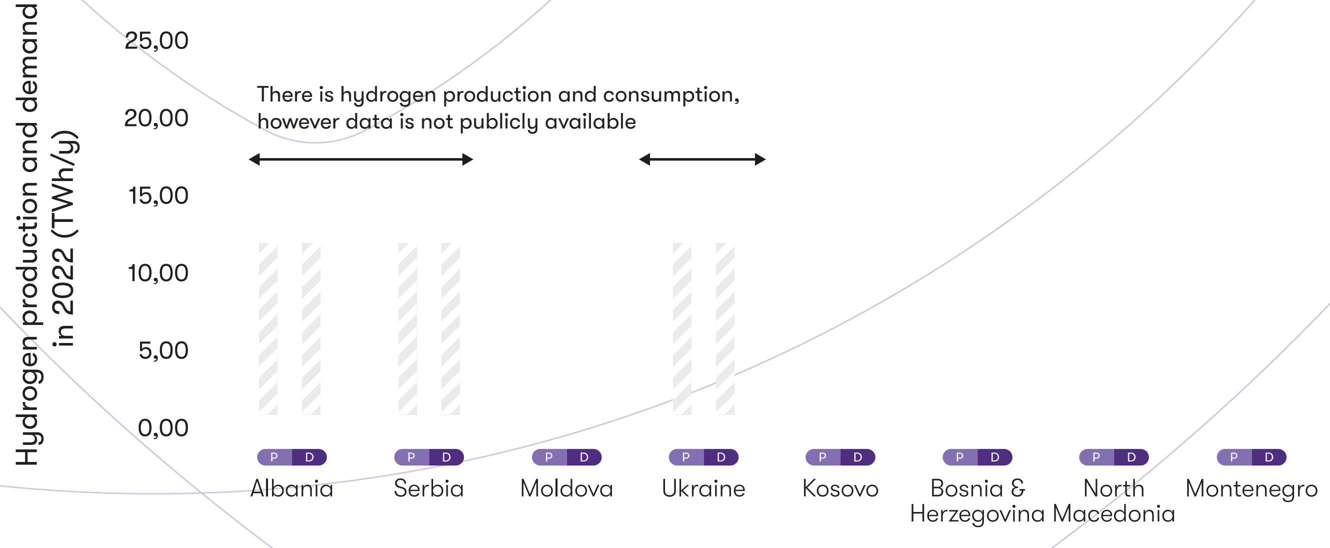
Current production and demand patterns

The first step of the analysis regards the assessment of the production and consumption patterns of renewable hydrogen and biomethane in the CESEC region, as well as the prevailing policy and regulatory environment. Overall, the CESEC region exhibits a large heterogeneity in the developments pertinent to the renewable and low-carbon gases in various aspects. As of 2024, production of hydrogen was mostly limited to captive fossil-based hydrogen (produced via reforming) for large hydrogen consumers and particularly refineries, steel, and cement industries.

In the CESEC region, only Italy produced fossil-based hydrogen with abatement as a result of combining carbon capture with the reforming process, with a production of slightly below 25 TWh annually, followed by Greece with approx. 13 TWh and Hungary about 7.5 TWh annually. Albania, Serbia and Ukraine also produced fossil-based hydrogen; however, no specific data are publicly available. On the other hand, countries like Moldova, Kosovo, Bosnia and Herzegovina, North Macedonia and Montenegro neither produce, nor consume hydrogen till present.

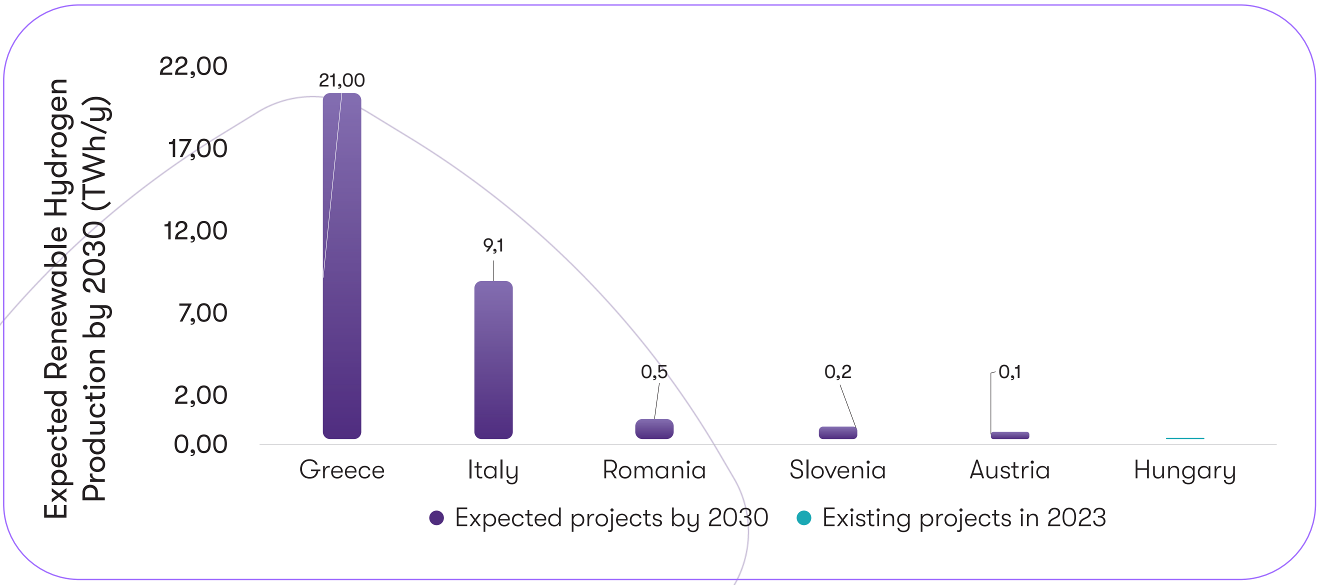
Figure: Hydrogen production and demand per sector (2022 data), Source: Hydrogen Production | European Hydrogen Observatory (europa.eu); Surveys and interviews with stakeholders





