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The renewable hydrogen potential of the Iberian Corridor

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Although the reviewers and the interviews participants have provided many constructive comments and suggestions, they were not asked to endorse the conclusions and/or recommendations. Responsibility for the final content of this report rests entirely with the authors.

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1 Executive Summary

In December 2019, the European Commission presented Europe's ambitious objective to become the world's first climate-neutral continent by 2050, with the Green Deal as its blueprint. Subsequently, in 2021 the European Parliament passed the European Climate Law, legally enforcing this target, alongside introducing the Fit for 55 package. This legislative framework comprises a series of proposals aimed at guiding the European Union toward achieving its climate targets by 2030 and beyond.

The importance of hydrogen[1] in attaining these objectives is highlighted by the EU Hydrogen Strategy, which includes a roadmap to enhance hydrogen adoption within the EU. This strategy sets a specific target of installing 40 GW of renewable sources dedicated to renewable hydrogen production through electrolysis and producing 10 Mt of renewable hydrogen by 2030.

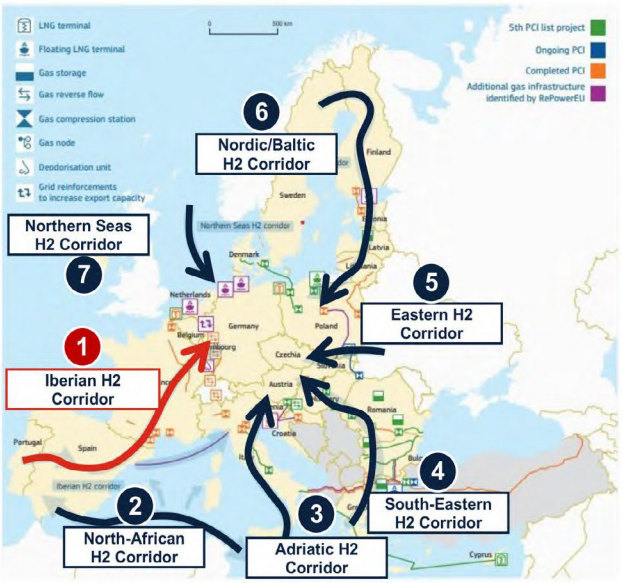
Introduced in May 2022, RePowerEU, Europe's initiative aimed at reducing dependence on Russian fossil fuels, has broadened the original H2 strategy by integrating 80 GW of renewable sources dedicated to renewable hydrogen production, and an extra 10 Mt[2] of imported renewable hydrogen. These heightened quantities are considered critical in light of the ongoing Russian conflict. The action plan introduces additional measures, placing emphasis on energy conservation, diversification of energy sources, acceleration of the energy transition, and the strategic combination of investments and reforms.

Furthermore, the RePowerEU initiative addresses the imbalances in hydrogen supply and demand across regions, considering the creation of hydrogen corridors in Europe with potential to bring supply from regions with abundant and economically viable hydrogen to those with high demand and lower renewable potential.

> **Hydrogen corridors emerge as a pragmatic, cost-effective solution to harmonize regional hydrogen imbalances of supply and demand throughout the continent**

[1]Subsequent references to hydrogen unless specified otherwise to be understood as: renewable and low-carbon hydrogen, with a focus on hydrogen from renewable sources.
[2]Unless otherwise stated, all quantities of hydrogen (in Mt, kt) are given as annual amounts (in Mt/yr, kt/yr).

Figure 1. Main hydrogen corridors of the RePowerEU



1. Iberian H2Corridor (Portugal, Spain, France, Belgium, Netherlands, Luxembourg)
2. North African H2 corridor (Morrocco, Algeria, Tunisia)
3. Adriatic H2 corridor (Italy, Switzerland, Austria, Slovenia, Croatia, Czech Republic)
4. South-Eastern H2 corridor (Greece, Bulgaria, Romania, Hungary, Slovakia, Croatia, Slovenia, Austria, Czechia)
5. Eastern H2 corridor (Czech Republic, Slovakia, Hungary, Croatia, Slovenia)
6. Nordic/Baltic H2 corridor (Finland, Sweden, Estonia, Latvia, Lithuania, Poland)
7. Northern Seas H2 corridor (UK, Netherlands, Belgium, Denmark, Germany)

Source: *RePowerEU Communication Action Plan (May 2022) BIP analysis*

This report specifically centres on the Southwest Europe corridor, commonly referred as the Iberian Corridor, and explores its potential development for the periods 2030, 2040 and 2050. More concretely, the report investigates the following key areas:

- **Current and future hydrogen ecosystem:** An overview of the EU regulatory and policy landscape, the ongoing hydrogen projects, and the sectors most likely to use hydrogen and their expected timeframes.
- **Analysis of hydrogen supply potential:** A comprehensive evaluation of the Iberian Peninsula's and potentially North African capacity, as well as France, to produce renewable hydrogen.
- **Study of the potential hydrogen demand:** An in-depth assessment of the expected demand of hydrogen in key centres along the corridor based on its evolving hydrogen needs.
- **Estimation of hydrogen net balance:** An estimation of the hydrogen net balance within the Iberian corridor, providing insights into the region's overall hydrogen production and consumption dynamics.
- **Hydrogen Infrastructure needs:** A detailed analysis of the infrastructure necessary to efficiently transport and distribute hydrogen to the North and Centre of the EU based on the estimated net balance.

> **The central goal of this report is to understand and leverage the hydrogen potential of the Iberian Peninsula and France, addressing both supply and demand dynamics, as well as the potential infrastructure needed to facilitate seamless hydrogen flows to North-Western Europe**

The assessment of the supply-demand balance underscores the crucial need for infrastructure interconnection between the countries to manage imbalances arising from different levels of renewable and low-carbon hydrogen production. Failure to establish connections among regions with specific needs may leave certain areas uncovered, while regions with surpluses may miss the opportunity to maximize their potential by relying solely on local consumption.

Table 1. Potential Hydrogen Supply-Demand net balance results for 2030, 2040 and 2050 per country (Mt)[3]

	2030			2040			2050		
	Supply	Demand	Net Balance	Supply	Demand	Net Balance	Supply	Demand	Net Balance
Portugal	0.4	0.2	0.1	1.3	0.5	0.8	2.0	0.5	1.6
Spain	2.2	0.9	1.3	4.1	2.3	1.8	5.4	2.5	2.9
France	1.5	0.9	0.6	2.1	3.2	-1.1	2.8	4.9	-2.1
Benelux & Germany	2.3	4.7	−2.4	4.1	9.1	-5.0	7.7	12.6	-4.9
Domestic Net Balance	6.3	6.7	-0.4	11.5	15.0	-3.5	17.9	20.4	-2.6
Imports from North Africa	-	-	-	1.1	-	1.1	2.0	-	2.0
Iberian Corridor Net Balance	6.3	6.7	-0.4	12.6	15.0	-2.4	19.8	20.4	-0.6
Impact from other corridors	0.5	-	0.5	1.3	-	1.3	0.7	-	0.7
Total Net Balance (Storage)	6.8	6.7	0.1 (0.1)	13.9	15.0	-1.1 (0.6)	20.5	20.4	0.1 (0.6)

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Other corridors considered: North Sea and Nordic & Baltic regions.
***Source**: Eurostat, National Policies of the Member States, BIP analysis*

Moreover, our assessment indicates that the regional evolution of the net balance would oscillate, with some regions initially experiencing surpluses, to transition to negative balances as the demand for hydrogen progressively increases. This highlights the dynamic nature of the hydrogen scene, emphasizing the need for strategic planning an infrastructure to effectively address evolving demands and production capacities across different regions.

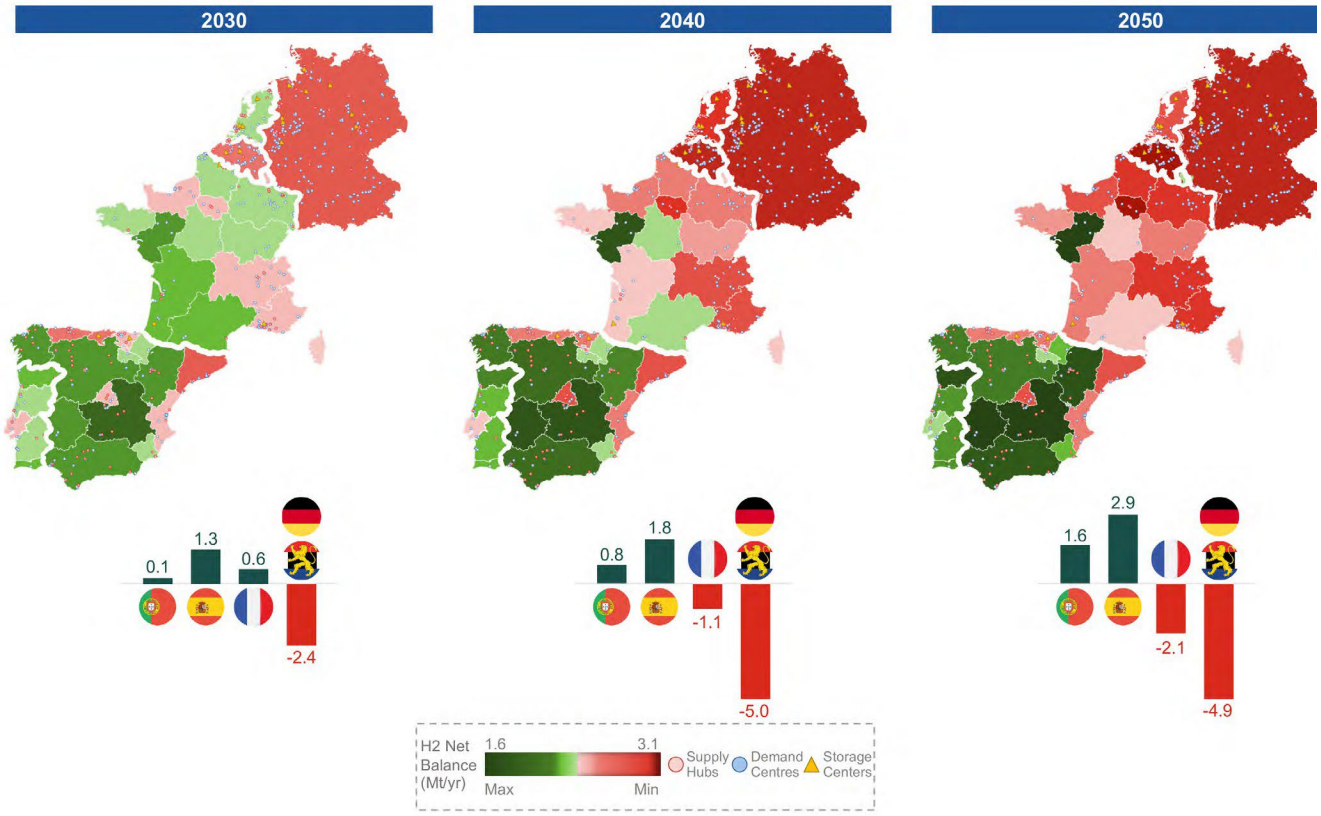
The Iberian Peninsula emerges as a significant contributor to the hydrogen corridor, particularly with Portugal and Spain showing potential oversupply in all horizons. Specific regions, including central and northern Portugal, as well as the south of Spain, distinguish themselves for their notable production capabilities, primarily powered by Solar PV technology and complemented by electricity from the grid.

[3]*The anticipated negative balance in 2040 would be as a result of the penetration of hydrogen in the industrial sector as substitution of natural gas, and would be expected to be covered by additional imports from outside the EU. Meanwhile, efforts are underway to develop sufficient supply capacities to achieve self-sufficiency again by 2050.*

France, initially oversupplied shifts towards becoming a major consumer and transit country for hydrogen in the long term. Some regions of France are oversupplied, especially in the first period, driven significantly by nuclear generation. The northern and eastern regions emerge as main demand areas, with refineries and chemical plants being the major consumers.

Benelux and Germany are anticipated to play a fundamental role as destinations within the corridor. In these regions, hydrogen production is expected to rely primarily on North Sea offshore wind, although this alone would not be sufficient to meet local demand. Germany stands out as the primary consumer, particularly in the industrial sector for thermal applications and as feedstock for refineries and chemicals.

Figure 2. Potential Net Balance by period and region (Mt)



Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *Eurostat, National Policies of the Member States, BIP analysis*

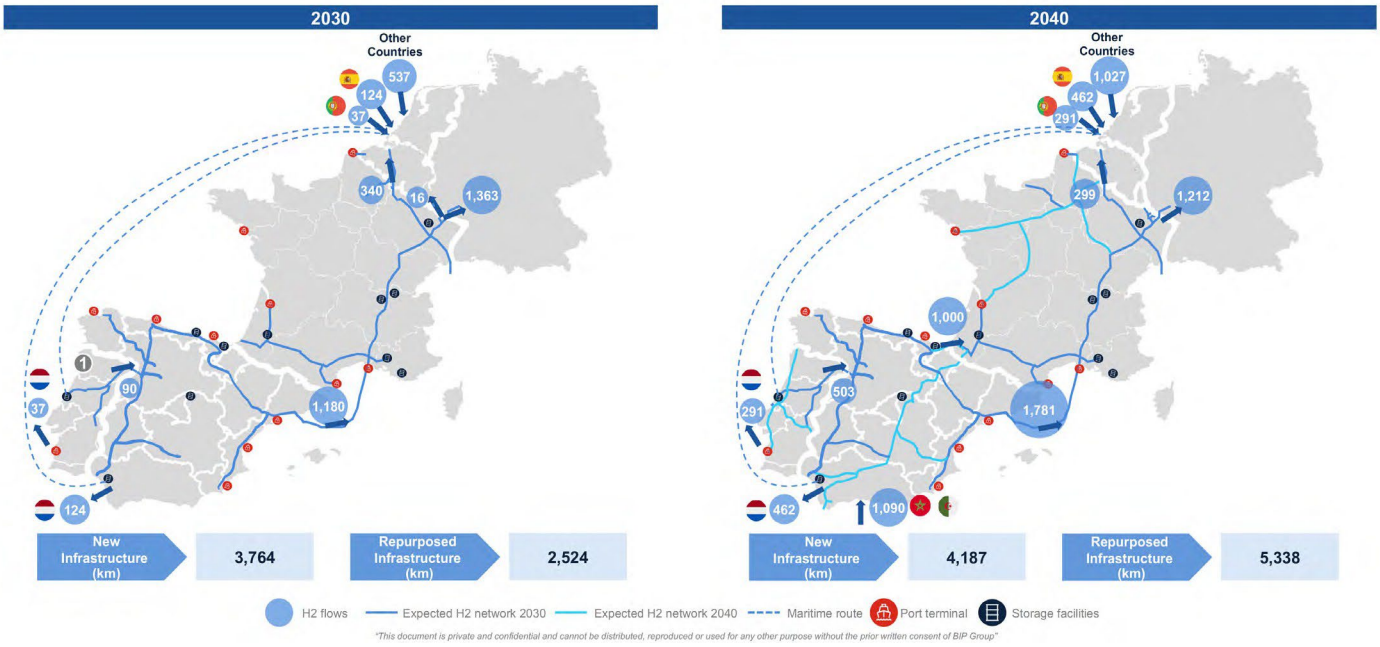
Based on the forecasted regional net balance, the study assessed hydrogen flows and infrastructure needs. To achieve this, various flow matrices were employed, dynamically analysing hydrogen production, demand, and inter-regional exchanges. The study considered various logistical solutions, such as pipelines and maritime routes, also factoring in the storage capacity of the studied countries.

The resulting plan until 2030 outlines a first period focused on developing primary connections between countries and hydrogen valleys. The focus would be on creating a robust infrastructure by developing and repurposing gas facilities to streamline the movement of hydrogen from regions with high supply to demand centres.

> **Collaborative initiatives, exemplified by projects like H2Med linking Portugal, Spain, France, Benelux, and Germany, illustrate the efforts in forming an interconnected hydrogen network across Europe**

From 2030 to 2040 a consolidation phase is envisioned, strengthening capacity connections between major countries, and integrating new valleys with additional connections. As countries enhance their renewable energy production capacities, there is a potential for the development of cross-border and intra-country connections to meet additional demand. Furthermore, the Iberian Corridor is expected to tap into imports from North African countries (Morocco and Algeria) in 2040, complementing the surplus hydrogen from the Iberian Peninsula.

Figure 3. Cross-Country Flows and infrastructure needs (kt/yr)



Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, Bip analysis*

In the 2050 horizon, the corridor is expected to mature, with supply potentially surpassing the projected infrastructure capacity. A stabilization phase becomes probable, necessitating enhancements to accommodate the increased supply and demand throughout the corridor. This may involve increasing capacity on existing routes or creating alternative routes for hydrogen transportation. Additionally, advancements in shipping technology are expected to make transportation via ships more competitive, prompting a key role for ports and associated infrastructure in progressively supporting pipeline transportation for hydrogen.

All in all, the Iberian corridor could play a crucial role in reaching the goals outlined in the Green Deal, RePowerEU plan, and the 2050 climate-neutral target. Portugal and Spain benefit from abundant solar and wind resources, complemented by additional renewable and nuclear potential in France, positioning the region as a cost-effective supplier of hydrogen to North-Western Europe.

The Iberian Corridor aims to meet increasing hydrogen demand in North-Western Europe, projected to reach 4.7 Mt by 2030 and rise to 12.5 Mt by 2050. Portugal, Spain, France, and potentially North Africa could produce up to 4 Mt of hydrogen by 2030, with the potential to exceed 12 Mt by 2050.

The expected outcome of this infrastructure development includes notable environmental advantages, with a projected reduction of 86 million metric tons of CO2 equivalent in 2030 and a more substantial decrease of 261 million metric tons of CO2 equivalent by 2050. These reductions are in accordance with established climate targets, contributing to both environmental sustainability and concurrent economic growth.

> **This infrastructure development is anticipated to result in significant environmental benefits, saving 86 Mt CO2eq in 2030 and a more substantial 261 Mt CO2eq in 2050**

While the prospects for the hydrogen ecosystem are promising, realizing this ambitious plan necessitates the development of a substantial infrastructure network spanning almost 18,000 km. Addressing potential bottlenecks would be also crucial for its success. Main challenges will be the classification of renewable hydrogen according to the Delegated Act, the harmonization of efficient grid development and tariff structures, and streamlining the often time-consuming permissions process.

Moreover, the development of new hydrogen production and infrastructure projects is contingent upon robust financing. The report points out the primary financing mechanisms designated by the European Union to propel the advancement of hydrogen technologies and infrastructure. These include, among others, the Recovery and Resilience Facility (RRF), European Investment Bank (EIB), InvestEU Fund, Innovation Fund, Connecting Europe Facility (CEF), Public Sector Loan Facility (PSLF), and Horizon Europe.

This array of funding sources reflects the EU's proactive approach in building a comprehensive financial ecosystem, fostering innovation, and creating an environment conducive to the widespread adoption of hydrogen technologies. By channelling support through diverse funding avenues, the EU aims to ensure the success of hydrogen projects, reinforcing its dedication to sustainable energy solutions and broader environmental goals.

2 Current and Future Hydrogen Ecosystem

2.1 EU Regulatory and Policy Framework

In December 2019, the European Commission unveiled Europe's ambitious goal to become the world's first climate-neutral continent by 2050, with the Green Deal serving as its guiding blueprint. Subsequently, in 2021, the European Parliament ratified the European Climate Law, legally binding the continent to this target, and introduced the Fit for 55 package. This legislative framework consists of a series of proposals designed to steer the European Union towards meeting its climate objectives by 2030 and beyond.