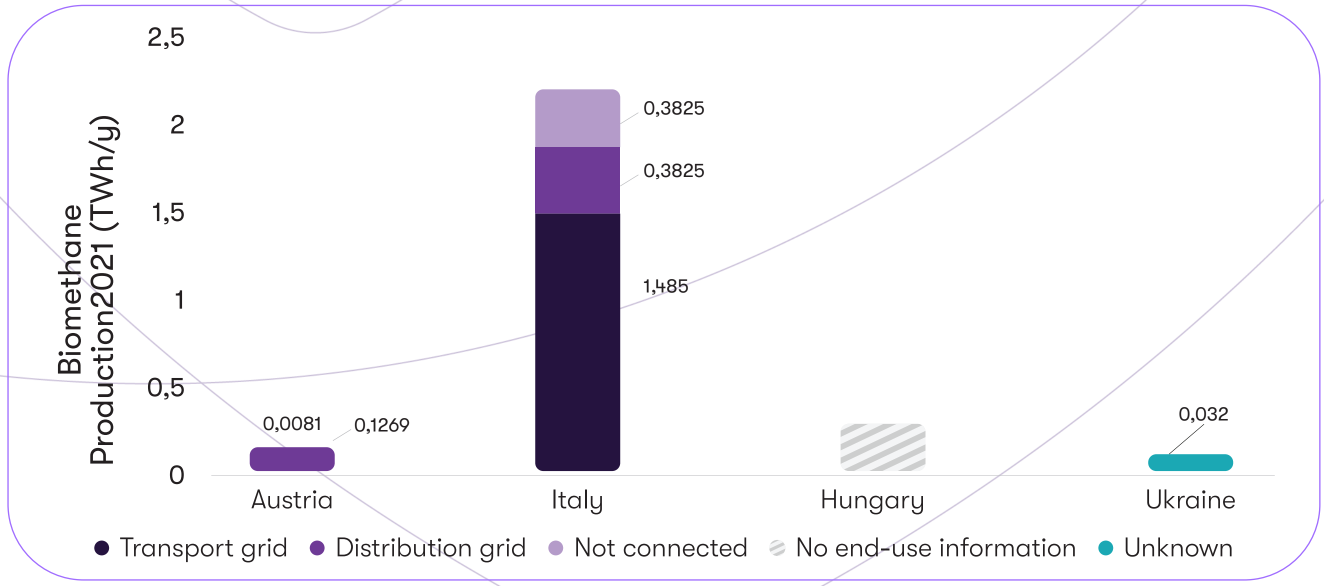
By 2023, very limited production of renewable hydrogen took place in Austria, Slovenia, Hungary and Greece, as a result of small-scale projects (below 2 MW electrolysers) that are either operational or at demonstration phase. Several hydrogen production projects are in development stage, which will supply approx. 30.9 TWh renewable hydrogen by 2030, should they materialise. Yet, announced projects are concentrated in very few countries only, i.e., Greece, Italy, Austria, Romania, Slovenia, and Hungary. In terms of policy formulation, Italy, Austria, Greece, Hungary, and Croatia have set targets of installed electrolyser capacity by 2030 (i.e., 5 GW, 1 GW, 300 MW, 240 MW and from 70 to 1,273 MW, respectively) according to their published strategic documents (i.e., draft updated NECPs, final NECPs, NHS).

Figure: Expected renewable hydrogen production by 2030 based on alkaline, proton exchange membrane and Other Electrolysis projects expected to be operational by 2030 in addition to the demo and operational projects in 2023. Source: IEA Hydrogen Production Projects Database



With regards to biomethane, to date, very few countries (i.e., Italy, Austria, Hungary, Ukraine) produce biomethane and only Italy and Hungary operate large-scale biomethane plants (i.e., >1000 m3/h). Several countries (i.e., Bulgaria, Croatia, Greece, Romania and Slovenia) report biogas production, which is a precursor of biomethane, as a result of existing financial incentives provided to biogas for power generation.

Figure: Biomethane production (2021 data), Source: EBA Statistical Report 2022 Tracking biogas and biomethane deployment across Europe; GIE Biomethane Map 2022-2023; Prospects of biomethane in Ukraine, UABIO, September 2023



Hydrogen and biomethane potential & production costs

CESEC countries possess excellent energy potential, such as biomass and organic waste, solar irradiance, and onshore and offshore wind. Previous analysis in the CESEC region[3] had estimated a potential of 1,180 GW of PV, 890 GW onshore wind potential and 62 GW of offshore wind. The study had estimated that the current cost-competitive potential for renewable electricity generation in South-East Europe is approx. 130 GW. Whereas only a portion of that reported technical potentials can be exploited cost-effectively until 2030, resource availability is not a limiting parameter for accelerating the deployment of renewable technologies and subsequently renewable and low-carbon gases within the region. The remaining techno-economic potential for renewable hydrogen in 2030 in the region, after the coverage of electricity supply needs[4], is approx. 2,600 TWh. The largest theoretical potential is found in Ukraine (approx. 700 TWh), Italy (520 TWh), Romania (430 TWh).

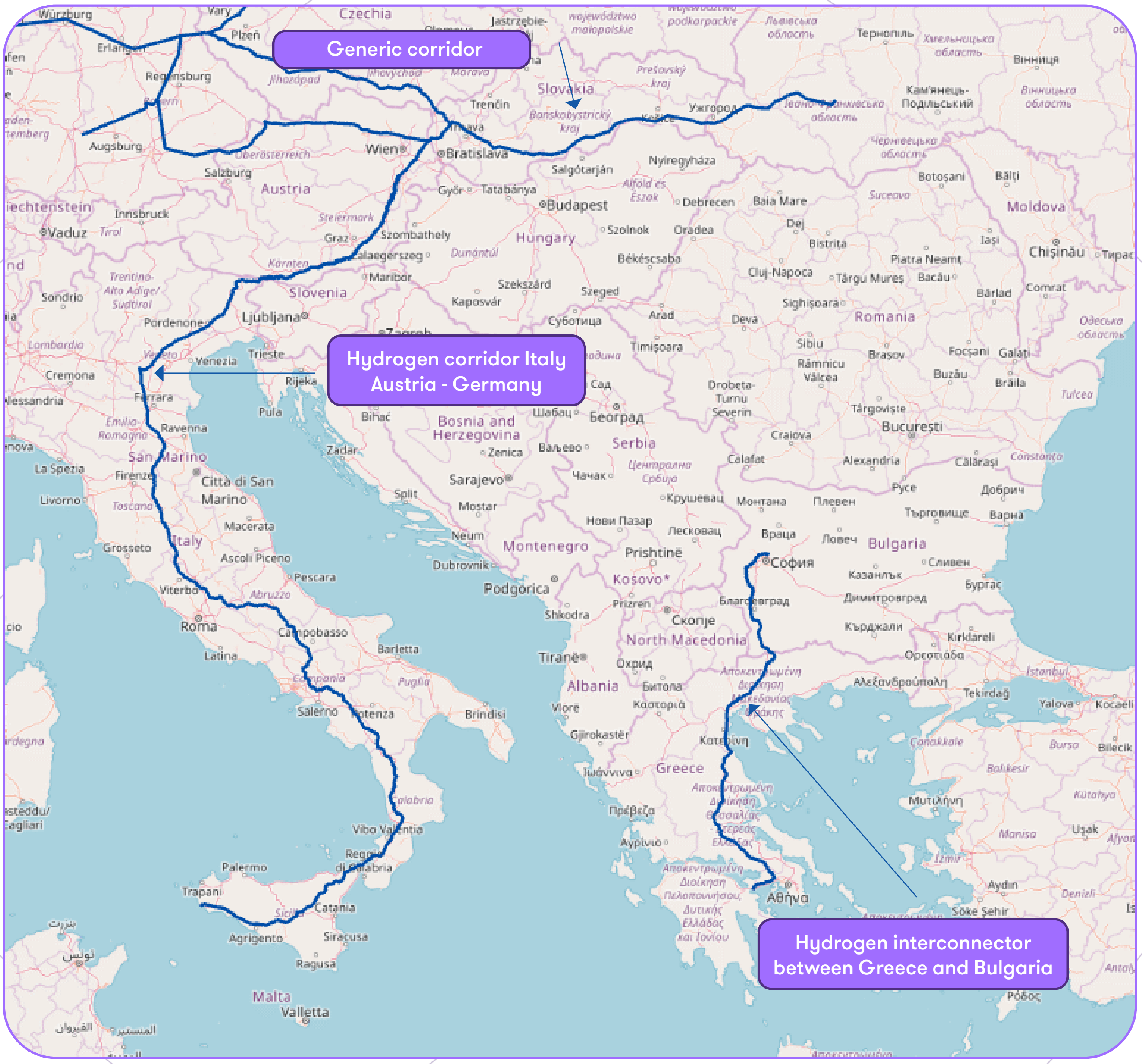
As in all areas in Europe, the levelised cost of renewable hydrogen (LCOH) is highly dependent on capital costs (particularly of the electrolyser) and the cost of renewable electricity. The latter cost driver is strongly affected by the RES mix and the capacity factor for each technology, which is slightly improving over time. The study estimates the LCOH[5] as produced in each of the CESEC countries by an electrolyser of 100 MW installed capacity assuming that the needs in electricity are met exclusively by solar PV. The estimates, considering the EU countries in the CESEC region only, range from 3.6 to 5.5 EUR/kg. Those are reasonable if compared with the reported median by Hydrogen Europe[6] (3.0 to 5.0 EUR/kg) in the EU countries (including UK and Norway).

The CESEC region also has a considerable biomethane techno-economic potential. The sustainable biomethane potential is calculated in each of the countries in the CESEC region following the Gas for Climate[7] methodology. The outcome of exercise highlights that Ukraine exhibits by far the largest potential in the region (approx. 20 TWh in 2030), followed by Italy (approx. 15 TWh), Romania (approx. 9 TWh) and Hungary (approx. 6.5 TWh).

With regards to biomethane production costs, the main cost drivers for the levelised cost of biomethane (LCOB) are the cost of the biodigesters, the feedstock cost and the cost of the upgrade and injection unit. The calculated LCOB ranges between 52 and 82 EUR/MWh, depending primarily on the availability of feedstock type and the plant size. It is noted that only in the case of agricultural residues, roadside feedstock costs[8] arise and are added to the transportation cost incurring from the feedstock source to the process plant.

[3] https://op.europa.eu/en/publication-detail/-/publication/434fb711-a5a4-11ec-83e1-01aa75ed71a1/language-en
[4] For power generation, heat and cooling and transport
[5] the calculated LCOH only covers hydrogen production costs, i.e., does not include additional costs of hydrogen compression (or liquefaction) and transportation.
[6] https://hydrogeneurope.eu/clean-hydrogen-monitor-2022/
[7] https://gasforclimate2050.eu/wp-content/uploads/2023/12/GfC_MarketStateTrends_2023.pdf
[8] Roadside feedstock costs are costs of biomass production, collection and pre-treatment, up to the road where the biomass feedstock is located. However, manure (liquid and solid) cost has been assume to be null. Most of the time, farmers give manure for free to the conversion plant in exchange of digestate used by the farmer as fertilizer.

Figure 29 Illustration of the PCI projects relevant to the CESEC region, as included in the PCI-PMI Transparency Platform



Infrastructure projects promoted in the CESEC region

The uptake of renewable and low-carbon gases will require the deployment of large-scale cross-border and national transmission projects. Overall, there is a large number of infrastructure[9] projects (i.e., projects related to transmission, distribution and storage) planned in the CESEC region. They are included in the national NDPs of the TSOs and the DSOs, the Union-wide TYNDP of ENTSOG[10], as well as reported by other publicly available sources, including the Hydrogen Infrastructure Map[11]. An exhaustive overview performed illustrates that Italy, Austria, Hungary, Romania and Greece have planned the highest number of infrastructure projects aimed at integrating hydrogen and/or biomethane in the region. Similarly, the majority of the projects concern renewable and low-carbon hydrogen and are located in Hungary, Romania and Italy. On the contrary, the biomethane infrastructure projects that are promoted are significantly fewer and located in Italy. Broadly, the majority of the promoted projects concern the transmission network alone. Part of the hydrogen infrastructure projects promoted in the region have been included in the 1st PCI/PMI list[12] which was published in November 2023 and came into force in May 2024. More specifically, the list features the Hydrogen corridor Italy – Austria – Germany (includes the Hydrogen Readiness of the TAG pipeline, the Hydrogen Backbone WAG and Penta West, and the Italian Hydrogen Backbone), the Hydrogen interconnector between Greece and Bulgaria (includes internal infrastructure in both countries), and the Generic Corridor aiming to transmit hydrogen from Ukraine to Slovakia, Czechia, Austria, and Germany.