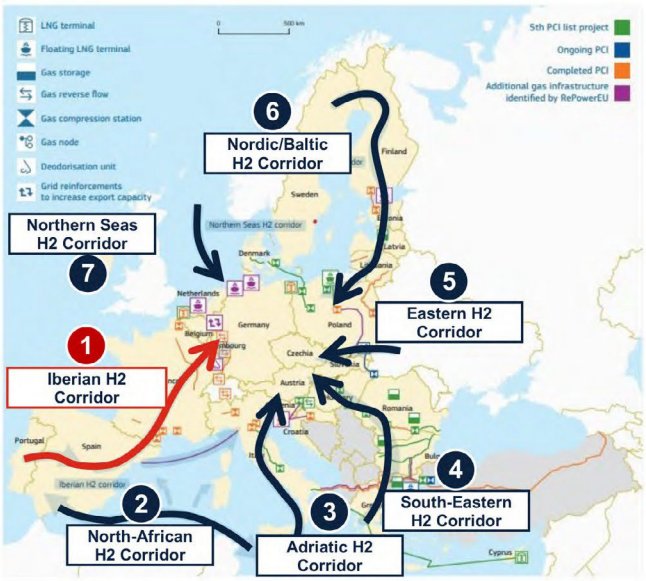
Hydrogen plays a crucial role in this endeavour, as emphasized by the EU Hydrogen Strategy. This strategy aims to increase the adoption of hydrogen within the EU and sets specific targets for renewable hydrogen production by 2030, including installing 40 GW of renewable sources dedicated to renewable hydrogen production through electrolysis and producing 10 Mt of renewable hydrogen by 2030.

The RePowerEU initiative, introduced in May 2022, builds upon the EU Hydrogen Strategy, and aims to reduce the EU's dependence on Russian fossil fuels, particularly in light of ongoing geopolitical tensions. As part of this initiative, an additional 10 Mt of imported renewable hydrogen is planned to be integrated into the EU's energy mix, as well as increasing the integration up to 80 GW of renewable sources dedicated to renewable hydrogen production. This expansion is seen as crucial for enhancing energy security and reducing reliance on fossil fuels from politically unstable regions.

In addition to increasing renewable hydrogen production, the RePowerEU initiative focuses on other measures such as energy conservation, diversification of energy sources, and accelerating the energy transition. It also emphasizes the strategic combination of investments and reforms to achieve these goals effectively.

One notable aspect of the RePowerEU initiative is its approach to addressing imbalances in hydrogen supply and demand across different regions of Europe. This includes the concept of hydrogen corridors, which are aimed at efficiently transporting hydrogen from regions with abundant renewable resources to areas with high demand and limited renewable potential. To achieve this objective seven potential corridors were defined.

Figure 4. Main hydrogen corridors of the RePowerEU



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7. Northern Seas H2 corridor (UK, Netherlands, Belgium, Denmark, Germany)

Source: *RePowerEU Communication Action Plan (May 2022) BIP analysis*

By establishing hydrogen corridors, the RePowerEU initiative aims to create a more integrated and harmonized hydrogen market across the continent

As for the need for infrastructure, Projects of Common Interest and Projects of Mutual Interest have been adopted through the implementation of the Trans-European Networks for Energy regulation (TEN-E)[4]. The TEN-E Regulation ensure that those cross-border relevant projects necessary for our energy and climate goals are being selected whilst giving the right investments signals to respond to Europe's energy and climate challenge. The first list of Projects of Common Interest and Projects of Mutual Interest under the new rules was adopted on the 28th November of 2023.

[4] *Trans-European Networks for Energy (europa.eu)*

The Fit-for-55 package also introduces a series of legislative proposals aimed at translating the European hydrogen strategy into a comprehensive policy framework for hydrogen across Europe. This includes the Hydrogen and Decarbonized Gas Market Package, which outlines initiatives to facilitate the establishment of dedicated infrastructure for hydrogen and to foster an efficient hydrogen market.

Furthermore, targets are proposed to increase the adoption of renewable hydrogen in industrial processes, as well as in aviation and maritime transportation.

- In the industry sector, the amended Renewable Energy Directive (RED III) aims to raise the share of renewable energy in industrial consumption to 42.5% by 2030, with an additional 2.5% indicative top-up to achieve a target of 45%. Hydrogen used for industrial energy consumption must prioritize reducing reliance on hydrogen produced from fossil fuels. It stipulates that renewable liquid and gaseous fuels of non-biological origin (RFNBOs) should account for at least 42% of hydrogen usage by 2030 and 60% by 2035.

- The regulations also extend to sustainable air transport, known as the ReFuelEU Aviation initiative. This directive targets a significant reduction in greenhouse gas emissions from planes by 2050, requiring flights departing EU airports to utilize increasing quantities of bio-based sustainable aviation fuels (SAFs) and green hydrogen-based synthetic e-fuels starting from 2025. For instance, aviation fuel in Europe should contain a 2% blend of bio-SAF from 2025, rising to 6% in 2030 and further increasing every five years until reaching 70% by 2050. Additionally, a percentage of fuel used by planes departing EU airports must be derived from synthetic kerosene, starting from 1.2% in 2030 and gradually increasing to 35% by 2050.

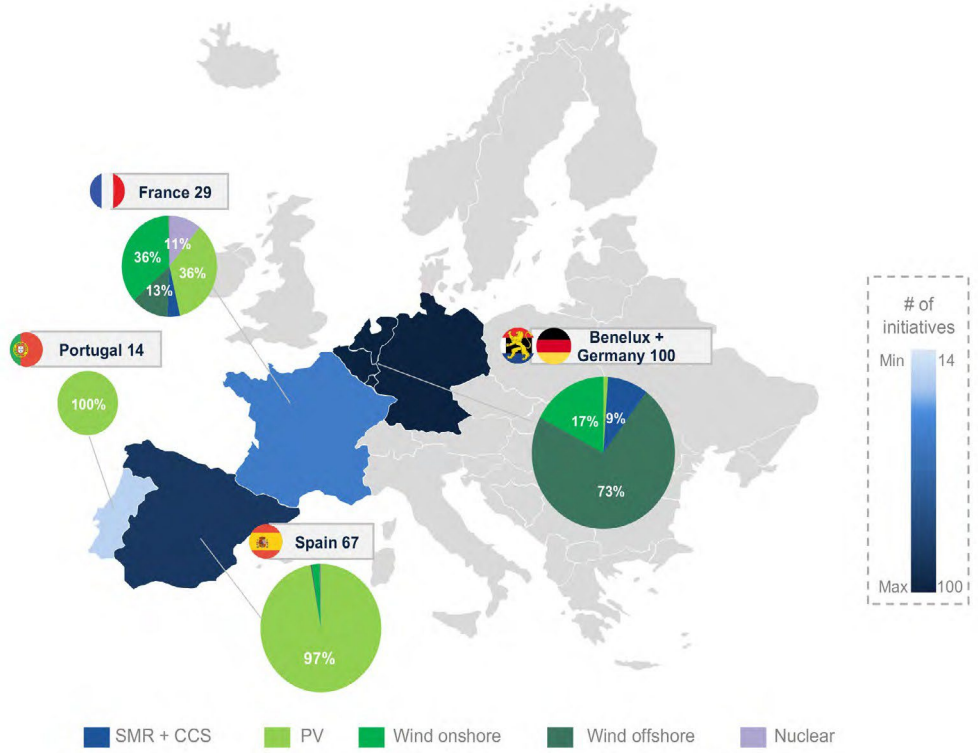
- Similarly, the package addresses the use of renewable and low-carbon fuels in maritime transport through the FuelEU Maritime directive. This directive includes measures to gradually decrease the greenhouse gas intensity of fuels used by the shipping sector, reducing by 2% in 2025 and by as much as 80% by 2050. It also introduces a special incentive regime to promote the uptake of renewable fuels of non-biological origin with high decarbonization potential.

The policy framework was completed with 2 delegated acts, formally adopted on 20 June 2023, applicable to renewable hydrogen under the Renewable Energy Directive. The first one covers renewable fuels of non-biological origin and sets the criteria for products that fall under the 'renewable hydrogen' category. The other one puts forward a detailed scheme to calculate the life-cycle emissions of renewable hydrogen and recycled carbon fuels to meet the greenhouse gas emission reduction threshold set in the directive.

2.2 Introduction to hydrogen supply and demand dynamics

In light of the policies established in the European Union, a significant number of projects dedicated to renewable and low carbon hydrogen production have been unveiled. A comprehensive assessment of over 200 hydrogen production projects has been conducted during this study. This assessment complements the analysis of renewable potential for hydrogen production, which will be further detailed in subsequent chapters. It also provides insights into the distribution and location of the primary hydrogen production hubs that are being planned.

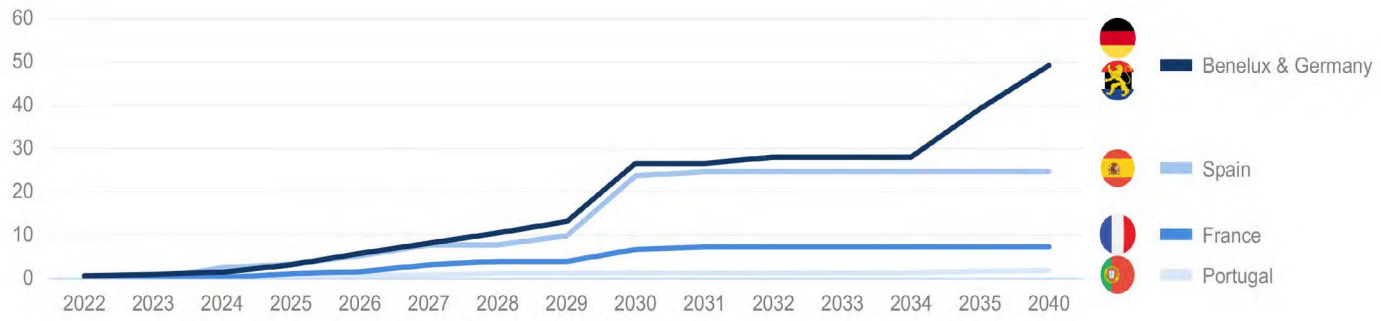
Figure 5. Pipeline of hydrogen projects and main technology used (# of projects)



The presented pie charts show the main technology of the selected projects, not all the technologies used in each project.
Source: PCI/PMI candidates, BIP analysis

This analysis reveals a projected surge in hydrogen production around 2030, with projects predominantly utilizing solar PV technology in the Iberian Peninsula, and wind offshore and onshore technologies in Benelux and Germany. France exhibits a more diversified technology mix for the 2030 period. However, information regarding electrolyser projects for the years 2040 and 2050 is scarce. Therefore, the projected installed capacity of electrolysers based on the project data does not fully reflect the anticipated increase in production during these periods.

Figure 6. Pipeline of hydrogen production projects by country (GW)



Source: PCI/PMI candidates, BIP analysis

Additionally, our study involves segmenting or categorizing the potential applications for hydrogen in the future. To this end, more than 20 potential uses or sectors have been identified wherein hydrogen could play a significant role. These applications have been grouped into three main categories: industry, transportation, and other uses. Furthermore, each category has been assigned potential roles for hydrogen, including as a feedstock, energy carrier for heating, or fuel.

Analysing this information regarding the potential uses or sectors where hydrogen could contribute to decarbonization has led to the determination of its potential penetration in each category. Based on this analysis, it has been established that, in terms of potential demand, renewable and low-carbon hydrogen are most likely to be utilized in the following ways:

- **Feedstock:** Substituting current hydrogen consumption in refineries, chemical, or iron and steel plants.
- **Energy source:** Substituting natural gas in sectors that involve medium and high temperature processes.
- **Fuel:** Substituting current fossil fuels in the long-distance transportation in road, aviation, and navigation.

> **Out of over 20 potential applications of hydrogen analysed, priority sectors for this study have been identified as those with the highest penetration potential, including its use as feedstock, as energy source in hard-to-abate sectors, and as a fuel in long-distance transportation**

While other sectors or end uses have been considered, their relative importance or lower penetration capacity suggests they may only be considered if the National Policies of the involved countries incorporate such applications. In such cases, alternative technologies may be more suitable for meeting decarbonization targets.

Table 2. Hydrogen potential penetration

		Use Case	Application	Current source	H2 potential	
Industry	Feedstock	**Refineries (oil)**	Use in sulphuration (hydrotreating) and hydrocracking processes	Fossil-fuel H2	High	Being already widely used in a fossil-fuel based form, H2 as a feedstock might have a key role in this segment thanks to high readiness level of technologies and few other carbon solutions
Industry	Feedstock	**Chemicals (i.e. fertilizers, cleaning products)**	Use as feedstock for ammonia and methanol production	Fossil-fuel H2	High	Being already widely used in a fossil-fuel based form, H2 as a feedstock might have a key role in this segment thanks to high readiness level of technologies and few other carbon solutions
Industry	Feedstock	**Iron and steel**	Use for direct reduction of iron (DRI) process	Fossil-fuel H2	High	Being already widely used in a fossil-fuel based form, H2 as a feedstock might have a key role in this segment thanks to high readiness level of technologies and few other carbon solutions
Industry	Energy carrier for heating	**Chemical and petrochemical**	Substitution of natural gas for heating in industrial processes (high temperatures e.g., ceramic, glass, paper, metallurgy)		High	High temperatures are needed as indirect heating (e.g. cracking of ethylene, etc.)
Industry	Energy carrier for heating	**Non-metallic minerals**	Substitution of natural gas for heating in industrial processes (high temperatures e.g., ceramic, glass, paper, metallurgy)		High	Very high temperatures are required for most of the production processes
Industry	Energy carrier for heating	**Paper, pulp and printing**	Substitution of natural gas for heating in industrial processes (high temperatures e.g., ceramic, glass, paper, metallurgy)		High	Substitute natural gas in boilers for drying
Industry	Energy carrier for heating	**Non-ferrous metals**	Substitution of natural gas for heating in industrial processes (high temperatures e.g., ceramic, glass, paper, metallurgy)		High	High temperatures required for melting processes
Industry	Energy carrier for heating	**Iron and steel**	Substitution of natural gas for heating in industrial processes (high temperatures e.g., ceramic, glass, paper, metallurgy)		High	Very high temperatures are needed for both steel finishing and iron production
Industry	Energy carrier for heating	Food, beverages, and tobacco	Substitution of natural gas for heating in industrial processes	Solid fossil fuels, Natural gas, Electricity & Oil and petroleum products	Medium	Heating is used mainly in the preparation phase, not very high on average
Industry	Energy carrier for heating	Mining, quarrying	Substitution of natural gas for heating in industrial processes	Solid fossil fuels, Natural gas, Electricity & Oil and petroleum products	Low	Low need for heating and with low temperatures only
Industry	Energy carrier for heating	Machinery	Substitution of natural gas for heating in industrial processes	Solid fossil fuels, Natural gas, Electricity & Oil and petroleum products	Low	Low need for heating and with low temperatures only
Industry	Energy carrier for heating	Construction	Substitution of natural gas for heating in industrial processes	Solid fossil fuels, Natural gas, Electricity & Oil and petroleum products	Low	Low need for heating and with low temperatures only
Industry	Energy carrier for heating	Transport and equipment	Substitution of natural gas for heating in industrial processes	Solid fossil fuels, Natural gas, Electricity & Oil and petroleum products	Low	Low need for heating and with low temperatures only
Industry	Energy carrier for heating	Wood and wood products	Substitution of natural gas for heating in industrial processes	Solid fossil fuels, Natural gas, Electricity & Oil and petroleum products	Low	Low need for heating and with low temperatures only
Industry	Energy carrier for heating	Textile and leather	Substitution of natural gas for heating in industrial processes	Solid fossil fuels, Natural gas, Electricity & Oil and petroleum products	Low	Low need for heating and with low temperatures only
Transport	Fuel	**Shipping**	Use to fuel ships through H2-derivatives synfuel, ammonia and methanol	Oil and petroleum products	High	Relevant use of SAF, ammonia and other hydrogen-derived synthetic fuels in medium-term is expected
Transport	Fuel	**Aviation**	Use as feedstock to produce synthetic fuels (SAF)	Oil and petroleum products	High	Relevant use of SAF, ammonia and other hydrogen-derived synthetic fuels in medium-term is expected
Transport	Fuel	**Heavy good vehicles, buses**	Use in fuel cell electric vehicles (FCEV)	Oil and petroleum products	High	Competition with battery electric vehicles (BEV) in long-distance transportation
Transport	Fuel	Passenger cars			Low	Electrification is expected to be more economical and feasible
Transport	Fuel	Trains	Use in fuel cell electric vehicles (FCEV)		Low	Penetration only where electrification is not feasible or convenient
Other	Fuel	Power supply	Co-firing of ammonia in coal power plants or gas turbines to use H2	Various	Low	Lower penetration expected since there are other technologies available for decarbonizing
Other	Fuel	Back-up, off- grid power	Fuel Cells systems in combination with storage create off-grid and backup power	Various	Low	Lower penetration expected since there are other technologies available for decarbonizing
Other	Fuel	Heating	Blending or pure H2 to substitute natural gas	Natural gas & Electricity	Low	Lower penetration expected since there are other technologies available for decarbonizing
Other	Fuel	Comb. Heat & Power	H2 used in fuel cells to produce both heat and power	Natural gas & Electricity	Low	Lower penetration expected since there are other technologies available for decarbonizing

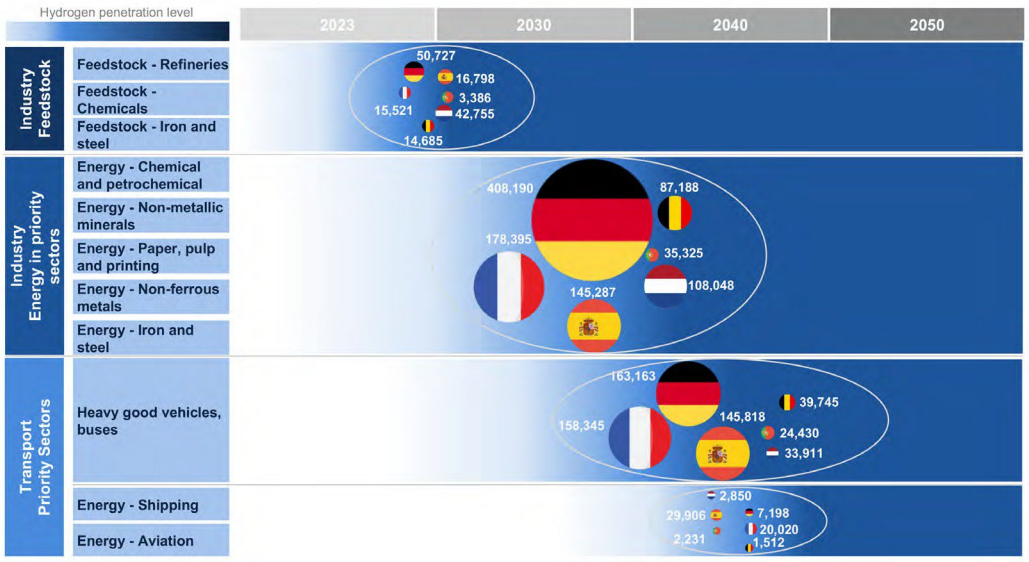
Source: EA, Hydrogen council, NACE list, SIEC, BIP analysis

For each of the priority sectors, it has been calculated the period in which hydrogen would be cost-competitive against the different sources currently being used, resulting in the following findings:

- **In the 2030 period,** renewable hydrogen would begin to be competitive for substituting hydrogen produced by Steam Methane Reforming (SMR), primarily as a feedstock in refineries and chemical plants for ammonia production, replacing the current main end-uses of hydrogen.
- **Between 2030 and 2040,** renewable hydrogen becomes competitive with natural gas in hard-to-abate sectors, prompting large-scale replacement of fossil fuel energy sources in industrial sectors, particularly in high-temperature processes where electrification is challenging. Additionally, increased demand in heavy-duty road transport, as well as in aviation and maritime transport would be expected.
- **From 2040 onwards,** the need of hydrogen in the industrial sectors and regions would increase. Furthermore, the implementation of the RefuelEU legislation, would increase the penetration of hydrogen in a larger scale in the transport sector, specifically in the aviation and navigation sectors as an e-fuel in different forms (e.g. e-methanol, ammonia, synfuels, etc.).