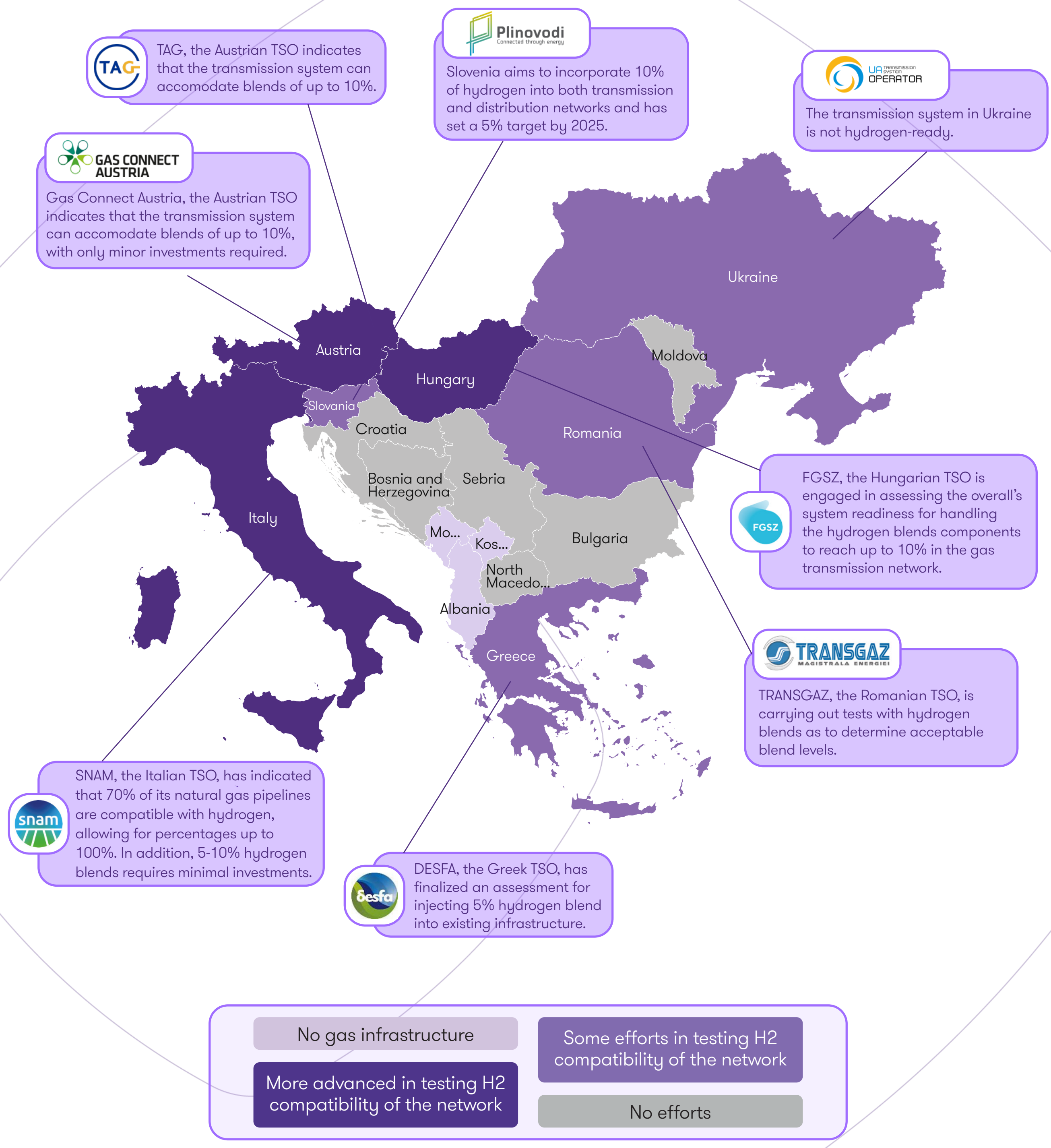
Infrastructure readiness

In general, there is currently a lack of infrastructure capable of accepting pure hydrogen in the CESEC region. TSOs and Storage Operators in several countries of the region have started conducting evaluations on their infrastructure components through laboratory testing to assess the infrastructure compatibility for hydrogen blends, as well as for pure hydrogen. However, the degree of progress varies significantly between the countries examined. Out of the CESEC countries, Italy, Austria and Hungary are more advanced with regards to the assessment of the compatibility of their networks.

Italy has possibly undertaken the most steps towards hydrogen readiness. Around 70% of SNAM's natural gas pipelines are compatible with pure hydrogen, with efforts being undertaken to increase this percentage to 100% of the network. SNAM indicates that reaching 5-10% hydrogen blends requires only minimal investments, mostly installation of gas chromatographs and other minor instruments replacements. In Austria, the ability of the transmission system to accommodate hydrogen blends up to 10% has been verified by technical assessments concluded by TAGG. This also requires only minor investments. Furthermore, the existing pipelines are compatible for pure hydrogen. The transmission system operated by Gas Connect Austria, the other country's operator, is reported to be able to accommodate hydrogen blends up to 4%[13]. In view of Slovenia's aim (NECP) to incorporate a 10% hydrogen share into the transmission and distribution network by 2030, Plinovodi is carrying out tests (pilot project at preliminary stage) and has set a target of 5% blending by 2025. In Romania, the gas TSO TRANSGAZ is carrying out tests with hydrogen blends and investigates the modifications required in the transmission network to make this possible. DESFA, the gas TSO of Greece, has finalised an initial assessment of its existing infrastructure for the injection of hydrogen blends showing that 5 % hydrogen blends into existing infrastructure for natural gas could be realised with minor modifications only. In Hungary, the gas TSO FGSZ declares a 2% hydrogen readiness of their system.