The largest opportunity[5] for hydrogen adoption is seen in the industry sector, particularly in Germany, followed by transportation where there is more balance between Germany, France, and Spain. The feedstock cluster has the lowest opportunity size but is expected to see significant penetration due to fewer alternative decarbonization options.

Figure 7. **Hydrogen potential period of penetration in priority sectors (energy consumption in GWh)[6]**



The blue background indicates the tipping point, the moment when renewable hydrogen is likely to become competitive with current energy sources in each sector and therefore it would start to penetrate the markets substituting those current sources.
Source: IEA, Irena, Eurostat, BIP analysis

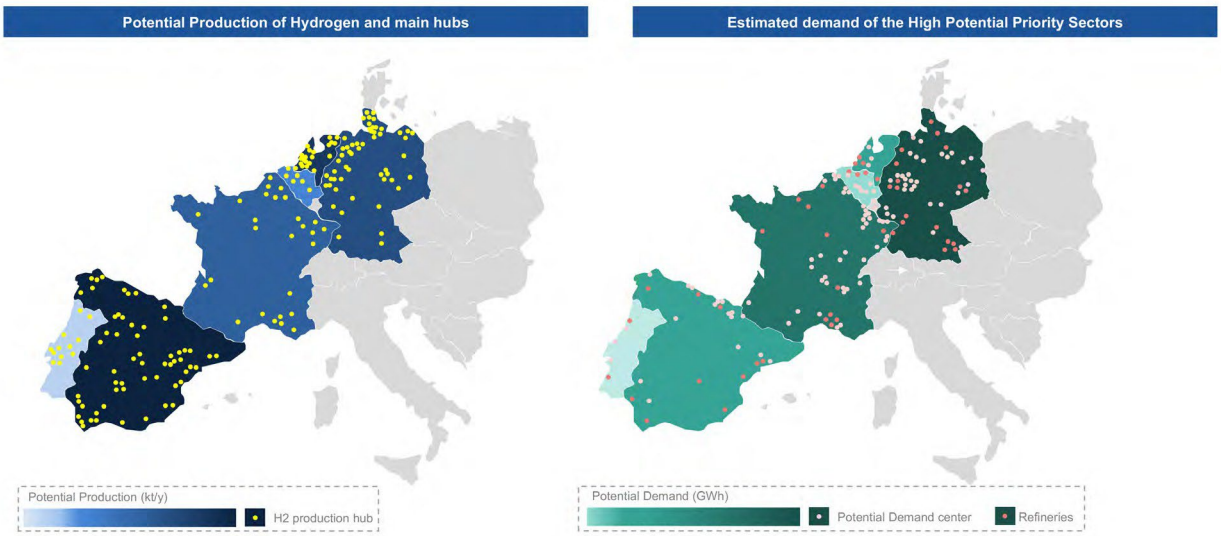
[5]*Opportunity refers to the amount of final energy consumed in each of these uses, which does not mean that it will be completely replaced by hydrogen, since there are other technologies or alternative sources.*
[6]*Aviation and navigation sectors only accounts for the domestic consumption as per considered in Eurostat.*

The estimations based on the list of these hydrogen production projects and the potential demand based on current energy consumption for the different priority sectors indicate that there is an imbalance between supply and demand:

- Electrolysers are planned throughout the territory of the Iberian Peninsula with a capacity that exceeds their domestic potential demand, characterised by a net supply of low cost, hydrogen resources. These regions benefit from vast renewable energy potential, high-capacity factors, and substantial land availability.

- On the other hand, the demand is mainly concentrated in the north of France, the Benelux region and Germany, where the planned hydrogen production would not be enough to cover their domestic demand, hence driving them to become the main importers for the surplus from the Iberian Peninsula.

Figure 8. **Preliminary supply and demand comparison of the countries in the corridor**



Results calculated as the projected production of hydrogen based on the projects studied and the current potential demand of the high priority sectors.
Source: *Eurostat, EU Energy and Industry Geography Lab, Fuel Cells and Hydrogen observatory, BIP Analysis*

Imbalances between supply and demand points are evident in certain countries. Consequently, hydrogen transportation routes are expected to be essential to link supply and demand.

The imbalances between supply and demand underscores the critical need for sufficient storage capacity and infrastructure to uphold a sustainable renewable and low-carbon hydrogen ecosystem within the Iberian Corridor. Subsequent chapters of this study delve into a detailed analysis of the potential hydrogen supply and demand for each region, spanning the horizons of 2030, 2040, and 2050.

3 Supply potential of the corridor

3.1 Main considerations for hydrogen supply calculation

Hydrogen supply has been calculated based on the renewable generation potential[7], in order to estimate the potential capacity to produce hydrogen of each country regardless of the production's projects. This methodology provides a more optimal estimation of the potential hydrogen supply for the 2030, 2040 and 2050 periods, as the production projects are planned currently for the 2030 horizon and would change over the years.

The starting point for our analysis is the potential production of renewable electricity, calculated by considering the planned installed capacity and the load factor specific to each region and technology. This initial estimation is then confined by the surplus electricity generated and the current electricity demand, establishing an upper limit on the amount of renewable energy available for hydrogen production, as it is assumed that electricity would be mainly used for energy purposes and only the surplus would be use for hydrogen production. The consumption of electricity in various sectors has been calculated based on electrification and efficiency levels. These calculations have been executed for different timeframes, regions, and technologies.

The main inputs for calculating the renewable potential have been the National Energy & Climate Plans (NECP) for the 2030 period and the long-term strategies (LTS) developed and shared by the countries with the European Commission for the 2040 and 2050 periods.

> **The renewable capacity projected shows the ambition for all the countries to comply with the decarbonization strategies proposed by the European Commission**

Additionally, the impact of the Delegated Act has been considered, as it defines the conditions under which hydrogen can be considered renewable. According to the act's text, there are different ways of considering that the hydrogen produced is renewable, differentiating when it is produced with direct connection or when it is produced with connection to the grid. This study focuses on the conditions necessary to produce hydrogen with backup connection, distinguishing:

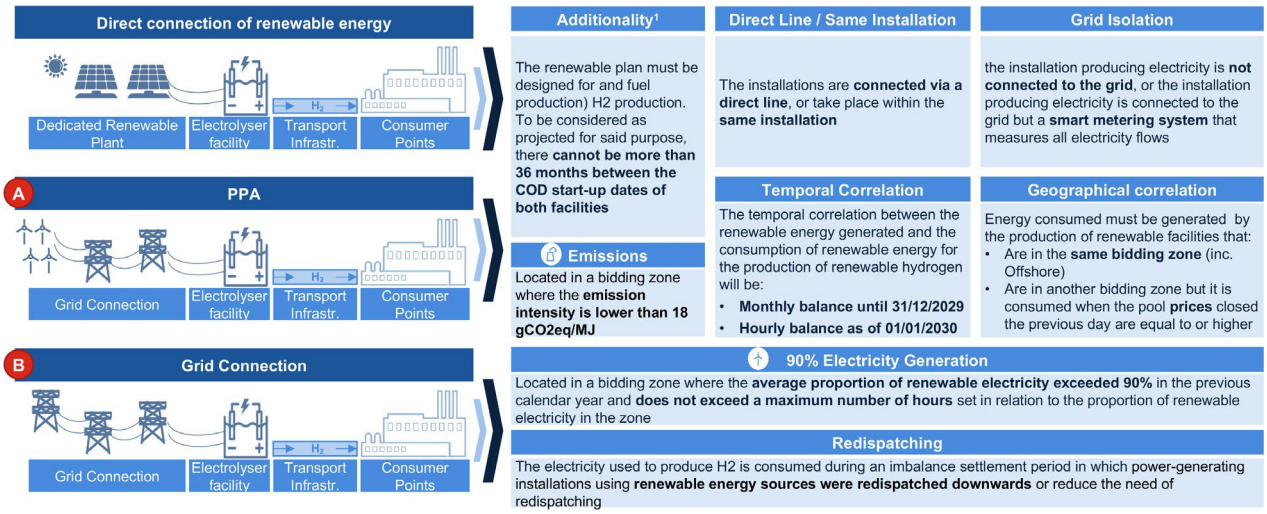
[7] *Renewable generation potential considered as production capacity with the highest load factor of each region and assuming the achievement of the renewable capacity objectives of the NECP and LTS*

A. Hydrogen produced through a Power Purchase Agreement (PPA): only considered renewable when complying with three criteria:

- **Geographical correlation:** energy consumed must be generated by the production of renewable facilities that are in the same bidding zone (inc. Offshore) or in another bidding zone but it is consumed when the pool prices closed the previous day are equal to or higher.
- **Temporal correlation:** between renewable energy generated and consumption of renewable energy to produce renewable H2 will be monthly balance until 31/12/2029, and hourly balance as of 01/01/2030.
- **Additionality[8]:** The renewable plan must be designed for H2 production. To be considered as projected for said purpose, there cannot be more than 36 months between the COD start-up dates of both facilities. If the bidding zone in which the facility is located has an emission intensity lower than 18 gCO2eq/MJ (emission criteria), it is not necessary to comply with the additionality criteria; that is any available renewable source of the bidding zone could be used for hydrogen production.

B. Hydrogen produced directly through grid connection: considered renewable when located in a bidding zone where the average proportion of renewable electricity exceeded 90% in the previous calendar year and does not exceed a maximum number of hours set in relation to the proportion of renewable electricity in the zone (renewable criteria).

Figure 9. Renewable production options described in the Delegated Act



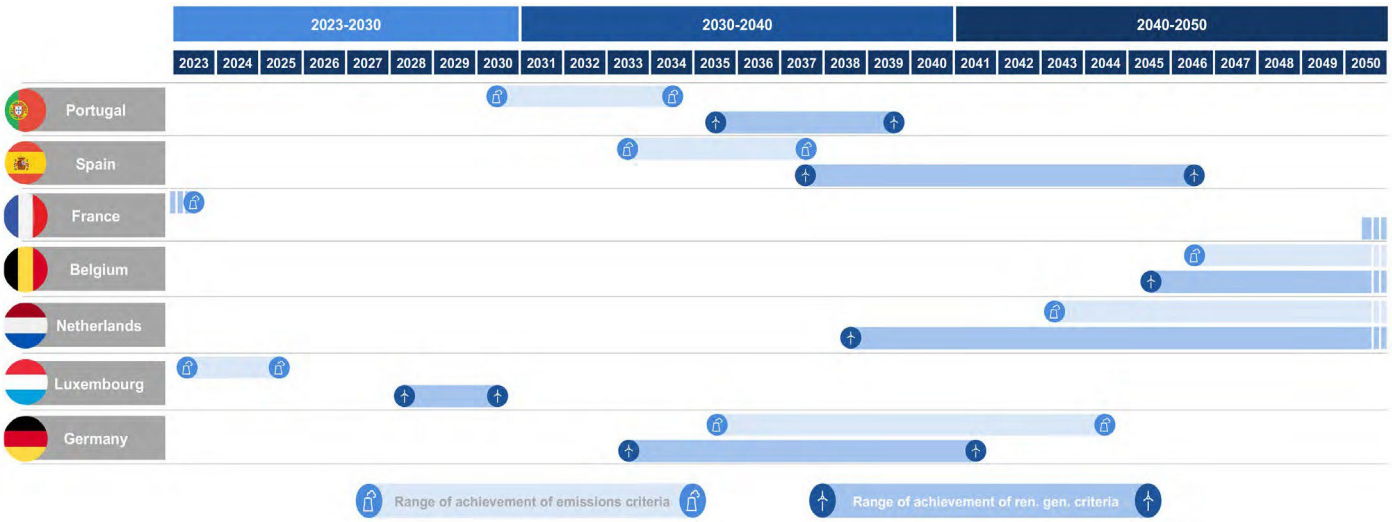
Source: *Delegated Act, BIP Analysis*

[8]*Additionality does not apply until 1st of January 2028 to installations producing renewable liquid and gaseous transport fuel of non-biological origin that come into operations before 1st of January 2028.*

According to available data and projections based on the National Energy & Climate Plans, Portugal could reach the emissions and renewable criteria by 2030 and 2034 respectively, while Spain could achieve them by 2033 and 2037. This means that from 2028 to 2033-35 these countries could only use additional capacity for hydrogen generation, and from 2030 to 2035-37 they should comply with the temporal and geographical correlation meaning that only part of the hydrogen produced could be considered as renewable.

France already complies with the emissions criteria, but they will encounter difficulties in meeting the renewable objective due to the high share of nuclear energy in the country's energy mix. This positions France as a potential low-carbon producer that could use current nuclear capacity for hydrogen generation.

Figure 10. **Estimation of potential date of compliance with delegated act conditions based on different scenarios[9]**



Source: *National Energy & Climate Plans, Long-Term strategies, EU Reference Scenario BIP analysis*

[9]*Different scenarios arising from distinct levels of adherence to National Policies (NECPs and Long-Term Strategies) as well as the EU-Reference Scenario*

3.2 Supply potential of the corridor

The major driver for the development of the Iberian corridor appears to be the high renewable potential of the south-west countries, together with the potential development of the connection with North Africa. This ecosystem could provide off-taker regions in North-Centre European countries with low-cost and high-volume hydrogen, especially due to the potential of solar PV with high expected capacity in the southern regions and a potential surplus of energy.

The supply potential of each of the regions have been calculated in different scenarios, with a minimum a maximum[10] value for each of the regions depending on different variables and hypotheses that have been considered, but to ensure a conservative perspective, data has been simplified by employing an average scenario. The main variables that impact on the results are the potential renewable capacity installed, the load factor for each region and the local demand of electricity. Considering that, the supply potential of the Iberian Corridor are as follows:

- **For the 2030 period, the hydrogen supply would be 6.3 Mt**, with the combination of solar PV and onshore wind being the technology with the highest weight in the share, accounting together for 58% of the total supply. This type of hybrid configuration, with solar PV as the main technology from plants in the southern regions, combined with onshore wind plants being developed in the centre of the peninsula, is being planned to increase the capacity factor for the electrolyzers up to 70%. Nevertheless, during this period, the limitation of the Delegated Act could hinder the hours of production in which hydrogen could be considered renewable, due to the temporal correlation condition.

  Wind offshore technologies being developed in the North Sea regions would initially account for 22% of the total supply. Nuclear technologies, mainly located in France, would play an important role in this initial period, comprising 20% of the share.

- **For the 2040 period, the hydrogen supply would be 11.5 Mt**. During this period, nuclear technologies for hydrogen generation located in France would reduce their share to 11%, while the combination of solar PV and onshore wind would increase to 65%. It is expected that throughout this timeframe, both Spain and Portugal would comply with the delegated act conditions, meaning that temporal correlation is no longer needed for classifying hydrogen as renewable in grid connection configurations.

  Considering this distribution, the share of the wind offshore technology mainly being developed in the North Sea regions would remain practically flat, accounting for 23% of the total supply.

[10] *The primary difference between the minimum and maximum scenarios lies in the differences of the load factors used in each scenario, and in the availability of electricity for hydrogen generation. In the minimum scenario, a significant portion of electricity is allocated to other purposes, particularly due to intensive electrification, thereby limiting the capacity for hydrogen production.*

- **For the 2050 period, the hydrogen supply would be 17.9 Mt,** assuming compliance with the targets of the Long-Term Strategies of each of the countries. The technology with the highest increase during this period would be offshore wind, rising from 23% to 28% of the total generation of the countries along the corridor. As in the other periods, it is expected that most of these farms would be located in the North Sea, but advancements in technology, with the increase in floating platforms, would allow the exploration of new locations in deeper waters.

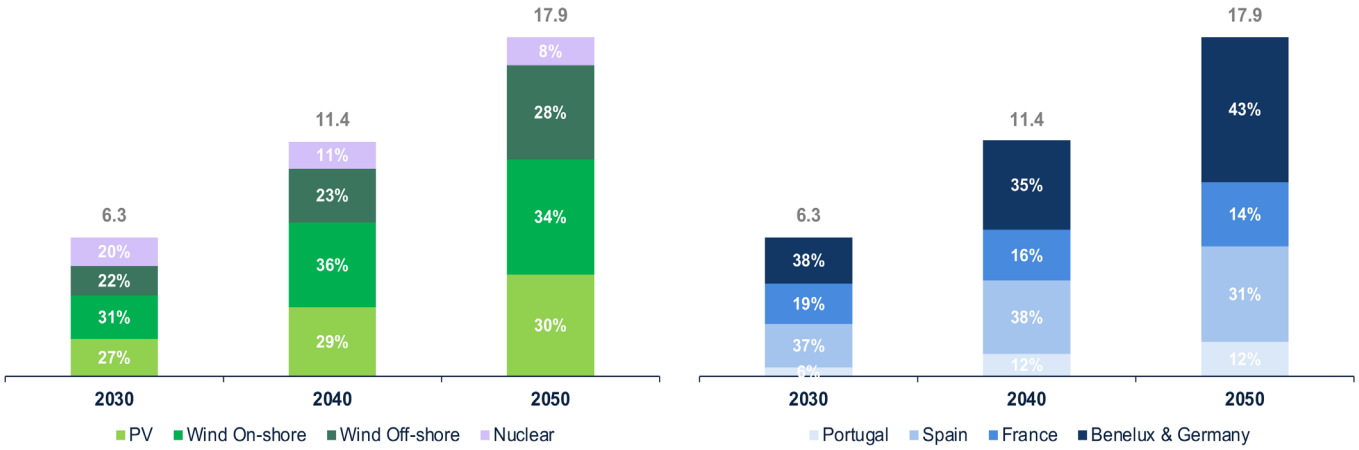
  The combination of solar PV and onshore wind would remain practically flat, accounting for 64% of the supply, with the Iberian Peninsula as the main player in these technologies. Meanwhile, nuclear technology for hydrogen generation in France would slightly reduce its share to 8%, leaving more space for renewables.

The evolution of the supply potential would be proportional to the installation of renewable energy sources planned according to the National Energy & Climate Plans and Long-Term Strategies.

Based on these considerations, the potential supply as domestic production of the Iberian Peninsula could be around 2.5 Mt in 2030, 5.3 Mt in 2040 and 7.4 Mt in 2050, accounting between a 40% and 50% of the total supply capacity of the corridor.

France stands as producer and exporting country for the 2030 period. Its production capacity goes up to slightly over 1.5 Mt in this period. For 2040 and 2050 the production could reach 2.0 and 2.8 Mt respectively, reducing its share of the total supply from 19% in the 2030 to 14% in the 2030 period.

Figure 11. Hydrogen supply potential by period per energy source and country (Mt)



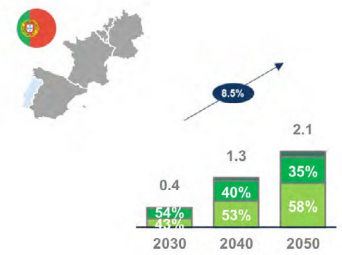
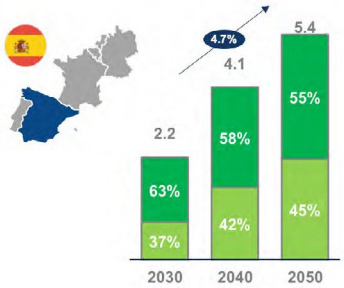
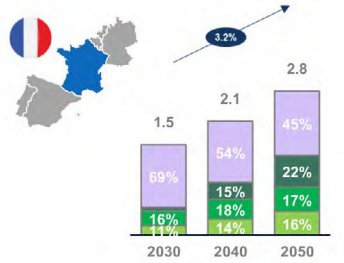
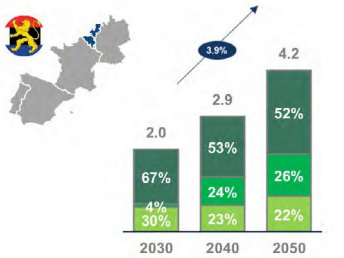
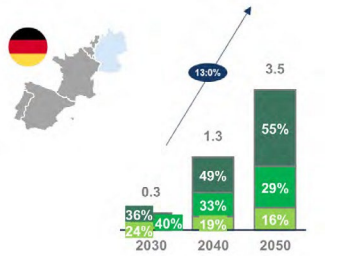
Results calculated as the potential supply based on the surplus of renewable electricity available for electrolysis after satisfying local demand. Technologies with lower load factor (such as Solar PV) are complemented with other technologies to reach 70% of load factor.
Source: *National Energy and Climate Plans, Long-Term strategies of the Member States, Wind Atlas, Solar Atlas, BIP Analysis*

The distribution of supply presents differences depending on the different regions within the countries .

- In the case of Portugal, Central and North regions are the areas with the highest production capacity within the country, being the Solar PV the predominant technology.
- For Spain, in all the different studied periods, the southern regions with predominant solar PV technologies (Castilla la Mancha and Andalucia) and central regions with wind onshore technologies (Aragon) would be the zones with highest supply potential.
- Outside the peninsula, the regions with highest potential production are those with access to wind offshore technologies located on the North Sea.

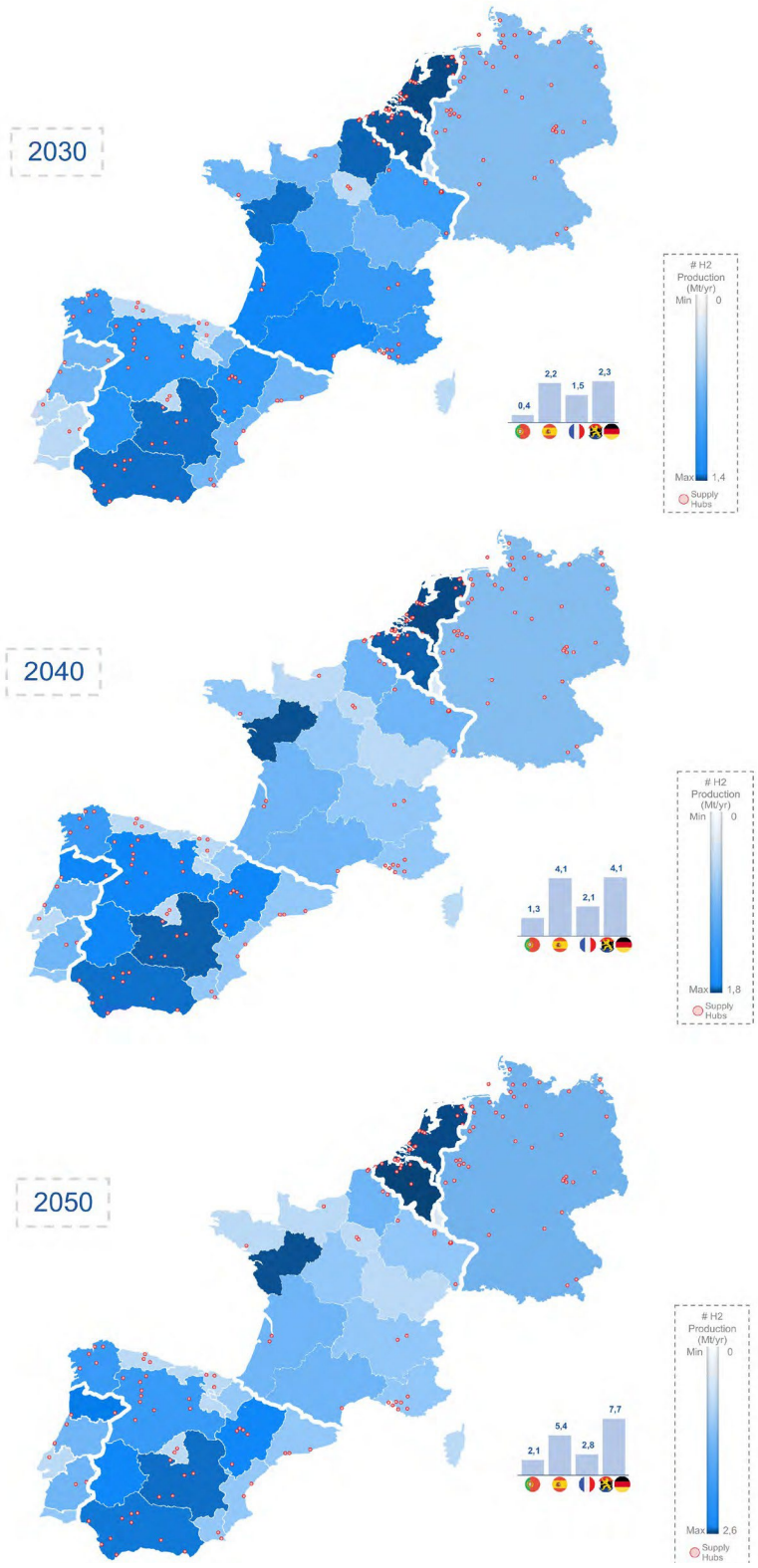
Regarding the evolution of the different regions, although it is true that some of them have more potential, especially due to the high load factor of some of the renewable technologies (for example, high load factors in the south for solar PV and in coastal areas and with conditions suitable for wind offshore), there are no relative differences between regions in each of the periods, meaning that those regions with the greatest potential supply in 2030 will continue to be so in successive periods. Nevertheless, it can be observed that the differences between those regions with the most potential and those with the least, increases as time progresses in the latest periods.

3.3 Detail of hydrogen supply per country

Country	H2 Domestic Production (Mt)	Boundary Conditions	H2 Supply Potential Highlights
		Portugal's renewable strategy results in a surplus of renewable electricity that could be used for hydrogen production. New National Policies outline a generation mix based on renewable capacity, supported by several gigawatts (GW) of storage capacity, including batteries and hydrogen. The objective is to reduce renewable curtailment and decrease dependence on other energy sources. In 2030, an installed renewable capacity of solar PV and wind technologies of ~23 GW is expected, of which around 60% would be solar PV.	Portugal is expected to be a potential hydrogen producer in the corridor reaching up to 0.4 Mt, 1.3 Mt, and 2.1 Mt in 2030, 2040 and 2050 respectively. The Portuguese regions with the highest production would be the North and Central regions. The H2Sines.RDAM in Sines should be highlighted as a future hydrogen production project in the country along with Aviation Synfuels in Figueira da Foz. Portugal also has other relevant infrastructure as the gas terminal placed in Sines (Alentejo) and the interconnection with Spain via Central region.
		The country's new national policies is focused on its renewable strategy, leaving a surplus of renewable electricity for hydrogen production, thanks to an increase in installed capacity of renewable sources. However, to ensure the reliability of the electricity system when renewable generation is limited by weather conditions, fossil fuel sources are maintained until late 2040's. Spain in 2030 is expected to increase the renewable capacity of solar PV and wind technologies from ~50 GW to ~140 GW, of which around 55% would be solar PV.	Spain has the potential to become a hydrogen producer in the studied corridor with up to 2.2 Mt, 4.1 Mt and 5.4 Mt in the studied periods. The region with the highest hydrogen production in the country could be the South region (mainly Castilla La Mancha and Andalusia). As future hydrogen projects in Spain, we highlight the Andalusian Valley and the Catalina H2 Project. Spain stands as one of the countries with more terminals, as well as other connections with France, such as the projected H2Med.
		For 2030, France aims to have renewable installed capacity of solar PV and wind technologies 85 GW of which around 52% would be solar PV, 41% of wind offshore, and 7% of wind offshore. France relies for most of its generation mix on nuclear power, being a player focused on low-carbon technologies for H2 generation. Nevertheless, that strategy is complemented with a growth in all renewable technologies.	France, apart from being a transit country with respect to the Iberian Peninsula production, has also strong potential for renewable hydrogen and could produce up to 1.5 Mt, 2.1 Mt and 2.8 Mt. The regions with more potential may be: West region (mainly Pays de la Loire) and the North region (mainly Hauts-de-France) with projects such Liberty Steel DRI plant or H2V Valenciennes. Through the North region, via pipeline, the country can export hydrogen to Belgium, via the West region, thanks to the gas terminal and via pipeline through Germany.
		The renewable installed capacity for 2030 in BENELUX could reach 65 GW, where 80% would be represented by wind generation. Netherlands' potential relies mainly on wind technology, thanks to the high load factor of the offshore technology, whereas Belgium's is limited compared to the other countries in the corridor. However, Belgium's national policies propose a strong increase in solar PV and wind onshore.	The principal production regions would be the South of Netherlands (mainly Zuid-Holland and Zeeland), and the North of Belgium (mainly Flanders); two regions highly dependent on wind offshore electricity generation. The main projects are H-Vision or Enecolyser and Hydrogen Delta in the South of Netherlands, or H2BE in the North of Belgium. The Port of Rotterdam aims to be the main hydrogen importer site, through which could be transported to demand centres in Benelux and Germany.
		Germany's primary energy strategy is to substitute current local fossil fuels plants by renewable technology with one of the most aggressive growth plans among the countries of the corridor. The installed capacity for 2030 is set to reach 189 GW, of which 51 % would be PV, 38% wind onshore and 11% wind offshore.	Germany may stand as an importer country. The production could be limited in the first period due to the high electrification foreseen by their national policies, resulting in little surplus that could be used for hydrogen production., therefore it could reach up to 0.3 Mt, 1.3 Mt and 3.5 Mt The main production region would be the North of Germany (mainly Niedersachsen and Schleswig-Holstein), thanks to wind offshore technology in the Baltic Sea, highlighting the projects: Hybridge or H2ercules and AquaVentus or eFarm respectively.

PV · Wind On-shore · Wind Off-shore · Nuclear · CAGR

Figure 12. Domestic Potential Supply of Hydrogen in the Iberian Corridor (Mt/yr)



4 Demand estimation of the corridor

4.1 Main considerations for hydrogen demand calculation

Hydrogen demand has been calculated based on the substitution of the current feedstock and other energy sources in the sectors analysed. To project the potential substitution by hydrogen, the existing sector-specific final energy consumption data at the national level, using Eurostat as primary source, has been extrapolated up to 2050.

This projection involves estimating the evolution of consumption based on the efficiency scenarios outlined in the National Energy and Climate Plans and National Long-term Strategies. These plans provide energy forecasts by sector for each country until 2050, measured in gigawatt-hours (GWh).

The distribution of this final energy consumption has been allocated per source and region:

- At the source level, an estimation is derived from various scenarios of electrification and renewable energy penetration (excluding biofuels) by sector at the national level. This allows the identification of the share of final energy that could be addressed by hydrogen, as it is assumed that hydrogen would mainly be utilized to substitute fossil fuels and not electricity nor direct renewable energy.

- The regional distribution has been determined based on the current situation defined by National and Regional Government agencies, as well as the anticipated evolution outlined in the National Energy and Climate Plans and National Long-term Strategies of each country.

Finally, a compilation of potential hydrogen penetration rates per sector and period has been gathered from several sources such as international agencies (e.g. IEA, IRENA and EHB). On the basis of this approach, various scenarios of potential hydrogen demand by sector until 2050, at national and

regional level, have been built. The basis for those scenarios is the result of the current and future hydrogen ecosystem analysis, more concretely the main uses for renewable hydrogen and potential penetration study, in which for each of the uses it has been calculated the tipping point in which hydrogen would start to compete against the traditional or incumbent sources.

> **Energy consumption projections have been calculated until 2050, for each region of the countries across the sectors studied, alongside determining the penetration ratio of hydrogen for all periods**

4.2 Demand estimation of the corridor

The demand estimation of each of the regions have been calculated in different scenarios, with a minimum a maximum value for each of the regions depending on different variables and hypotheses that have been considered. The main variables that impact on the results are the potential electrification, the efficiency expected and the hydrogen penetration in the different sectors. As in the supply chapter, and in order to ensure a conservative perspective, the data has been simplified by employing an average scenario. Considering that, the demand estimation of the countries along the corridor are as follows:

- **In 2030, hydrogen demand would be 6.7 Mt**, being the substitution of current hydrogen produced by SMR the main end use of hydrogen. Consumptions will be divided between the Feedstock and Industry sectors, accounting for 52% and 45% respectively, leaving transport with a consumption of 3% of total hydrogen consumption, which in this period would be entirely dedicated to heavy good vehicles and buses.

  From the hydrogen penetration as feedstock end use, almost half of it would be likely to be dedicated to refineries, one third to ammonia and the remaining third to methanol, other chemicals, and energy.

  Within industry the most relevant subsectors are expected to be iron and steel, non-metallic minerals, paper pulp and printing, non-ferrous metals, and chemical and petrochemical as energy use.

- **In 2040, hydrogen consumption of the corridor would be 15.1 Mt**, with an increase in the values due to the entrance of the hard-to-abate industrial sectors, which as stated in the current and future hydrogen ecosystem chapter, is the cluster with the highest opportunity size. Therefore, industry is expected to become the most significant sector of hydrogen consumption of the mix, accounting for 43% of the total consumption. The transport sector would grow exponentially, reaching 28% of total consumption, which is due to hydrogen being likely to become competitive in the transport of heavy goods vehicles and buses in 2035.

  As feedstock, the majority of penetration is expected during the 2030 period, resulting in moderate growth in the 2040 period, and maintaining a lower relative share of around 25%.

In addition, in light of Germany's anticipated intentions to transition its heating systems from natural gas to hydrogen, the study has considered the potential demand for hydrogen in the residential and service sectors for heating purposes in Germany accounting, together with other non-priority uses, for 3% of relative share.

- **In 2050, the hydrogen demand would be 20.4 Mt**, continuing with the ascending line due to an increase in the hard to abate sectors, to which would be added the increase in other important sectors that reach their tipping point such as navigation and aviation. On the other side, the distribution of consumption between the different sectors is not expected to experience major changes vis-à-vis 2040.

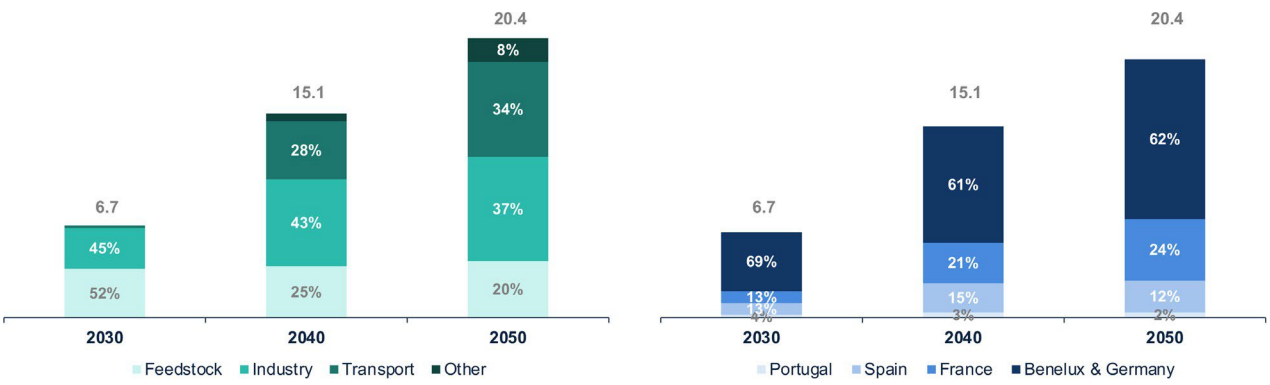
  The participation in the consumption mix of the industry sector would be the highest, accounting for 37%; chemical and petrochemical industry are expected to show the highest share of the industry's subsectors as in previous periods – i.e. almost half of industry's total consumption in 2050.

  As feedstock, the penetration would remain practically flat, accounting for 20% of participation in the total consumption. This would leave the transport sector with 34% of the corridor's total hydrogen consumption; in particular, the increase is expected to come from the competitiveness of the use of e-methanol and other fuels produced by renewable hydrogen during this period for the maritime and aviation sectors.

Regarding country distribution, in 2030, almost 70% of the demand is centred in Benelux and Germany, with France accounting for an additional 13%. In the 2040 and 2050 periods, the distribution remains approximately 60% for Benelux and Germany, while France increases its share up to 21% of the demand, reaching 24% in the 2050 period.

> **Energy consumption projections have been calculated until 2050, for each region of the countries across the sectors studied, alongside determining the penetration ratio of hydrogen for all periods**

Figure 13. Hydrogen potential demand distribution by period per sector and country (Mt)



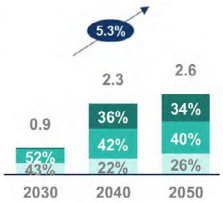
Source: *National Energy and Climate Plans, Long-Term strategies of the Member States, National statistic institutions, BIP Analysis*

The distribution of demand presents also differences depending on the different regions within the countries:

- The primary regions of Portugal for hydrogen consumption are the Central and Northern regions, coinciding with the highest supply potential regions.
- In Spain, the mineral industry is prevalent throughout the country followed by the chemical and petrochemical industry, with refineries distributed in the mediterranean and northwestern coast side of the country as the main consumers, along with the ammonia plants. The regions with the highest hydrogen demand are coastal and industrial areas such as Catalonia, for the mineral and chemical industry, and Andalusia.
- In France, the primary demand regions are in the north and southeast, mainly on refineries and chemical plants. Notably, Hauts-de-France will have high demand in the western part for the mineral industry, and Grand Est will see consumption spread across its central and eastern areas.
- In the Benelux region, the primary use for hydrogen is as feedstock in refineries and chemical plants. Germany would be the highest hydrogen consumer in the corridor, highlighting the total amount of consumption that represent the industrial sector, as well as the increase in the last period in other non-priority uses such as power generation, or the residential and service sectors for heating purposes.