[9] Infrastructure projects are considered to include as per TEN-E the following project categories: pipelines for transporting hydrogen, including the use of repurposed natural gas infrastructure, facilities for storing hydrogen, facilities for receiving, storing, and regasifying liquefied hydrogen or hydrogen carriers, equipment and installations for safely and efficiently operating a hydrogen system, equipment for the transport sector that utilises hydrogen or hydrogen-derived fuels, smart gas grids that allow for the integration of renewable gases. Smart grids projects are broadly included under either transmission or distribution.
[10] ENTSOG exceptionally published an updated TYNDP list of projects in October 2022 in response to the goals set in the EC's REPowerEU Plan and its associated initiatives to accelerate the integration of renewable gases
[11] H2 Infrastructure Map Europe (h2inframap.eu)
[12] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=PI_COM:C(2023)7930
[13] Gas Connect Austria (2023). Personal communication, 07 March

Figure: Number of infrastructure projects across the CESEC countries grouped per type of molecule



Austria, Italy, and Hungary are the only countries in the CESEC region that have advanced towards the integration of biomethane into their national system as not only do they produce biomethane but also directly inject quantities of it into the existing gas transmission and distribution systems. The injection of biomethane in Austria takes place exclusively at the distribution level. On the other hand, available information indicates that both the transmission and distribution networks in Italy and Hungary receive injections of biomethane. There are only high reported quantities of biomethane produced and injected into the Hungarian national gas grid. For the rest of the countries, there is neither biomethane injection, nor R&D or pilot projects focused on biomethane and none of the existing biogas plants have been upgraded for production of biomethane.

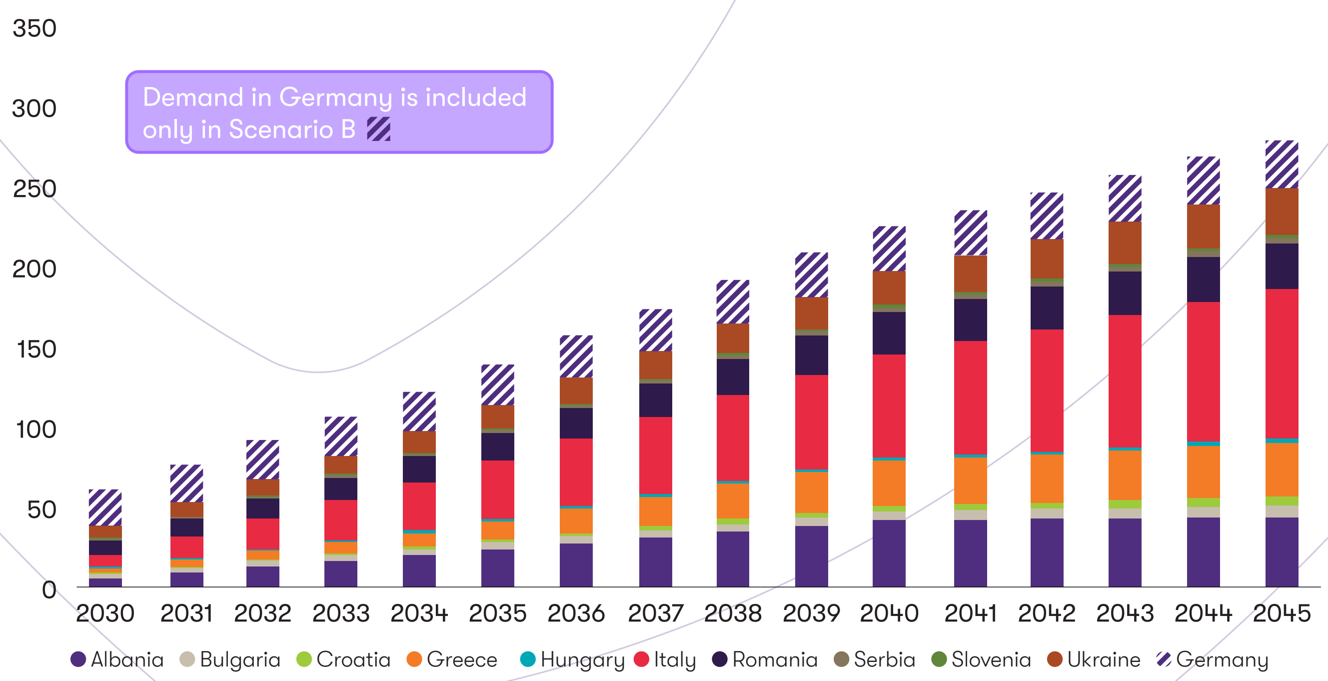
Regional Infrastructure Development Modelling for hydrogen

Having assessed demand for renewable gases, as well as the potential for RES (and their costs) to be used in the production of renewable hydrogen to meet that demand across the CESEC countries, the likely least costly deployment of infrastructure by 2050 is modelled, aiming to yield valuable insights for policymakers. Two major scenarios are elaborated in the context of the modelling analysis for the time horizons of 2030 and 2050:

- Scenario A - CESEC Regional, focusing exclusively on the CESEC countries (internally interconnected with each other as applicable, using existing power and gas interconnections but isolated (in hydrogen terms) from the rest of Europe without considering any imports or exports from the region.
- Scenario B - CESEC + Germany / North Africa, taking into consideration the increased hydrogen demand in Germany, as well as the prospect of large amounts of hydrogen produced in North Africa and supplied to Italy via undersea pipelines and further to the region.