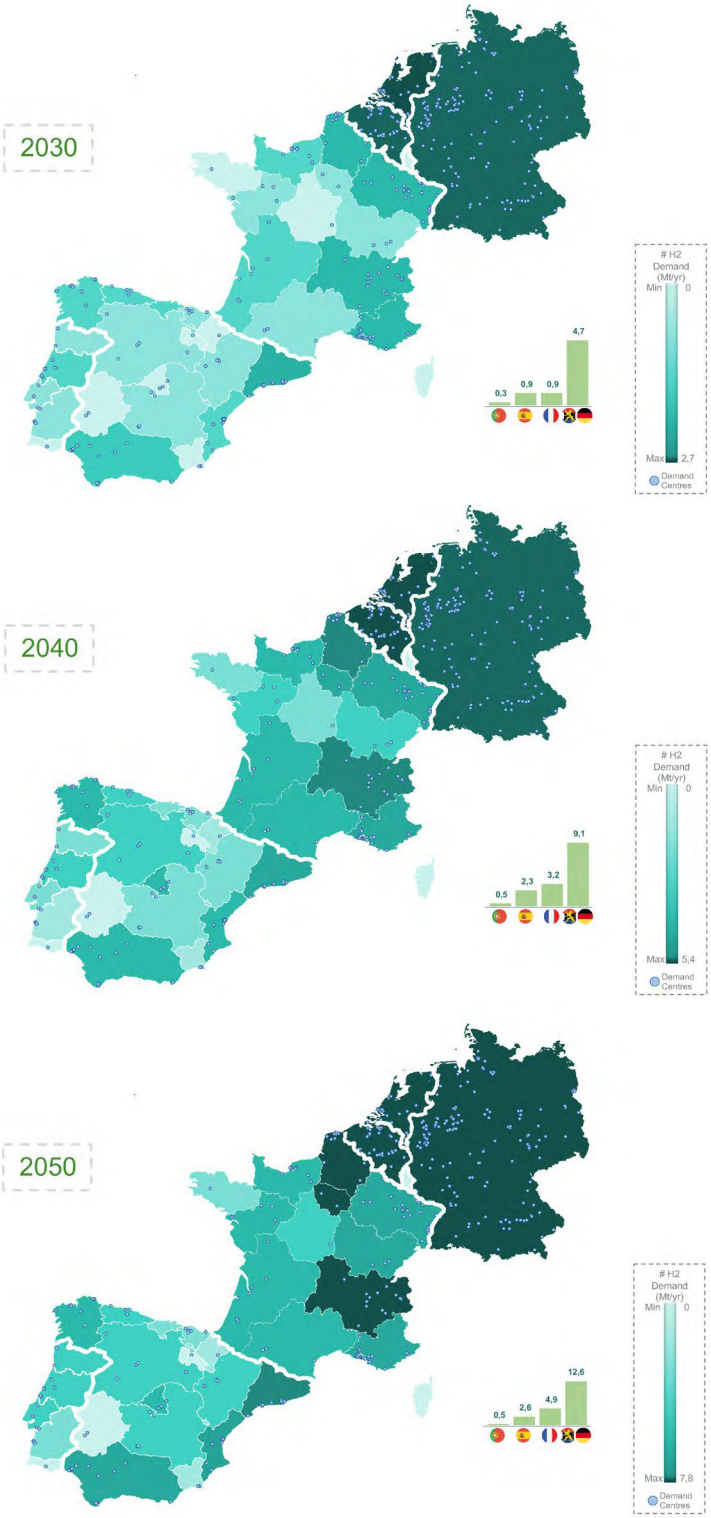
Regarding the evolution of the different regions, it is slightly different than in supply, in which no specific differences between the regions with high and low potential was found during the evolution of the periods. In the case of the demand, the first regions with highest penetration ratio are those with refineries or chemical plants. Nevertheless, from 2040 onwards the distribution varies with the integration of the hard-to-abate sectors, driving changes in regions with the highest potential penetration of hydrogen.

4.3 Detail of hydrogen demand per country

Country	H2 Domestic Production (Mt)	Boundary Conditions	H2 Demand Potential Highlights
		Compared to other countries along the corridor, Portugal shows less penetration potential for hydrogen due to a high level of electrification in the industries, especially in the hard to abate sectors, and high objectives of efficiency in the final energy consumption as per considered in the NECP. In aggregated numbers, energy demand in industry and transport is lower when compared to other countries, leaving less space for hydrogen penetration.	Portugal shows a modest H2 demand compared to other countries in the corridor, especially North-Centre Countries, going from an expected demand of 0.3 Mt in 2030 to 0.5 Mt in 2050 with a CAGR of 3.0%. The consumption of hydrogen would be mainly in the industry sector, expecting to be approximately 65% of the total consumption during all the periods. The main consumer regions will be Central and North regions. In the Central zone, main uses would be mineral industry, paper and wood; in the North, the paper and wood industry would be the main sector.
		Spain's penetration potential for hydrogen would be considered as medium comparing with other EU countries, especially due to a medium level of electrification in the industry sector in which the emission reduction is expected by the change of current fuels to other renewable sources. Efficiency is mainly focused on the transport sector affecting less in the industry final energy demand as per considered in the NECP.	Expected H2 demand in Spain would increase from 0.9 Mt in 2030 up to 2.6 Mt in 2050 with a CAGR of 5.3%, highlighting the growth in the 2040 period with the entrance of the penetration in the hard to abate sectors. It is expected that around 50% of the total hydrogen consumption will be in the industrial sector, with the main consumer centres in coastal regions of the North and Mediterranean areas, also highlighting the Southwest region.
		France is the second country with the highest current final energy consumption of the countries along the corridor after Germany. In terms of projections, there is no special efficiency provided by the NECP and LTS for the industry sector and an increase in energy demand is expected in the long term; moreover, there are lower electrification levels projected in the industry and transport sectors, leaving more potential for hydrogen penetration.	France's final H2 demand would experience the highest growth with 8.8% of CAGR from 2030, with 0.9 Mt of consumption, to 2050, reaching 4.9 Mt of demand. To be highlighted the growth between the 2040 and 2050 periods due to the increase in penetration in the transport sector and the consolidation of the industry penetration in the hard to abate sectors. The main demand centres are located in the North and Southeast regions, with the main refineries and the chemical plants.
		The Benelux region is one of the main consumer areas of the corridor. It is expected to present a high demand of hydrogen due to the high level of consumption in the priority sectors. Additionally, the efficiency measures presented in the NECP are more focused on the transport, residential and service sectors more than industries, in which the measures are focused on electrification.	The H2 demand of the Benelux region is the second highest in the corridor going from 2.1 Mt in 2030, to more than 5.1 Mt in the 2050 period highlighting the consumption share as feedstock in refineries and chemical plants. The Netherlands contains the regions with the highest demand, especially in the first period. However, between 2030 and 2040 the existing difference in consumption is expected to be reduced.
		Germany's demand is the highest in the corridor, due to its role as a major consumer of final energy compared to the other countries in the corridor, especially in the high priority sectors. The inclusion in the NECP of high electrification level, as well high objectives of efficiency in industry, does not prevent from remaining the main consumer of hydrogen and the potential final destination of hydrogen flows. The NECP also presents penetration of H2 in other sectors besides industry.	The demand for H2 in Germany would increase from 2.6 Mt in 2030, potentially reaching up to 7.5 Mt in 2050, making it the highest in the corridor. Apart from the consumption in the industrial and transport sectors it also presents a potential demand in other sectors such as buildings or power generation that could reach 23% in the 2050 according to the National Policies. The country's main demand points are located in the industrial sites in the west of the countries, also highlighting the southern regions.

Feedstock ■ Industry ■ Transport ■ Other CAGR

Figure 14. Domestic Potential Demand of Hydrogen in the Iberian Corridor (Mt/yr)



5 Hydrogen net balance of the corridor

5.1 Domestic Net Balance

Working on the basis of the supply and demand estimations, the domestic net balance has been calculated for the countries participating in the corridor. This data serves as the foundation for the infrastructure assessment, wherein the net balances are distributed among the various regional hydrogen flows under consideration. In this case, to ensure a conservative perspective, the data has been simplified across different scenarios by employing an average scenario. This approach minimizes the likelihood of stranded assets that could potentially emerge in the maximum scenario and offers a more pragmatic vision than the minimum scenario, where the potential capacity of some countries to export hydrogen could be undervalued.

> **Previously analysed results proved the capacity of the Iberian Peninsula to export hydrogen, in its pure form or its derivatives, to demand centres in Northern-European countries, standing out as one of the great players in hydrogen export**

For 2030 a total surplus in the Iberian Peninsula greater than 1.4 Mt would be expected. For the other upcoming periods, this total export capacity would increase up to 2.6 and 4.5 Mt in 2040 and 2050, respectively.

As for France, its exports in 2030 could be slightly over 0.6 Mt. However, for 2040 and 2050, although the hydrogen production is expected to grow by 25% and 55% respectively, French demand is expected to soar as well, leaving a net balance of -1.1 and -2.1 Mt. Thus, in 2030 France appears as an exporter; while for 2040-2050 it will need hydrogen from other countries, also playing a key role as a transit country within the corridor in terms of infrastructure, by accommodating all the hydrogen flows from southern countries.

The other countries within the corridor would stand as importers, being these the Benelux region and Germany, where major industrial clusters and refineries would be the first sectors to use renewable hydrogen. These countries will potentially produce up to 2.3 Mt in 2030, but the demand will reach also up to 4.7 Mt, demonstrating the necessity of imports from other regions and countries. The estimated net balance could result in a need of 2.4 Mt in 2030, 5.0 Mt in 2040, and 4.9 Mt in 2050 aggregating all these country's needs.

In addition to hydrogen imports from the Iberian Peninsula and France via pipeline, transportation through ships from major ports such as Rotterdam is expected to be at the forefront of distributing imported hydrogen and its derivatives to Benelux and Germany.

Additionally, for the calculation of the flows and infrastructure it is important to consider imports from other third countries that extend the length of the corridor. These imports belong mainly to North African nations, primarily Algeria and Morocco. They anticipate significant advancements in renewable energy capacity, particularly in the years 2040 and 2050, when it is expected that there could be infrastructure for accommodating the flows along the corridor. Considering that, imports from North Africa countries would start in 2040 with around 1.1 Mt and could grow up to 2.0 Mt in 2050 with the objective of upholding the security of supply within the corridor. These results together with the domestic net balance of each country compose the total net balance of the corridor.

Finally, it is also important to consider the impact from other European Corridors, specifically in the demand intensive countries such as Germany. While North Africa imports have an impact on the flows and infrastructure of the whole corridor, the other corridors only have an impact on the demand regions of North-Centre Europe. Pertaining to the countries of the European Union, they have been categorized according to the European corridors as follows:

- **Adriatic Europe Corridor:** various reports indicate that the corridor is expected to have a surplus of hydrogen primarily for Germany, mainly through imports from the North African countries. Given that these countries have been reflected in the Iberian corridor calculations, that surplus have been not considered to avoid double counting.

- **Northern Sea Corridor:** the North Sea Corridor is expected to have the capacity to export hydrogen. In this analysis, this corridor has been considered, encompassing both offshore projects in Germany, the Netherlands, and terminal-based projects in the Netherlands.

- **Nordic and Baltic Corridor:** the Baltic Corridor is expected to have significant hydrogen export potential. Consequently, it has been included in the calculations, in alignment with the surplus projections outlined in several reports.

- **Eastern and South-Eastern Europe Corridors:** these corridors depend on imports from outside the EU, specifically Ukraine, to meet its internal demand and facilitate exports to Germany. As a result, this corridor was excluded, considering that the EU's internal surplus will likely suffice to meet the corridor's requirements.

Considering that, the imports from European corridors would be around 0.5 Mt in 2030, 1.0 Mt in 2040 and 0.7 Mt in 2050. The primary reason for the decrease in 2050 is due to the net balance being calculated in a way that prioritizes meeting initially the demand from countries considered within the corridor. Only after fulfilling this demand is the excess from other corridors utilized. While in 2040 there is a greater need, stemming from a more significant increase in demand compared to production during that period, by 2050, this gap diminishes. Consequently, imports from other corridors decrease as a result.

Table 3. Potential Hydrogen Demand-Supply net balance results per horizon and country

	2030			2040			2050		
	Supply	Demand	Net Balance	Supply	Demand	Net Balance	Supply	Demand	Net Balance
Portugal	0.4	0.2	0.1	1.3	0.5	0.8	2.0	0.5	1.6
Spain	2.2	0.9	1.3	4.1	2.3	1.8	5.4	2.5	2.9
France	1.5	0.9	0.6	2.1	3.2	-1.1	2.8	4.9	-2.1
Benelux & Germany	2.3	4.7	−2.4	4.1	9.1	-5.0	7.7	12.6	-4.9
Domestic Net Balance	6.3	6.7	-0.4	11.5	15.0	-3.5	17.9	20.4	-2.6
Imports from North Africa	-	-	-	1.1	-	1.1	2.0	-	2.0
Iberian Corridor Net Balance	6.3	6.7	-0.4	12.6	15.0	-2.4	19.8	20.4	-0.6
Impact from other corridors	0.5	-	0.5	1.3	-	1.3	0.7	-	0.7
Total Net Balance (Storage)	6.8	6.7	0.1 (0.1)	13.9	15.0	-1.1 (0.6)	20.5	20.4	0.1 (0.6)

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Other corridors considered: North Sea and Nordic & Baltic regions.
***Source**: National Policies of the Member States, Bip analysis.*

[11] *The anticipated negative balance in 2040 would be as a result of the penetration of hydrogen in the industrial sector as substitution of natural gas, and would be expected to be covered by additional imports from outside the EU. Meanwhile, efforts are underway to develop sufficient supply capacities to achieve self-sufficiency again by 2050.*

5.2 Detail of hydrogen net balance per country

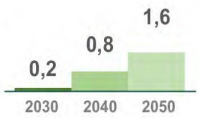
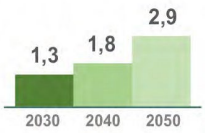
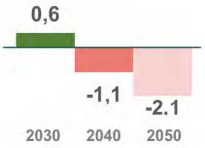
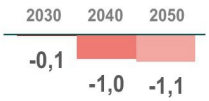
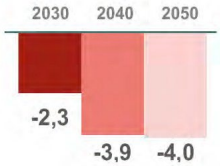
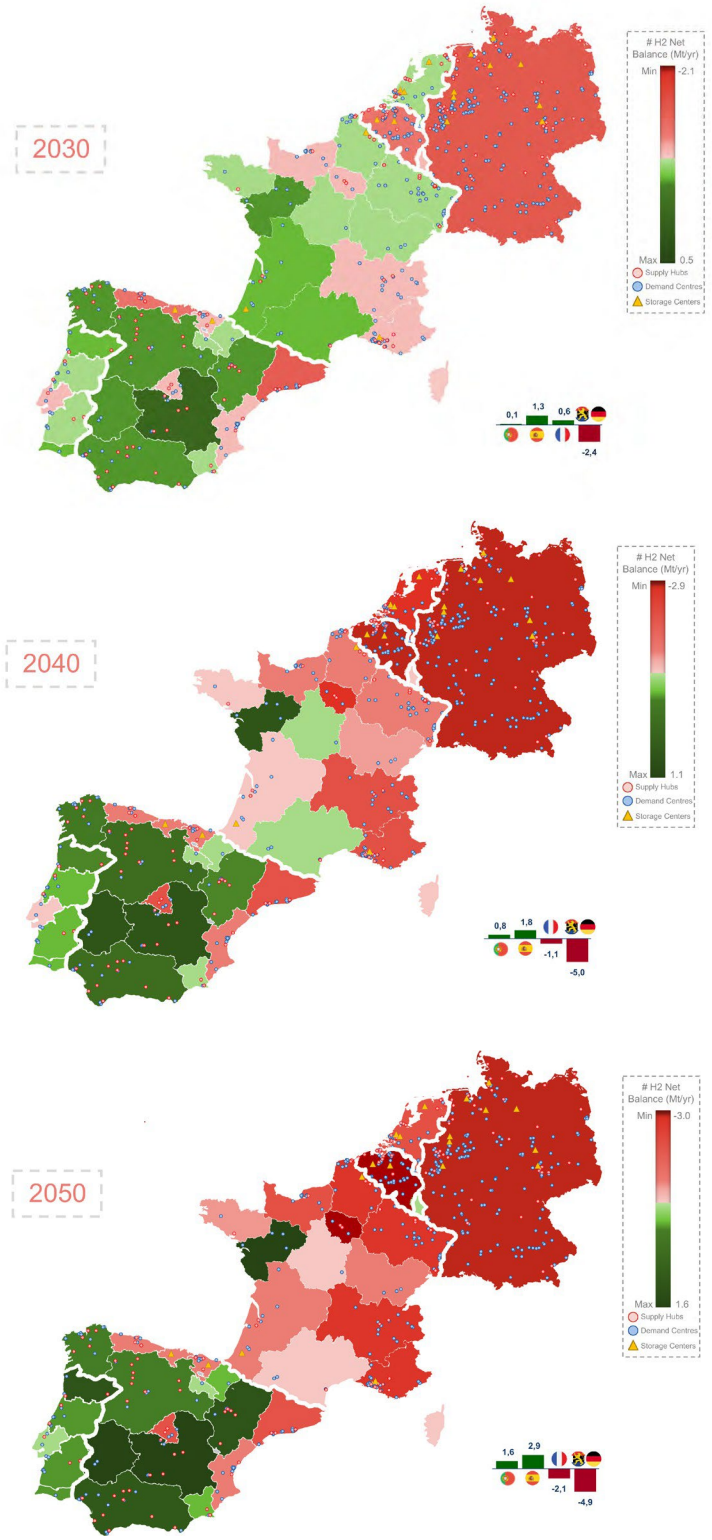
Country	H2 Domestic Production (Mt)	Country Role in the Corridor	Regional Highlights
		Portugal is a potential producer of hydrogen, and it is expected to be a hydrogen exporter in each of the periods studied. Its strategic location with a large generation of renewable energies, leads to a surplus that allows its use to produce hydrogen. That, combined with a low demand, gives Portugal the definition of a potential exporter in the corridor.	All the regions of Portugal show a positive balance, except for the Lisbon region in 2030. It is worth highlighting that the North region presents the highest positive balance in the country in all periods, accounting for ~50% of the total surplus in each of the three periods studied.
		Spain will be an exporting country, thanks to its strategic location, which projects a large generation of renewable energies, thus having a surplus that allows its use to produce hydrogen. This production capacity exceeds the estimated demand, making Spain a potential exporter in the corridor.	The southern and central regions of the country, except for the capital, Madrid, have a positive net balance, unlike the northern and mediterranean regions. The regions with the highest net balance are the southern ones (Andalucía, Castilla la Manch, and Extremadura) during all the periods studied, due to their high potential for renewable energy generation, which is combined with a low demand.
		France's position in the corridor defines it as a transit country, connecting North Africa and the Iberian Peninsula, potential producers of renewable energies and hydrogen, with Germany, the main consumer of hydrogen. France is also expected to be a key player in terms of infrastructure for accommodating the expected flows due to this imbalance. In its role as a transit country, in some of the periods, it will also be considered as a hydrogen importer.	French regions are expected to undergo a significant variation in net balance in each of the periods studied. In 2030, only few regions have a negative net balance, and are located in the east and northwest of the country (Île-de-France and Corse), while the region with the highest net balance is located in the west (Pays de la Loire). In 2050, the country will experience a major change, with only that region remaining with a positive balance.
		The Benelux region plays a transit and a consumer role. The role of the region as a transit area and a hydrogen importer stems from: its strategic position, mainly of Rotterdam in the Netherlands, as the main point of hydrogen imports; a production of hydrogen higher than Germany's (due to the expected lower electrification in its national policies); a lower demand and final consumption	The net balance of both the Netherlands and Belgium are positive for the 2030 period, however, as time progresses and the penetration of hydrogen increase, they become negative in 2040, increasing the gap until 2050. On the other hand, Luxembourg has a negative net balance for the 2030 and 2040 period, while in 2050 it has a positive net balance due to the increase in supply
		Germany shows a need for hydrogen in all the periods; however, the increase of demand in the last period is almost nil, due to its high efficiency objectives. The high electrification foreseen by its national policies limits the hydrogen production. This, combined with the highest demand for hydrogen in the corridor (being the largest consumer) driven by industry, makes Germany an importer.	The north region of Germany (Schleswig-Holstein and Niedersachsen) plays a significant role in Germany's net balance in all periods studied, presenting a positive balance, while the rest experience a need for hydrogen. The difference in relation to other regions is due to their strategic position, as they have a coastline on the North Sea with large production capacity of renewable hydrogen.

Figure 15. Domestic Potential Net Balance of Hydrogen in the Iberian Corridor (Mt/yr)



6 Assessment of hydrogen infrastructure needs

6.1 Main considerations for the infrastructure assessment

The hydrogen flows assessment builds upon previous net balance results. It focuses on addressing the necessity or excess of hydrogen in each region and period, aiming to determine how and where to allocate hydrogen flows from regions and countries with a positive net balance to those regions with a higher demand than their local potential supply.

To assess hydrogen flows, various flow matrices have been employed to dynamically analyse how much hydrogen a region produces, demands, receives from other regions/countries, storages, and sends to others. These matrices also account for imports from other corridors within Europe and from third countries like Morocco and Algeria.

Furthermore, specific assumptions have been formulated for the project based on its conditions:

- In pursuit of the European Union's primary objective to attain energy self-sufficiency and reduce dependence on external sources, it is assumed that renewable hydrogen generated within the European countries will be prioritized over external sources.
- The study is focused on the pipeline projected infrastructure and the further needs that may arise to accommodate hydrogen flows from the corridor first, and imports later. However, other route options as transportation through a carrier (ammonia mainly) have been considered. The reason for focusing on pipelines instead of other forms of transport is the price estimations of each different form of transport.

- The primary focus of the project lies in the development of infrastructure within the corridor. Consequently, a limited price analysis was conducted during the first task of the project, solely for the purpose of comparing hydrogen with other energy sources.

For this part of the study, the primary sources used included the TYNDP projected infrastructure, PCI/PMI EU granted projects, and the initiative by thirty-two energy infrastructure operators known as the European Hydrogen Backbone.

The infrastructure calculation was based on the infrastructure already planned by the main stakeholders based on the before mentioned sources. By overlapping the projected infrastructure with key parameters such as capacity and calculated flows, it is possible to assess whether the infrastructure is oversized, undersized, or sufficient to accommodate hydrogen flows. Additionally, this analysis may reveal regions without any projected infrastructure.

This output is a result of an iterative process that analyses the most optimal routes to meet the identified needs, always considering a percentage of security of supply and the storage capacity of each region or country.

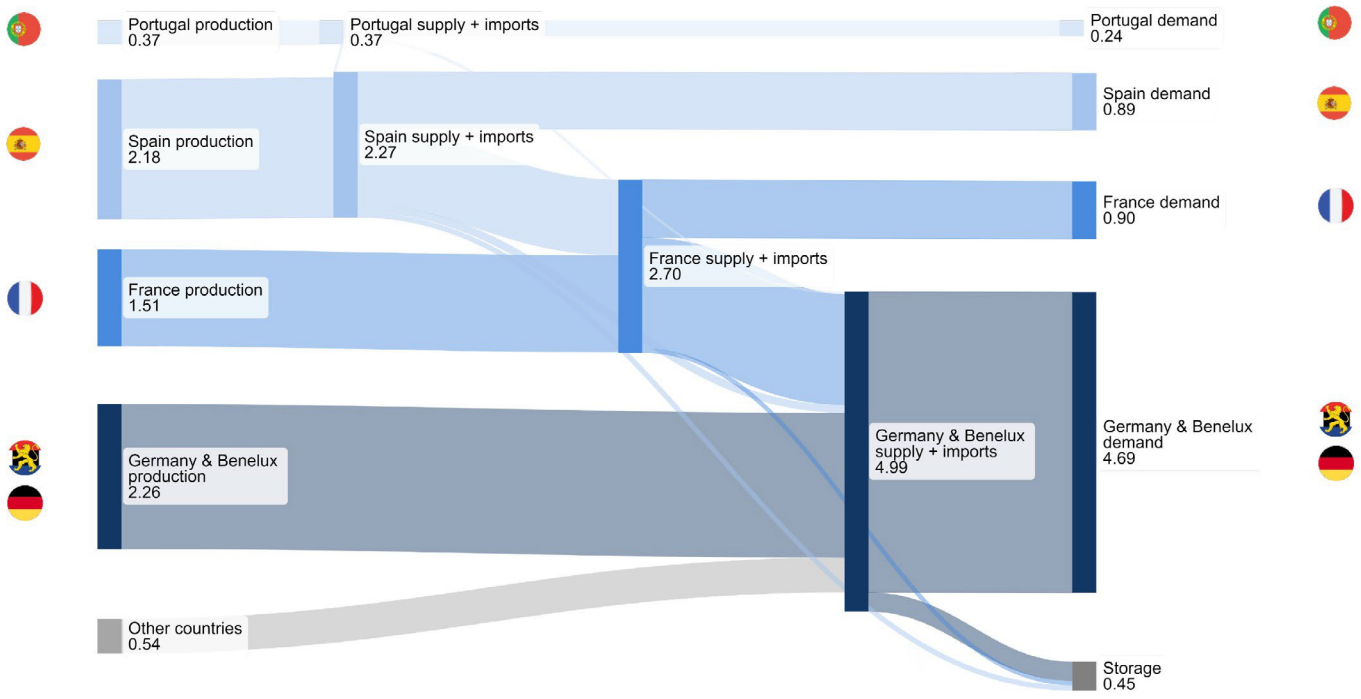
6.2 Cross-border infrastructure overview

2030 period

In 2030, our forecast anticipates a demand that could reach 6 Mt of hydrogen from the countries involved in the corridor. The majority of this demand is concentrated in Benelux and Germany, with 2.6 Mt and 2 Mt respectively. As highlighted in the chapter on the future hydrogen ecosystem, the bulk of production is expected to originate from the Iberian Peninsula and France.

This sets in motion a cascade of flows, initiating in Portugal and aggregating hydrogen streams passing through Spain and France before reaching North Europe. From Portugal to Spain, a transfer of 90 kt is expected, which adds to Spain's production to export nearly 1.2 Mt to France. From these flows, over 1.9 Mt would then reach Benelux and Germany. Additionally, maritime routes from Portugal or Spain, primarily directed to the port of Rotterdam, are also envisaged.

Figure 16. Estimated cross-border hydrogen flows for 2030 (Mt/yr)



Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *National Energy and Climate Plans, Long-Term strategies, European Hydrogen Backbone, BIP Analysis.*

In this period, the initial phase of the corridor's development is slated to commence. This kick-off phase will be marked by the establishment of the primary connections between the participating countries

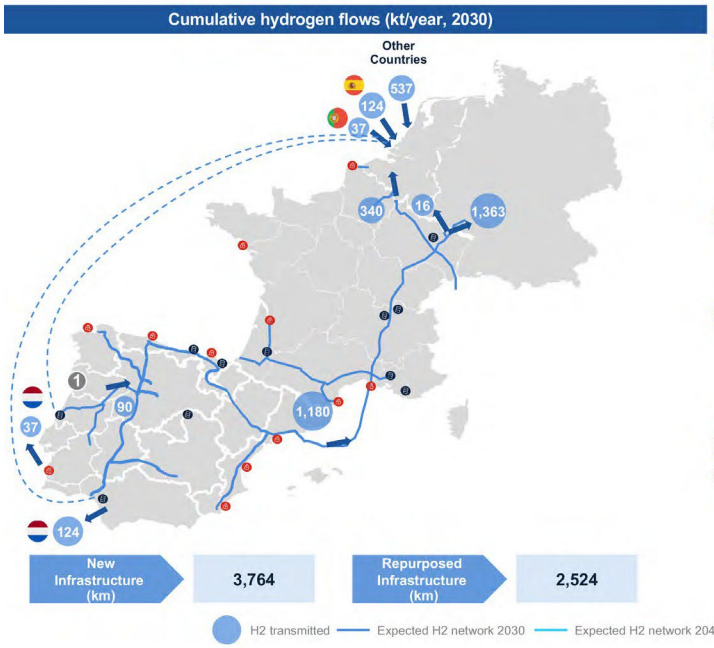
Concurrently, the inception of the first hydrogen valleys would take place. These valleys, serving as concentrated hubs for hydrogen production and distribution, are expected to play a crucial role in the overall hydrogen network. This phase represents a significant step towards the creation of a robust and interconnected hydrogen infrastructure across Europe.

The projected infrastructure for new and repurposed gas will play a central role in accommodating the regional and national flows of hydrogen. These flows originate from regions with high-supply capacity and are directed towards demand centres that require hydrogen. In this context, a multitude

of cross-border projects have emerged, complemented by intra-country projects. Together, these initiatives are instrumental in creating an interconnected hydrogen network across Europe.

One such significant project is the H2Med project. This project is intended for transporting hydrogen from Portugal and Spain, specifically connecting the northern region of Portugal with the north of Spain. The project extends its reach to France, establishing connections between Barcelona and Marseille, and further extends up to Benelux and Germany through the eastern part of France.

Figure 17. Estimated infrastructure for accommodating cross-border hydrogen flows for 2030 (Mt/yr)



Hydrogen flow summary (kt/year, 2030)

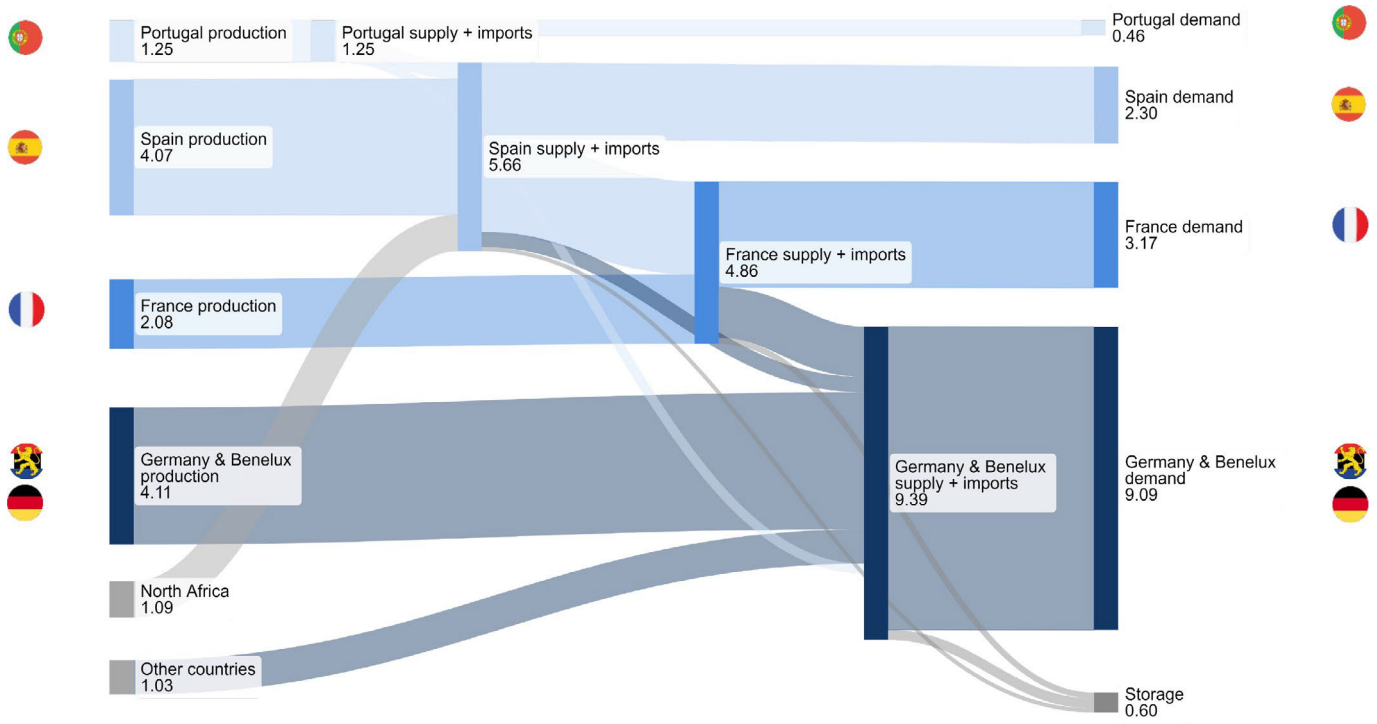
ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
	Portugal	369	242	127	-	-	Spain	90
							Netherlands	37
							France	1,180
	Spain	2,182	892	1,290	Portugal	90	Netherlands	124
							Storage	76
	France	1,506	901	605	Spain	1,180	Belgium	340
							Luxembourg	16
							Germany	1,363
							Storage	65
	Benelux and Germany	2,258	4,687	2,429	Portugal	37	Storage	297
					Spain	124		
					France	1,719		
					Other Countries	1,363		
	Total	6,316	6,725	(408)	Other Countries	537	Storage	439

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

2040 period

In the subsequent period, the hydrogen flows follow a comparable route, moving from southwest to north-centre. However, a noteworthy difference is the inclusion of imports from North Africa. Additionally, the flows are anticipated to experience a significant increase, leading to a transfer from Portugal to Spain that could amount to 0.5 Mt. This transfer would complement Spain's production, allowing for the export of nearly 2.7 Mt to France. From these flows, over 2.3 Mt would then proceed to Germany. Similar to the previous period, maritime routes from Portugal or Spain to the port of Rotterdam are also envisioned, contributing to an estimated total of 2 Mt in hydrogen flows.

Figure 18. Estimated cross-border hydrogen flows for 2040 (Mt/yr)



Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *National Energy and Climate Plans, Long-Term strategies, European Hydrogen Backbone, BIP Analysis.*

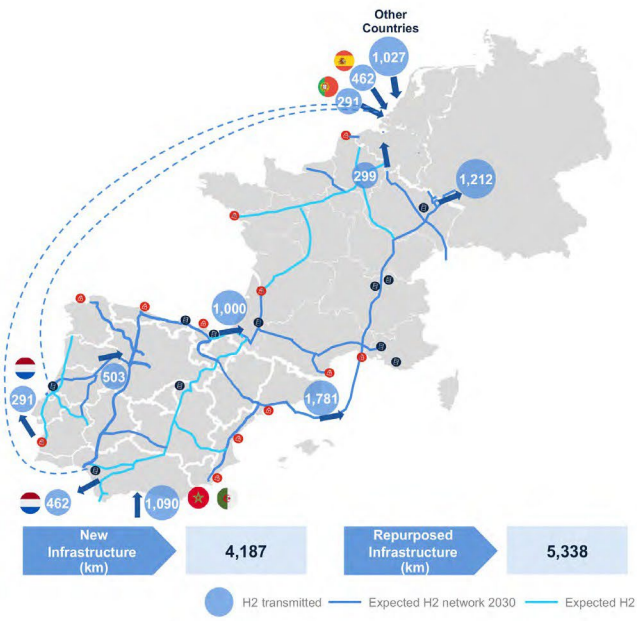
In this period, the consolidation phase of the corridor's development is projected to take place. This phase will be characterized by a significant enhancement in the capacity of connections between the main participating countries.

As the renewable energy capacity of various countries expands in alignment with their respective national policies, there will be an imperative need to augment existing infrastructures. The enhancement in capacity is crucial to accommodate the increasing demand and supply of hydrogen across these nations beyond the 2030 time horizon. Moreover, this phase will also witness the establishment of new hydrogen valleys. These valleys, serving as additional hubs for hydrogen production and distribution, will be connected to the existing network through new connections. The establishment of these new connections is integral to expanding the reach of the hydrogen network and ensuring its efficiency.

To circumvent potential capacity bottlenecks during this period, the development of additional cross-border connections is envisaged, along with country-specific connections. One such proposed connection is between the North of Spain and the South-West of France. This connection could potentially facilitate the continued supply of excess hydrogen from the Iberian Peninsula to northern regions. Additionally, during this period, the development of a western hydrogen branch in France is also anticipated.

Looking ahead to 2040, the Iberian Corridor is expected to benefit from imports originating from North-African countries, specifically Morocco and Algeria. These imports are projected to serve up to 1 Mt. When combined with the 2.5 Mt of excess from the Iberian Peninsula, this quantity could potentially meet a significant amount of the needs of the countries involved in the corridor. This strategic planning and development of infrastructure is key to ensure a sustainable and efficient hydrogen network across Europe.

Figure 19. Estimated cross-border hydrogen flows for 2040 (Mt/yr)



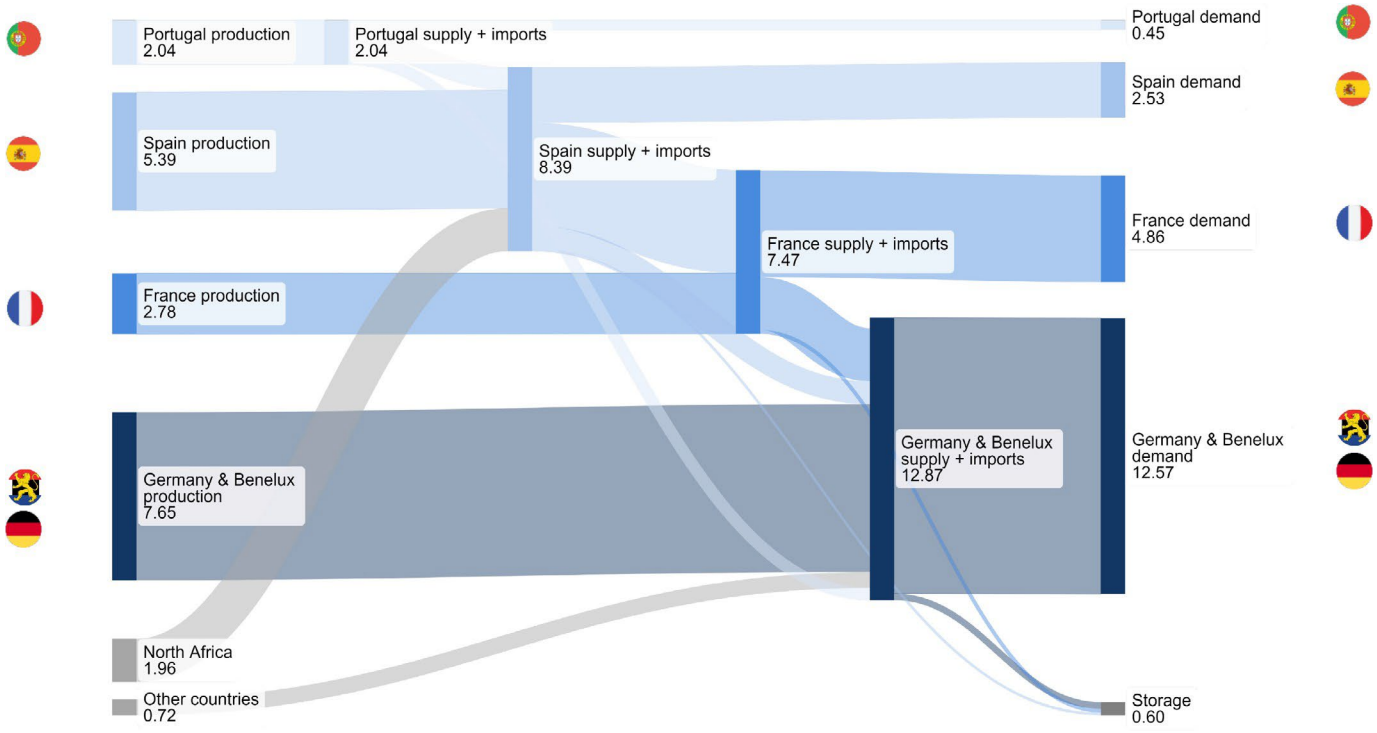
ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
	Portugal	1,250	456	794	-	-	Spain	503
							Netherlands	291
	Spain	4,071	2,304	1,767	North Africa	1,090	France	2,781
					Portugal	503	Netherlands	462
							Storage	117
	France	2,084	3,173	1,089	Spain	2,781	Belgium	299
							Germany	1,212
							Storage	182
	Benelux and Germany	4,105	9,090	4,985	Portugal	291	Storage	297
					Spain	462		
					France	1,511		
					Oth. Count.	1,027		
	Total	11,510	15,024	(3,515)	North Africa	1,090	Storage	596
					Other Countries	1,027		

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

2050 period

In the 2050 horizon, the corridor is expected to reach its maturity, with potential flows higher than the projected infrastructure. A phase of stabilization would be the most probable scenario. The infrastructure would need to be enhanced to absorb the increase in supply and demand in all the corridor, by increasing the capacity in the current routes or developing alternative routes for hydrogen. At this point, the transportation through shipping would become a more viable option as cost reductions are expected with the technology evolution, so the ports and their installations would have a key role in supporting the pipeline transportation.