The analytical framework for conducted quantitative assessment utilises a large array of assumptions regarding fuel sourcing, generation mix, transmission infrastructure, as well as planned infrastructure projects in each country. Most of these assumptions have been derived from national policy and strategic documents (such as NECPs, NHSs, TYNDPs, etc.). In the absence of formal hydrogen targets data/forecasts for some of the countries in the CESEC region, assumptions have been provided by stakeholders in the conducted interviews, namely European Commission (EC) and gas TSOs. Regarding the power generation mix, the model considers the data from Reference Scenario 2020 fuel mix evolution, as publicly available from EC. In the taken approach, hydrogen demand after 2030 is assumed to be supplied exclusively through electrolysers supplied by RES. Moreover, hydrogen is assumed to substitute non-power gas demand in industry and transport. Finally, it has been assumed that hydrogen will not be made available for power generation purposes, as this is deemed uneconomical and energy intensive.

Figure Total annual renewable hydrogen demand in the industrial sector in the CESEC region and Germany (in TWh)



In terms of the hydrogen transmission network planning, the model encompasses the development of cross-border hydrogen transportation capacity through conventional steel high-pressure pipeline networks. Using the published Union-wide TYNDP of ENTSOG, a list of proposed projects for dedicated hydrogen pipelines is incorporated, assuming predefined capacities. The model is allowed to determine when, where, and to what extent these pipelines would be constructed. Also, the model is set free to build incremental hydrogen transmission capacities where needed after 2034, to meet cross-border demand/supply imbalances and minimise total system costs for the period to 2050.

Until 2030 the policy targets set by CESEC countries as stated in their NECPs and as submitted in the context of the PCI/PMI projects, indicate that demand will primarily be covered by domestic supply. Onwards, and until 2050 capital-intensive cross-border dedicated hydrogen pipelines will have to be developed, potentially in combination with repurposing of existing assets.

Prominent findings of the modelling analysis include:

- As a general remark, modelling analysis conducted through PLEXOS aligns with the results of the PCI/PMI process with regards to future cross-border flows and the need for respective transmission infrastructures.
- In the Scenario A – CESEC Regional in 2030, local hydrogen demand does not appear to be sufficient to justify the development cross-border transportation corridors either through Tunisia/Italy or from Greece toward Central-Eastern Europe. However, the comparison of scenarios A and B clearly indicates that demand in Germany is a catalyst for large scale cross- border infrastructures and that eventual hydrogen needs of Germany will partly determine the sizing of the proposed infrastructures in the CESEC region.
- Eventually three corridors emerge with high degree of certainty, i.e., imports from Algeria and Tunisia to Italy and onwards to Germany, a hydrogen corridor initiating from Greece through the Balkan region (Bulgaria, Romania) and further north to Germany and a corridor originating from Ukraine to Germany through Slovakia and Czech Republic, as well as Slovakia and Austria.
- It would be also very plausible to assume that in the hydrogen corridor that will originate from Greece to Bulgaria, Romania and northern, other Energy Community Contracting Parties such as Serbia, North Macedonia, Bosnia and Herzegovina may connect to that corridor, assuming repurposing of existing assets and potentially also transforming projects that were originally designed for natural gas but are hydrogen-ready.
- The supply routes to meet high demand in Italy and Germany largely depend on assumptions regarding its cost at the entry point in South Italy from Tunisia (and other non-techno-economic aspects such as political stability in Ukraine). In this context, it appears highly plausible to deploy large RES and electrolyser installations in North Africa, where greater RES capacity factors are assumed to produce renewable hydrogen in order to meet demand in the CESEC region.
- In the case of commercial arrangements between industrial consumers in Germany and developers of renewable hydrogen projects in North Africa, a much larger part of German demand will be supplied from Africa through the SoutH2 Corridor via Italy and Austria (i.e. German imports from the CESEC region will constitute a higher percentage compared to the 40% of the total imports currently assumed) and the flows from North Africa to Germany will be even higher.
- Overall, across the two scenarios, it is observed that there is a huge potential for further expanding the RES build-out in the CESEC region. As the countries move away from fossil fuels, they have the prospect of collectively planning RES generation and hydrogen production capacity development, as well as the development of corresponding transmission networks. Given that the timeframe of the analysis extends well beyond the ten-year period of the TSO network development plans, there is a need for a greater number of projects to accommodate hydrogen flows that are either immature or not even on planning stage yet.
- In order to satisfy the overall hydrogen needs, considerable electrolyser capacity is required to be developed in the CESEC region, amounting to approx. 75 GW in Scenario A and 62 GW in Scenario B until 2045. Under Scenario B, significantly less RES generation capacity is required for electrolyser needs, underlining the impact of the hydrogen transported from North Africa at lower costs, which is able to cover part of CESEC's demand. Thus, CESEC countries follow a more moderate approach on the development of electrolyser installations on their ground.
- Considering the NECP targets for 2030 and the data communicated during the PCI/PMI process needs, it is estimated that renewable hydrogen in the CESEC region (excluding consumption in Germany) can displace approx. annually 54 TWh of natural gas in industry and diesel (for the transport sector) in 2030 and approx. 411 TWh in 2050, assuming that all hydrogen produced is renewable.

Figure Annual hydrogen cross-border flows and production in the CESEC region for 2030 under Scenario A – CESEC Regional