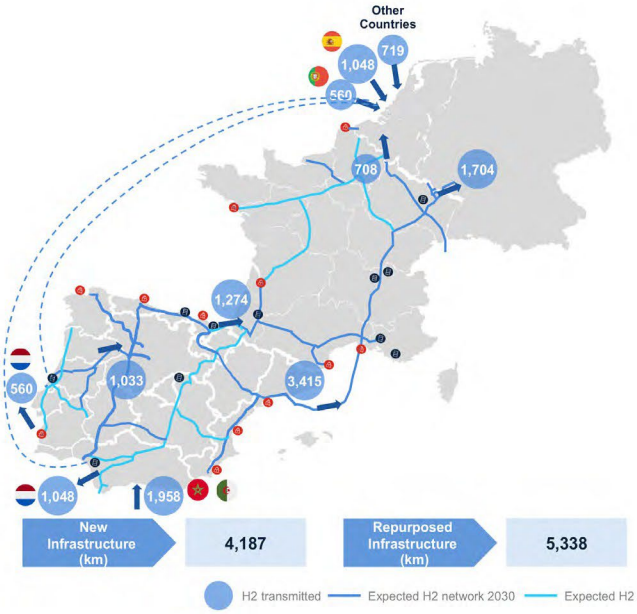
Figure 20. Estimated cross-border hydrogen flows for 2050 (Mt/yr)



Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *National Energy and Climate Plans, Long-Term strategies, European Hydrogen Backbone, BIP Analysis.*

It is anticipated that there would be a potential demand of 20.3 Mt in the Iberian Corridor, driven by the growth of hydrogen adoption, particularly in the transport sector, and the advancement in the industrial sector. The rise in production from the Iberian Peninsula, coupled with the potential exports from North African countries, would contribute 10 Mt to the corridor, satisfying a substantial portion of the demand from other countries in the study. This would, in turn, diminish the necessity for hydrogen from outside the corridor.

Figure 21. Estimated cross-border hydrogen flows for 2050 (Mt/yr)



ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
	Portugal	2,041	448	1,593	-	-	Spain	1,033
							Netherlands	560
	Spain	5,386	2,523	2,863	North Africa	1,958	France	4,689
					Portugal	1,033	Netherlands	1,048
							Storage	117
	France	2,775	4,855	2,080	Spain	4,689	Belgium	708
							Germany	1,704
							Storage	197
	Benelux and Germany	7,645	12,573	4,928	Portugal	560	Storage	297
					Spain	1,048		
					France	2,412		
					Other Countr.	719		
	Total	17,847	20,399	(2,553)	North Africa	1,958	Storage	611
					Other Countries	719		

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

6.3 Main drivers and barriers of the corridor

The substantial potential of renewable energy, specifically solar and wind, establishes a foundation for the provision of abundant and economically viable hydrogen to recipient regions in North-Western Europe.

The establishment of the Iberian Corridor is poised to meet the expanding demand for hydrogen in Northwestern European countries, particularly in the Benelux region and Germany, whose projections indicate a prospective demand surge from 4.7 Mt in 2030 to a substantial 12.6 Mt by 2050. The fulfilment of this increasing demand hinges on the renewable and low-carbon potential inherent in Portugal, France, and Spain. These nations collectively exhibit a hydrogen generation capacity of up to 4 Mt by 2030, a figure that could surpass 10 Mt by 2050, with an additional 2 Mt sourced from North Africa.

> **The renewable hydrogen potential of the Iberian Peninsula is key for achieving Green Deal and RePowerEU plan goals, as well as the 2050 climate neutral target with abundant solar and wind energy resources that enable cost-effective hydrogen supply to North-Western Europe**

Additionally, the development of the corridor would contribute with:

- **Diversity of energy sources:** the envisioned connection with North Africa holds the promise of diversifying energy sources through collaborative engagements with third countries. This collaborative approach entails establishing partnerships with potential suppliers in the Southern Neighbourhood.

- **Interconnected growth:** the strategic development of infrastructure as an underlying framework serves to catalyse forthcoming projects in the countries along the corridor. Without the establishment of this corridor, such initiatives would be constrained to addressing only local demand, thereby diminishing their overall impact on decarbonization and missing out on the economies of scale imperative for cost-efficient implementation.

- **Investment optimization through repurposing of existing gas infrastructure:** the proposed corridor is positioned to capitalize on repurposing segments of the existing gas infrastructure. This approach not only optimizes investment but also mitigates the risk of stranded assets, ensuring a pragmatic and sustainable pathway towards achieving the outlined decarbonization goals.

- **Emissions reductions:** beyond the quantifiable benefits in meeting hydrogen demand, this infrastructure overhaul is anticipated to yield substantial environmental gains, specifically, it is estimated to save a capacity equivalent to 86 Mt CO2eq in 2030 and an impressive 261 Mt CO2eq by 2050. Such achievements align with predefined reduction targets and concurrently contribute to fostering a sustainable economy by generating a multitude of local jobs within the region.

While the prospects for the hydrogen ecosystem are promising, realizing this ambitious plan necessitates the development of a substantial infrastructure network spanning almost 18,000 km and this progress is not without challenges. In the context of the Iberian Corridor, where PV technology emerges as the primary means of hydrogen production, several considerations and bottlenecks that need to be addressed come to the fore:

- **Classification of renewable hydrogen under the Delegated Act:** Solar PV possesses the distinct advantage of being a cost-effective technology. However, it is essential to acknowledge that solar PV exhibits a comparatively lower load factor in comparison to alternative technologies such as onshore wind. This discrepancy implies that a grid connection or storage becomes imperative for the cost-effective production of hydrogen in order to optimize the utilization of electrolysers in a consistent manner.

  The key point here is that hydrogen produced through a grid connection is classified as renewable only if it is situated in a bidding zone where the average proportion of renewable electricity surpassed 90% in the preceding calendar year, adhering to the renewable criteria. In the absence of meeting this renewable threshold, only hydrogen produced

with temporal correlation is acknowledged as renewable. Notably, the realization of this renewable objective is contingent upon the implementation of renewable power outlined in the NECPs.

- **Efficient grid development:** the electric grid assumes a pivotal role in shaping the evolution of the ecosystem. The successful development of the NECPs hinges significantly on the capacity of the electric grid to absorb the influx of new renewable power. This dependency accentuates the importance of planning the expansion of transmission and distribution grids in an efficient manner. To mitigate potential challenges, it is imperative to establish clear and comprehensive regulations that prevent grid congestion, ensuring a seamless integration of the increasing renewable power capacity into the system.

- **Harmonization of tariffs structures:** tariffs also play a crucial role as a factor that has direct implications for LCOH. Recognizing the indispensable role of electricity costs in achieving competitive hydrogen production, it is recommended to address tariff structures. As an example, to enhance the economic viability of hydrogen production, it would be a potential solution that electricity consumed by electrolysers is exempt from access tariffs. This exemption aligns with the broader objective of optimizing the cost-effectiveness of hydrogen production and contributes to the overall competitiveness of hydrogen as a sustainable energy source.

- **Streamlining permissions processes:** The development of the hydrogen ecosystem within the Iberian Corridor faces another significant hurdle in the form of the permitting process, a bottleneck that must be addressed for timely progress. The validation process for renewable energy projects has emerged as a substantial impediment across various countries, creating delays that pose a notable challenge to meeting predetermined environmental objectives. Within the European Union, the average time required for validating the construction of photovoltaic plants is nearly 6 years, and for wind plants, it exceeds 3 years.

  To overcome this hurdle and enhance the efficiency of the validation process, the EU have been working in speeding the permitting process through the Member States, at latest the RED III Directive has defined the Renewable Acceleration Areas, named previously the renewables go-to areas. These areas aim to expedite the permitting process by allowing new applications to be exempt from dedicated environmental impact assessments. This is achieved through a screening process guided by defined rules and measures. The entire permit-granting process, including access and connection permissions to the grid, need to be shorter than one year.

> **Key strategies for fostering a sustainable hydrogen ecosystem in the Iberian Corridor include overcoming bottlenecks like the conditions of the Delegated Act for the classification of renewable hydrogen, efficient grid development and tariff structures, and streamlining permission processes**

The effective implementation of these measures is paramount to preventing constraints on the realization of the hydrogen ecosystem's potential, ensuring that environmental objectives are met without compromising the overall pace of development within the Iberian Corridor.

7 EU financing mechanisms

7.1 Overview of financial support options

Substantial investments will be required to develop the hydrogen production projects as well as the corridors, with financial support emerging as a key facilitator. The EU plays a crucial role in this regard, directing funds through targeted energy-specific programs and broader horizontal initiatives. The significance of financial support becomes particularly pronounced in the context of developing hydrogen infrastructure, where the EU provides significant funding[12] for research and development of hydrogen technologies and infrastructure, including:

Grants and subsidies

- **State Aid for Important Projects of Common European Interest (IPCEIs):** Investment support for hydrogen is provided through the Important Projects of Common European Interest (IPCEIs) on hydrogen the various waves of IPCEIs with the participation of EU Member States. The first IPCEI, called "Hy2Tech" includes 41 projects and was approved in July 2022. These projects aim to develop innovative technologies for the hydrogen value chain, such as hydrogen generation; fuel cells; hydrogen storage, transport, and distribution; and end-user applications. In September 2022, the Commission approved "Hy2Use", which complements "Hy2Tech" and focuses on projects for the deployment of hydrogen-related infrastructures and hydrogen applications in the industrial sector, bringing Europe closer to the target of installing 6 GW of renewable electrolysis by 2024 and 40 GW by 2030. The third IPCEI wave "Hy2Infra" and the fourth wave Hy2Move are currently under development. Hy2Infra is dedicated to hydrogen-related infrastructure (pipelines, ports, and storage facilities) while Hy2Move focuses on mobility.

[12] *Funding guide - European Commission*

- **Recovery and Resilience Facility (RRF):** the Recovery and Resilience Facility dedicates over EUR 10 billion to hydrogen. The RFF serves as a temporary recovery instrument dedicated to helping EU Member States implement reforms and investments in line with country-specific challenges and recommendations[13].

- **Horizon Europe:** The RePowerEU, launched to reduce the EU's dependence on Russian fossil fuels and accelerate the green transition, focuses on hydrogen production and infrastructure. It includes funding to reinforce existing programmes, including an additional investment of €200 million for the Clean Hydrogen Partnership through the Horizon Europe Programme. Horizon Europe is the EU's key funding programme for research and innovation. It has a budget of around EUR 95.5 billion for 2021-2027. Pillars II (global challenges and European industrial competitiveness) and III (Innovative Europe) are of specific interest for deployment of low carbon industry applications and breakthrough technologies, including hydrogen. Horizon can support a wide range of hydrogen actions covering all stages of project life cycle including the research and development stages, innovation actions, innovation, and market deployment, or testing and demonstration of hydrogen technologies in industrial environments through Open Innovation Test Beds (OITB). A significant part of Pillar II (budget of EUR 53.5 billion) will be implemented through European partnerships that are set up based on memoranda of understanding or contractual arrangements between the Commission and the partners and based separate work programmes. Pillar III includes the European Innovation Council (budget of EUR 10 billion) that is covered by a separate work programme. It aims to foster all forms of innovation, including non-technological innovation, by facilitating technological development, demonstration, and knowledge transfer, and strengthen deployment of innovative solutions.

- **Innovation Fund:** The Innovation Fund is a key funding instrument. The fund aims at supporting large-scale demonstration projects for innovative low-carbon technologies, including hydrogen-based solutions. It is open to projects for breakthrough technologies for all energy- intensive industry sectors in the scope of the Emission Trading System (ETS) Directive. Funding, in the form of grants, is open to large-scale and small-scale projects. Projects receiving support should not be commercially available and be sufficiently mature to be ready for demonstration at a pre-commercial scale. Competitive bidding will expand the portfolio of support mechanisms currently under the Innovation Fund. In this regard, the Commission at present is considering the following types of support to be awarded by competitive bidding to hydrogen producers or purchasers: Contract for Difference (CD); Carbon Contract for Difference (CCD) or Fixed premium Conduct.

- **Connecting Europe Facility (CEF):** The Connecting Europe Facility is a key EU funding instrument in delivering the European Green Deal and an important enabler towards the Union's decarbonisation objectives for 2030 and 2050. The CEF is divided into three sectors: Transport, Digital and Energy. CEF investments fill the missing links in Europe's energy, transport, and digital backbone. One of the key priorities of CEF is enabling and strengthening the synergies between the three sectors. The energy sector is of particular relevance to hydrogen-based projects. CEF Energy (CEF-E budget is EUR 5.84 billion for the period 2021-2027. CEF-E is closely related to the Trans-European Networks for Energy (TEN-E) policy, which focuses on linking the energy infrastructure of EU countries. The TEN-E policy identifies priority corridors

[13] *National Energy and Climate plans 2021-2030 and Country Recommendations*

and thematic areas. As for CEF Transport (CEF-T), it contributes to the implementation of the Trans-European Transport Network (TEN-T) by financing key projects aimed at improving infrastructure, including the deployment of alternative fuel infrastructure in line with the relevant Regulation (AFIR), which requires that hydrogen refuelling infrastructure that can serve both cars and lorries is deployed from 2030 in all urban nodes and every 200 km along the TEN-T core network.

Financial instruments

- **InvestEU Fund:** the InvestEU Fund will mobilize more than 372 billion EUR of public and private investment through an EU budget guarantee of EUR 26.2 billion (EUR 10.6 billion as of March 2023). This fund is a market-based and demand-based instrument supporting four Policy Windows, specifically the sustainable infrastructure policy window which comprises: energy, renewable energy, and the deployment of sustainable technologies that contribute to the environmental or climate resilience objectives of the Union. Currently, Wallonia is exploring ways to combine other EIB financing with EU funds (including under the InvestEU) and with regional funds e.g., for the possible creation of a Walloon hydrogen fund.

- **European Investment Bank (EIB):** the European Investment Bank is a key implementing partner of the InvestEU Fund. Over the past 8 years, the EIB has provided over EUR 550 million in direct financial support related to hydrogen technologies, helping to mobilise EUR 1.2 billion in overall investment. In addition, the EIB has provided advisory support to projects across Europe representing over EUR 1 billion in potential investment. Currently, the EIB supports technologies such as electrolysers, catalysts, and fuel cells. Via blending operations, the EIB finances large-scale hydrogen production, including electrolysis, carbon capture and storage, and hydrogen stations.

- **Public Sector Loan Facility (PSLF):** As a pillar under the Just Transition Mechanism, the Public Sector Loan Facility combines EUR 1.5 billion of grants, financed from the EU budget, with EUR 10 billion of loans from EIB. This instrument will exclusively target public entities, providing support to projects that do not generate a sufficient stream of own resources to be financed commercially. Projects are expected to include investments in all types of public infrastructures, such as in the areas of energy and transport, district heating networks, energy efficiency measures including renovation of buildings, as well as social infrastructure.

7.2 Detail of financial support options per country

Portugal

Portugal has created an incentives system for the production of renewable hydrogen and other renewable gases arising from the allocation of the Recovery and Resilience Plan (PRR) as part of the Recovery and Resilience Facility

The PRR applies to all public or private companies that: (i) requested prior registration to produce renewable gases; and (ii) obtained a prior assessment from The Directorate of Energy and Geology ("DGEG") that it is an eligible operation. Funding per beneficiary and per project wiDll have a maximum amount of support of EUR 5 million, although this may rise to EUR 10 million if projects cover more elements along the value chain (i.e., that includes the integration of production, distribution, and the final consumer). The maximum co-financing rate is 100% of the total expenditure considered eligible. On May 2023, Portugal sent an updated version of the PRR to the European Commission.

Under REPowerEU, Portugal's government has announced it will be launching a EUR 70 million programme to support the production of hydrogen and renewable gases. In terms of reforms, the REPowerEU chapter includes a reform to streamline permitting, including the creation of a one-stop-shop for licencing renewables projects and the training of public employees dealing with renewables permitting (C21-r48), and the adoption a set of actions which will help the take-up of biomethane and renewable hydrogen in the country. The chapter also includes investments to support and facilitate the development of renewables.

The "Decarbonization of Industry" incentive system aims at promoting and financially support projects aimed at low carbon processes and technologies in industry, energy efficiency measures in industry, incorporation of energy from renewable sources and storage and development of industry decarbonization roadmaps. It is subject to maximum co-financing rates on the expenses considered eligible.

On January 4th, 2023, Portugal established a centralized purchase system for biomethane and hydrogen produced from water electrolysis through a competitive procedure (not yet launched). This auction is a mechanism to support the production of gases of renewable origin or low carbon content gases and the obligation for gas suppliers (whose supply to end customers exceeds 2.000 GWh per year) to incorporate in their supply a percentage not lower than 1% of biomethane or hydrogen produced by electrolysis from water. Under the tender will be included 150 GWh/ year of biomethane and 120 GWh/year of hydrogen, which might be divided into lots in the tender procedure, and that will be injected into the public gas grid through supply contracts to be concluded between producers and the wholesaler supplier of last resort ("CURg").

The Portuguese government provides an income tax exemption for the decentralized production of renewable electricity, which is either used onsite or sold by the reinjection to the national

electricity network. Furthermore, as per the Hydrogen Public Funding Compass[14] there are some additional funds as the RRF C14 - *Hydrogen & Renewable gases* with EUR 185 million, the RRF C11 - *Industry decarbonization* with EUR 715 million and the *SI Inovação Produtiva* with EUR 150 million and a support scheme in form of hydrogen auctions with 150 GWh/year of biomethane and 120 GWh/year of green hydrogen, in 10-year contracts at a maximum price of EUR 62 per MWh for biomethane and EUR 127 per MWh for green hydrogen.

Spain

Through the RRF under the temporary recovery instrument NextGenerationEU (endowed with EUR 750 billion for the period 2021-2026), Spain will receive EUR 163 billion, becoming the first beneficiary among all Member States. The first part of this allocation, articulated through the Spanish 'Recovery, Transformation and Resilience Plan' (PRTR), consisted of EUR 70,5 billion in the form of grants for the period between 2021 and 2023, of which EUR 1.5 billion were allocated to boost renewable hydrogen, in line with the national Hydrogen Roadmap. The second part of the RRF allocation is articulated through the Addenda, alongside the EUR 2,6 billion that Spain will receive from REPowerEU. In this period, from 2024-2026, Spain foresees further grants for renewable hydrogen projects for another EUR 1.6 billion.