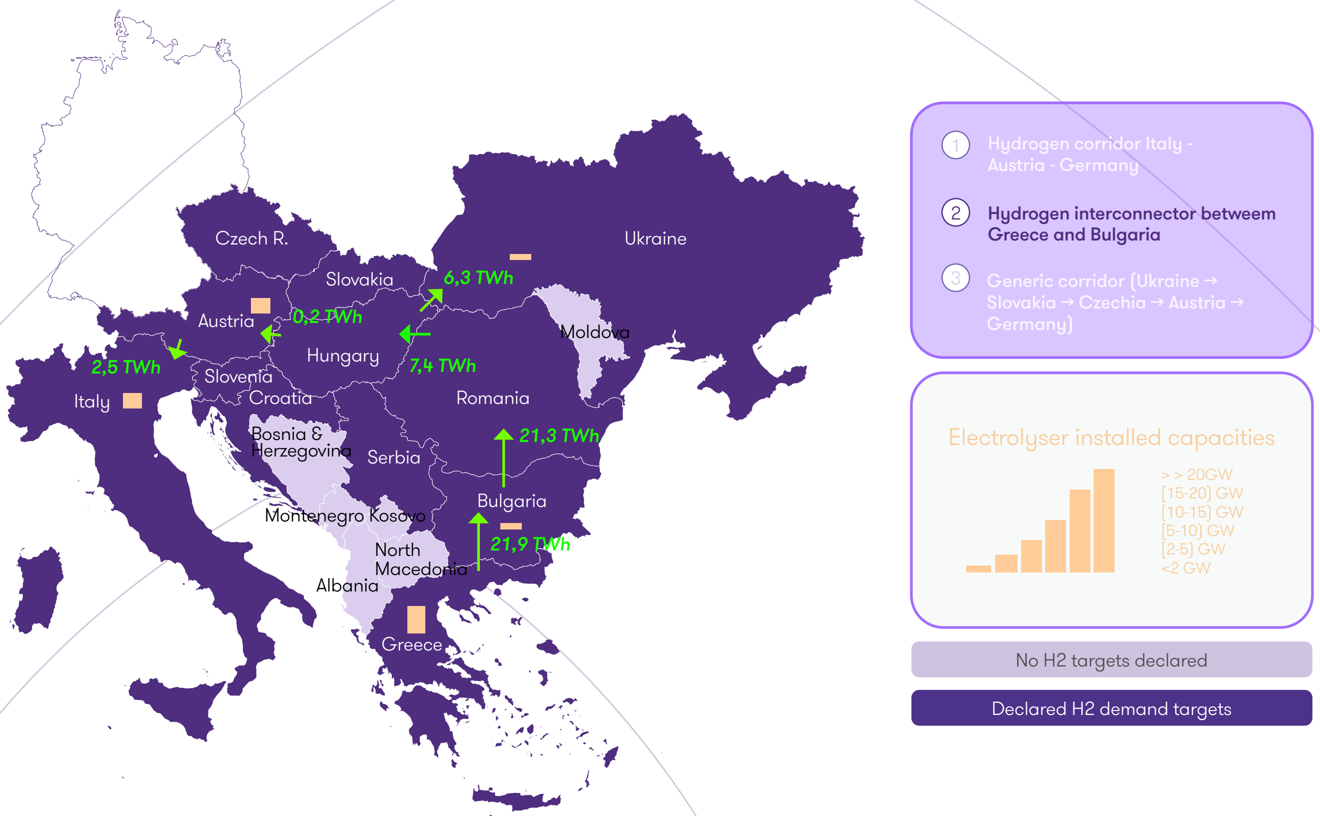
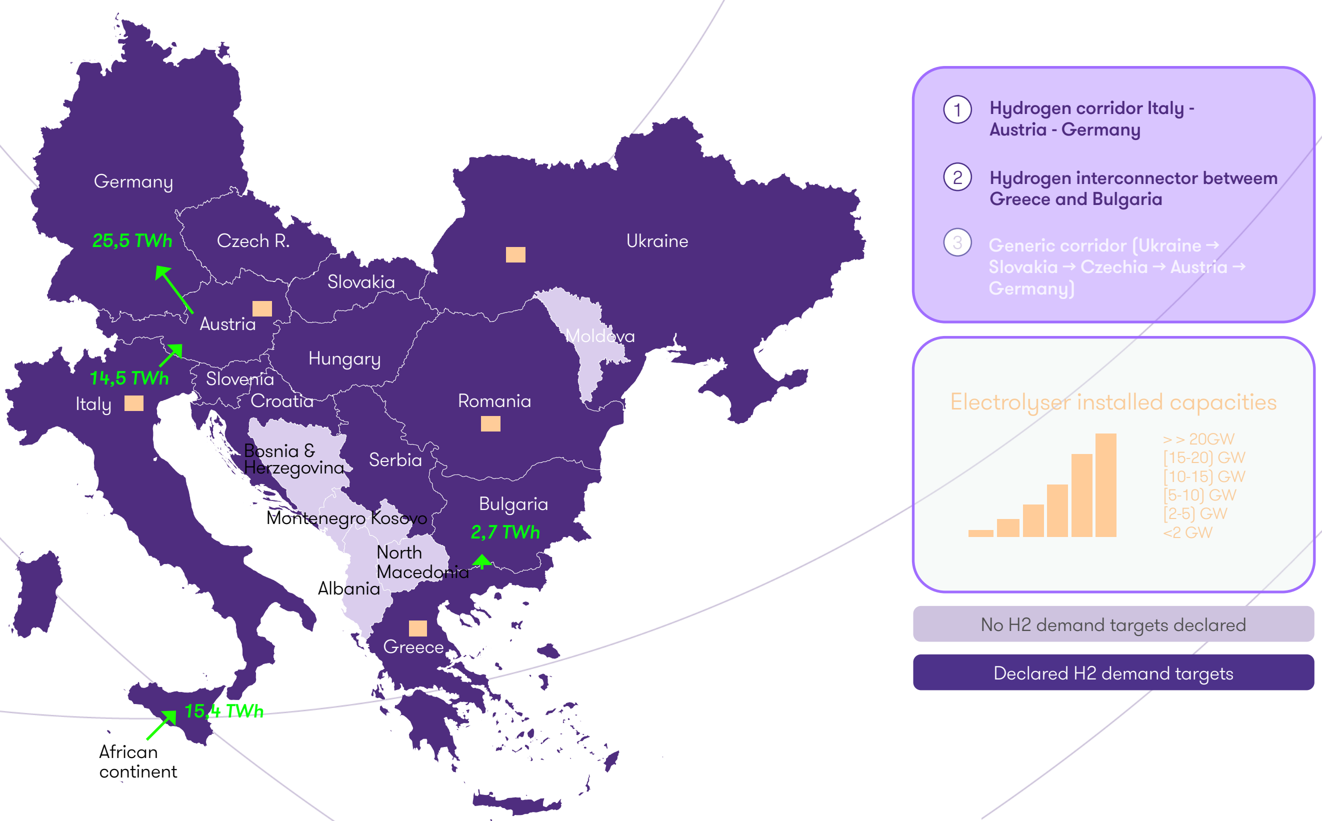


Figure Annual hydrogen cross-border flows and production in the CESEC region for 2030 under Scenario B – CESEC + Germany / North Africa



Policy, market and regulatory context

From a policy, regulatory and market perspective, in the course of the study, various challenges have been identified by stakeholders relevant to the uptake of renewable and low-carbon gases.

Key issues that have been identified include the following:

- The regulatory framework for hydrogen at EU level will soon be in place, i.e. the EU Hydrogen and Decarbonised Gas Market Package, and transposed into national legislation initially of Member States and subsequently of Energy Community Contracting Parties. In view of the anticipated challenges relating to the transposition, active support from CESEC High-Level Group is likely to be needed. It is therefore anticipated that the absence of a clear regulatory framework which creates uncertainty for investors, will soon be remediated and that CESEC countries will gradually proceed to the implementation of the relevant primary and secondary framework. To this end, useful lessons can be drawn from countries of Central and Northern Europe with regards to the effectiveness of the implemented regulatory frameworks.

- Existence of limited submissions only of draft updated NECPs and developed policy documents and strategies (such as National Hydrogen and Biomethane Strategies) that foster the integration of renewable and low-carbon gases. Moreover, while most EU countries in the region include clear policies and provisions for these gases in their NECPs, in some cases, targets, forecasts and implementing actions are missing or need to be further elaborated.
- Demand for hydrogen end-uses per sector in the vast majority of cases is either not clearly mapped in the entire CESEC region or there is an inherent uncertainty with regards to its buildup, thus impeding forward looking infrastructure planning. Moreover, it becomes even more challenging projecting the demand beyond the horizon of 2030.
- The costs for the production of renewable hydrogen and biomethane are still higher compared to the fossil fuels that they are going to substitute or the traditional means of their production (such as reforming) and, thus, not yet competitive without support schemes. The gradual decrease of production costs (for instance electrolysers, renewables) as a result of technological improvement in combination with increasing ETS prices and targeted support schemes are key drivers for creating a renewable hydrogen market.
- The decentralised biomethane production patterns create challenges for accommodating scattered volumes into limited injection points. Moreover, difficulties in the supply chain related to ensuring stable and sufficient feedstock streams for large-scale plants impede the development of economies of scale.

Infrastructure development

The development of dedicated infrastructure or the refurbishment of existing infrastructure for the transportation of renewable and low-carbon gases face a number of challenges:

- Injection and transportation of pure hydrogen is not possible at the moment in any of the CESEC countries. Hydrogen blends are possible to a certain extent in some countries, yet bearing challenges, i.e., potential need for deblending, varying standards, different energy contents, instability of the blend, etc. Moreover, there is absence of reception, storage and regasification or decompression facilities for liquefied hydrogen or hydrogen embedded in other chemical substances.
- Hydrogen blending could only represent a temporary solution, which comes at a cost, could result in lock-ins, stranded assets and overall is not promoted by EU policy and legislation.
- The industry's limited experience with pipelines designed for 100% hydrogen transport poses challenges and uncertainties such as embrittlement, which can compromise system safety and reliability of infrastructures. In addition, many aspects of hydrogen integration, including material degradation and equipment stack durability, are still largely unexplored, contributing to the overall uncertainty.
- Progress has been achieved in several countries with regards to either assessing or constructing hydrogen-ready pipelines which appear to be the most cost-effective transportation mode for medium- to long-distances transportation, i.e., above 100 kilometres. Nevertheless, further technical and economic assessment needs to be made with regards to the hydrogen readiness of infrastructure and the prospects of either refurbishment of existing LNG terminals and the design of hydrogen or hydrogen carrier terminals (e.g., ammonia/methanol), with the latter being the most realistic option, yet still very expensive.
- With regards to biomethane, reverse flow possibility from the distribution network to the transmission system will become increasingly important upon increasing injected biomethane quantities that will potentially surpass the demand at the distribution level. Therefore, the installation of reverse flow facilities, prioritising gas grid injection for biomethane and increasing cooperation between transmission/distribution adjacent gas grid Operators is crucial, should be studied and prioritised by TSO/DSOs.
- Excessive oxygen concentrations in biomethane can cause issues like corrosion, bacterial growth, and sulphur build-up and, thus, limits on the oxygen acceptance levels exist at country level. Those are, however, diverse and in some cases very low, especially compared to typical levels of oxygen at the outlet of the biomethane production plant. Thus, countries with strict oxygen acceptance levels might need to modify their gas quality standards towards more reasonable levels. This is important especially on the transmission and storage side in order to harmonise the quality standards across the overall region and facilitate cross-border trade.

What defines our unparalleled edge

Grant Thornton is one of the world's leading organizations of independent assurance, tax and advisory firms, with 73,000+ people in over 150 countries. And we're here to make business more personal and build trust in to every result.

Grant Thornton Greece is a leading provider of audit, tax and advisory services. With our presence in 5 cities in Greece and a headcount of 1,200 people, we apply strong technical expertise and extensive experience to ensure that our clients receive a truly different experience. We offer an integrated approach, focusing on our clients' needs, draw on the knowledge arising from our local insight and understanding, combined with our global presence.

Through our promise "Go Beyond. Move forward together", we positively shape tomorrow together, we move together into the new era and we stand by our people, our society, our clients and our partners, at every step. We redefine the way the businesses operate and go beyond the "business as usual" concept.

Our clients demonstrate a high level of satisfaction and loyalty, with an NPS (Net Promoter Score) of 78%, one of the highest among Grant Thornton member-firm network in over 150 countries. The efficient structure and presence of Grant Thornton globally, coupled with a deep understanding of both local and global dynamics, bring Grant Thornton in Greece at the forefront of today's business landscape as one of the fastest-growing professional services firm in our country.

A dedicated team of experts

Ioannis Stefanou
Partner, Head of Energy Sector

E ioannis.stefanou@gr.gt.com

Dr. Despina Tzoulaki
Senior Magager, Energy Sector

E despina.tzoulaki@gr.gt.com

John Dimitropoulos
Principal, Energy Sector

E john.dimitropoulos@gr.gt.com

Maria Aslanoglou
Senior, Energy Sector

E maria.aslanoglou@gr.gt.com

Agis Koumentakos
Senior, Energy Sector

E agis.koumentakos@gr.gt.com

Grant Thornton

grant-thornton.gr