Within the framework of the Recovery, Transformation and Resilience Plan, as well as through national funds, Spain provides funding to hydrogen projects via the following main programmes:

- **PERTE ERHA:** The Spanish government launched twelve Strategic Projects for Economic Recovery and Transformation, generally known as "PERTEs". These are integrated projects transversally covering various policies and components of the PRTR. One of them is the PERTE for Renewable Energies, Hydrogen and Storage (ERHA), with the specific objective of positioning Spain as a country of reference in this area by promoting the development of knowledge, technologies and competitiveness along the value chains for renewable energies and storage, and hydrogen. This PERTE integrates the contribution allocated to Spain as part of the Plan REPowerEU, and has a total public budget of EUR 10.800 million (2021-2026). Some of the programmes detailed below are part of this PERTE.

- **H2 Pioneers:** grants to promote the deployment of hydrogen commercial applications through comprehensive projects that include production, distribution, and consumption of renewable hydrogen in the same territorial location. EUR 300 million have been allocated to a total of 31 projects. An extension of this programme is expected for the period 2024-2026 (Addenda).

- **Innovative value chain of renewable hydrogen:** With four sub-lines, the programme supports technical knowledge, productive capacity, and the creation of a hydrogen value chain in Spain. Nearly EUR 200 million have been allocated until now to 45 projects. An extension of this programme is expected for the period 2024-2026 (Addenda).

[14] *Portugal Hydrogen Public Funding Compass*

- **Hydrogen Valleys:** The programme, expected for 2024, will support the creation of renewable hydrogen clusters or valleys for sectoral integration where production, transformation and large-scale consumption take place in the same geographical zone.

- **MOVES:** With a total allocation exceeding EUR 100 billion after several extensions, the programme subsidises the purchase of clean vehicles, including fuel-cell vehicles (between EUR 600 and EUR 15,000, depending on the type of vehicle) and the deployment of recharging infrastructure.

- **The Centre for Technological Development and Innovation** (CDTI) manages a range of R&D&I programmes in the form of partially reimbursable grants aimed at applied projects in variety of strategic areas, including large industrial research and experimental development or technological capabilities for sustainable energy, including hydrogen.

Additionally, in September 2021, in response to the global energy crisis, Spain implemented a reduction in electricity grid access tariffs to avoid any increase in the price of electricity for domestic consumers in the regulated marketed. In this Context, the Council of Ministers approved the Plan +SE (+Energy Security), which, in measure, rolls out tax incentives for the energy transition. Under Plan +SE, several regulations have been approved as the unrestricted depreciation for investments in assets that use renewable energy.

France

The French Government has committed EUR 100 billion with the France Relance recovery plan under the RRF, from which EUR 30 billion is dedicated to advance clean energy technologies and promote sustainable development. A significant portion of these funds (~40%) will be sourced from the European Union, emphasizing international cooperation in clean energy initiatives.

This plan prioritizes a low-carbon hydrogen sector, integrated into a more extensive European framework, and EUR 7 billion will be invested in renewable and low carbon hydrogen energy with an additional EUR 500 million that will be invested in disruptive technologies (wind, land, offshore, photovoltaics) aligned with Plan France 2030. From those EUR 7 billion, EUR 2 billion are specifically allocated for electrolyser capacity.

The investment is planned to be executed before the end of 2030, following the guidelines outlined in the National Strategy for the Development of Low-Carbon Hydrogen (published in September 2020).

In France, state-owned public body ADEME awards subsidies following the organization of tenders for projects. Law-Decree No 2021-167 establishes public support mechanisms for renewable and low-carbon hydrogen production projects. This support can take the form of operating aid (OPEX) or a combination of financial support for investment (OPEX) and operating aid (CAPEX), with aid duration potentially extending up to 20 years.

[15] *Spain Hydrogen Public Funding Compass*

The Hydrogen Ordinance stipulates that renewable and low-carbon hydrogen producers are eligible for a support scheme that finances capital and operating expenditures. Additionally, the Multiannual Energy Program (Programmation pluriannuelle de l'énergie -PPE), established for the periods 2019–2023 and 2024–2028, offers extra financial backing for the French hydrogen sector. Lastly, decarbonized hydrogen projects will receive funding through the PIA (Investment for the future program) in addition to the support mechanism and local calls for projects.

Furthermore, as per the Hydrogen Funding Compass[16] there are some additional funds as the: *IPCEI* with EUR 1.575 million, the *Briques technologiques et démonstrateurs hydrogène* with EUR 350 million, the *Ecosystèmes territoriaux hydrogène* with EUR 325 million, the *Programmes et Equipements Prioritaires de Recherche* with EUR 80 million and the Hydrogen production support scheme with EUR 650 million.

[16] *France Hydrogen Public Funding Compass*

8 Annex

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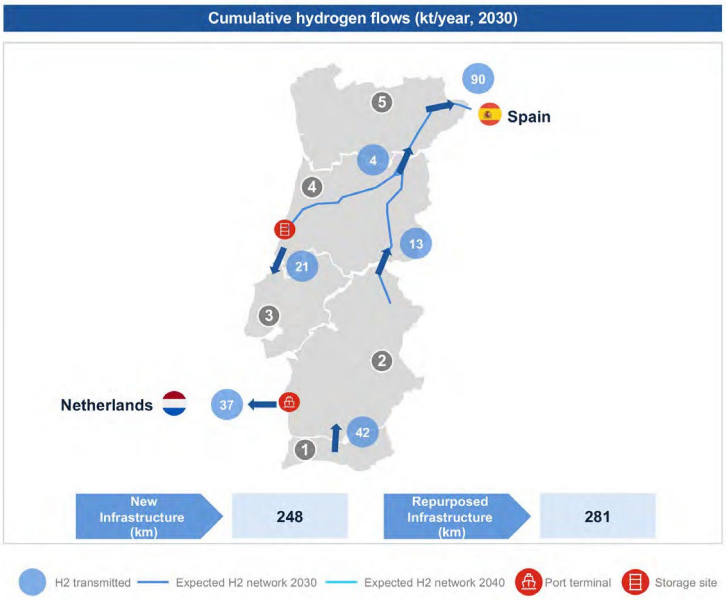
1 Regional flows analysis

1.1. Regional flows for 2030 period

Figure 22. Regional flows Portugal 2030 (kt/yr)

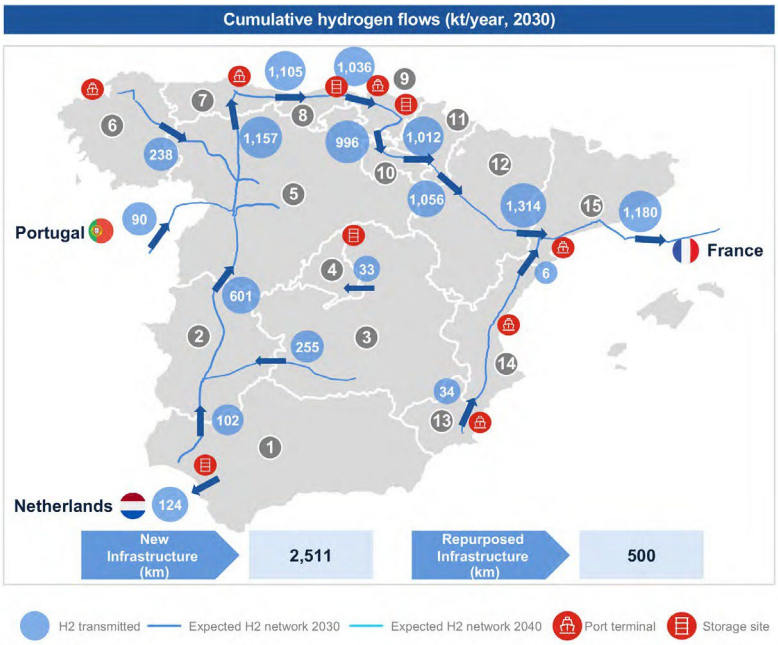


Hydrogen flow summary (kt/year, 2030)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Algarve	43	1	42	-	-	Alentejo	42
2	Alentejo	62	54	8	Algarve	42	Centre	13
							Netherlands	37
3	Lisbon	22	43	21	Centre	21	-	-
4	Centre	96	84	12	Alentejo	13	Lisbon	21
							North	4
5	North	146	60	86	Centre	4	Castilla y Leon	90
	Total	369	242	127	-	-	Netherlands	37
							Spain	90

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

Figure 23. Regional flows Spain 2030 (kt/yr)

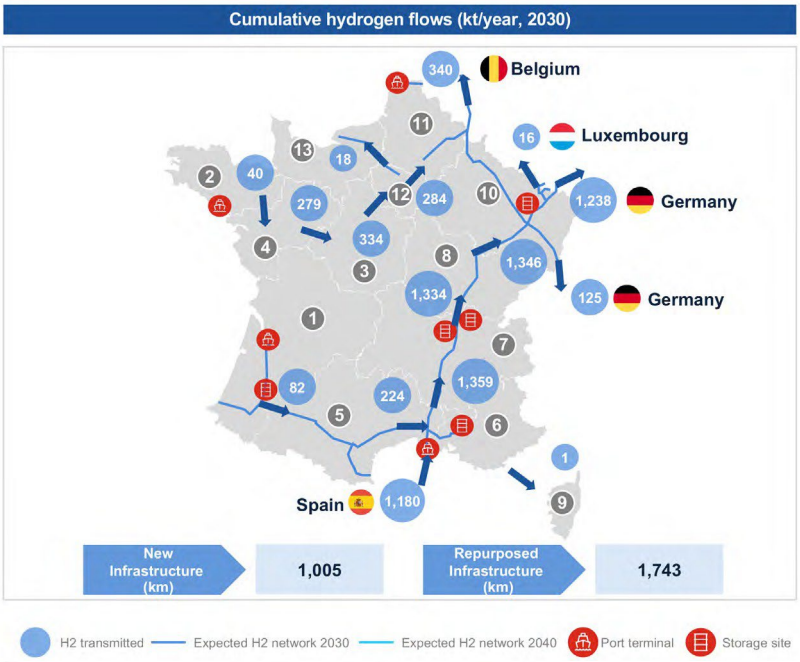


Hydrogen flow summary (kt/year, 2030)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Andalucía	327	93	234	-	-	Extremadura Netherlands Storage	324 124 8
2	Extremadura	255	12	243	Andalucia C. La Mancha	102 255	C. y Leon	601
3	C. La Mancha	380	40	340	-	-	Madrid Extremadura Storage	33 255 52
4	Madrid	2	35	33	C. La Mancha	33	-	-
5	C. Y Leon	279	51	228	North Extremadura Galicia	90 601 238	Asturias	1,157
6	Galicia	322	84	238	-	-	C. Y Leon	238
7	Asturias	27	79	52	C. Y Leon	1,157	Cantabria	1,105
8	Cantabria	1	60	59	Asturias	1,105	País Vasco Storage	1,036 10
9	Pais Vasco	8	41	33	Cantabria	1,036	La Rioja Storage	996 7
10	Navarra	68	24	44	La Rioja	1,012	Aragon	1,056
11	La Rioja	21	5	16	País Vasco	996	Navarra	1,012
12	Aragon	304	46	258	Navarra	1,056	Cataluña	1,314
13	Cataluña	67	207	140	Aragon	1,314	P.-Alpes-Côte d'Azur	1,180
14	C. Valenciana	60	88	28	Murcia	34	Cataluña	6
15	Murcia	61	27	34	-	-	C. Valenciana	34
	Total	2,182	892	1,290	Portugal	90	Netherlands France Storage	124 1,180 76

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

Figure 24. Regional flows France 2030 (kt/yr)



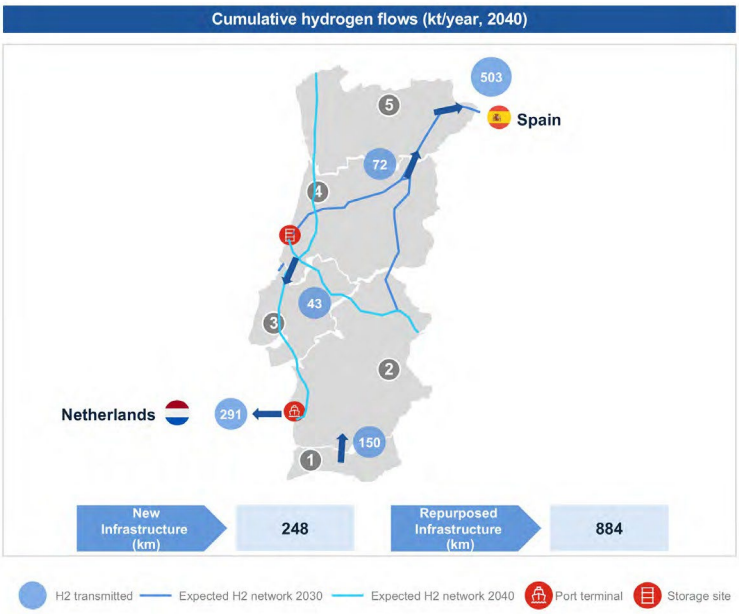
Hydrogen flow summary (kt/year, 2030)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Nouvelle-Aquitaine	172	68	104	-	-	Occitanie Storage	81 22
2	Bretagne	192	41	40	-	-	Pays de la Loire	40
3	Centre-Val de Loire	82	27	55	Pays de la Loire	279	Île-de-France	334
4	Pays de la Loire	282	43	239	Bretagne	40	Centre-Val de Loire	279
5	Occitanie	192	41	151	Nouvelle-Aquitaine	82	P.-Alpes-Côte d'Azur Storage	224 9
6	Provence-Alpes-Côte d'Azur	72	109	37	Cataluña Occitanie	1,180 224	A.-Rhône-Alpes Corse Storage	1,359 1 6
7	Auvergne-Rhône-Alpes	88	103	25	P.-Alpes-Côte d'Azur	1,359	Bourgogne-Franche-Comté	1,334
8	Bourgogne-Franche-Comté	52	40	12	Auvergne-Rhône-Alpes	1,334	Grand Est	1,346
9	Corse	-	1	1	P.-Alpes-Côte d'Azur	1	-	-
10	Grand Est	165	129	36	Bourgogne-Franche-Comté	1,346	Luxembourg Saarland B.Warttemberg Storage	16 1,238 125 3
11	Hauts-de-France	265	184	81	Île-de-France	284	Belgium Storage	340 25
12	Île-de-France	12	44	32	Centre-Val de Loire	334	H.-de-France Normandie	284 18
13	Normandie	56	74	18	Île-de-France	18	-	-
	Total	1,506	901	605	Spain	1,180	Luxembourg Belgium Germany Storage	16 340 1,363 65

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

1.2. Regional flows for 2040 period

Figure 25. Regional flows Portugal 2040 (kt/yr)

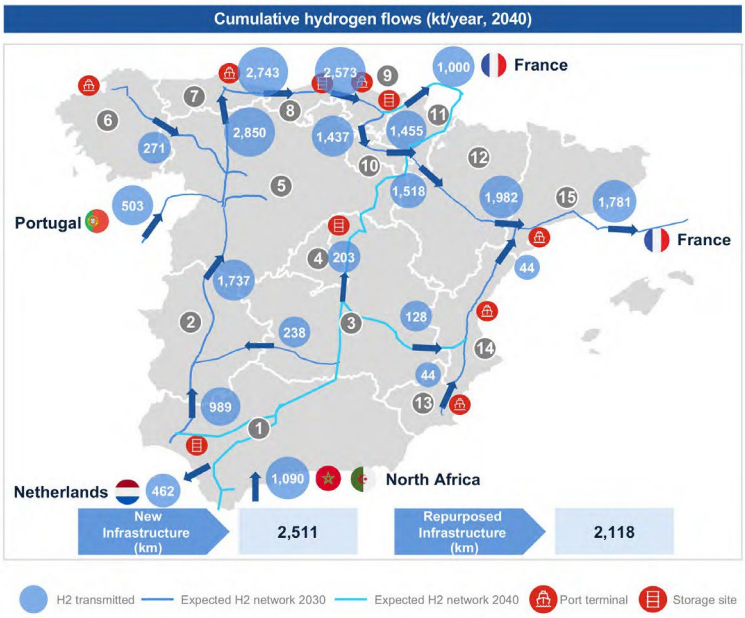


Hydrogen flow summary (kt/year, 2040)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Algarve	152	2	150	-	-	Alentejo	150
2	Alentejo	228	87	141	Algarve	150	Netherlands	291
3	Lisbon	78	121	43	Centre	43	-	-
4	Centre	259	144	115	-	-	Lisbon	43
							North	72
5	North	533	102	431	Centre	72	Castilla y Leon	503
	Total	1,250	456	794	-	-	Netherlands	291
							Spain	503

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

Figure 26. Regional flows Spain 2040 (kt/yr)

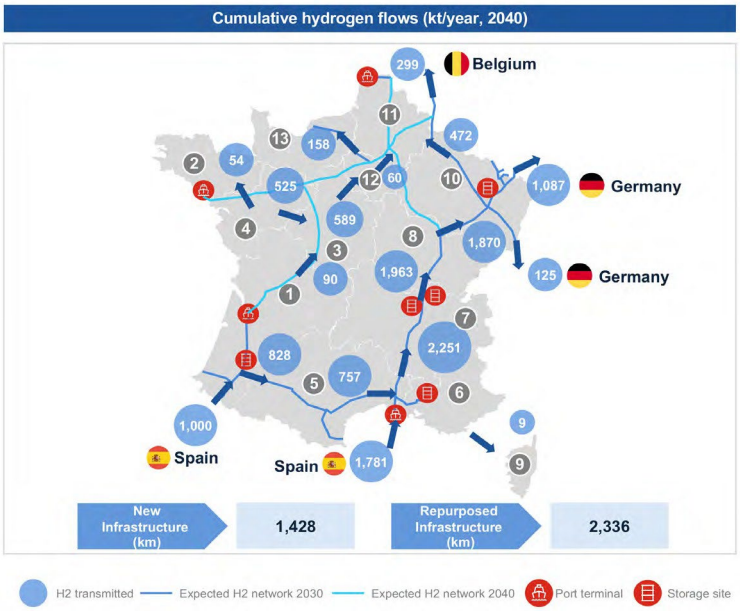


Hydrogen flow summary (kt/year, 2040)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Andalucía	651	282	368	North Africa	1,090	Extremadura Netherlands Storage	989 462 8
2	Extremadura	550	41	508	Andalucía C. La Mancha	989 238	C. y Leon	1,737
3	C. La Mancha	746	125	621	-	-	Madrid Extremadura C. Valenciana Storage	203 238 128 52
4	Madrid	5	208	203	C. La Mancha	203	-	-
5	C. Y Leon	499	160	339	North Extremadura Galicia	503 1,737 271	Asturias	2,850
6	Galicia	465	194	272	-	-	C. Y Leon	271
7	Asturias	47	154	108	C. Y Leon	2,850	Cantabria	2,743
8	Cantabria	3	140	137	Asturias	2,743	País Vasco Storage	2,573 33
9	Pais Vasco	14	125	110	Cantabria	2,573	La Rioja N.-Aquitaine Storage	1,437 1,000 24
10	Navarra	123	60	63	La Rioja	1,455	Aragon	1,518
11	La Rioja	39	21	18	País Vasco	1,437	Navarra	1,455
12	Aragon	569	105	464	Navarra	1,518	Cataluña	1,982
13	Cataluña	12	366	245	Aragon	1,982	P.-Alpes-Côte d'Azur	1,781
14	C. Valenciana	111	239	129	C. La Mancha Murcia	128 44	Cataluña	44
15	Murcia	128	84	44	-	-	C. Valenciana	44
	Total	4,071	2,304	1,767	Portugal North Africa	503 1,090	Netherlands France Storage	462 2,781 117

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

Figure 27. Regional flows France 2040 (kt/yr)



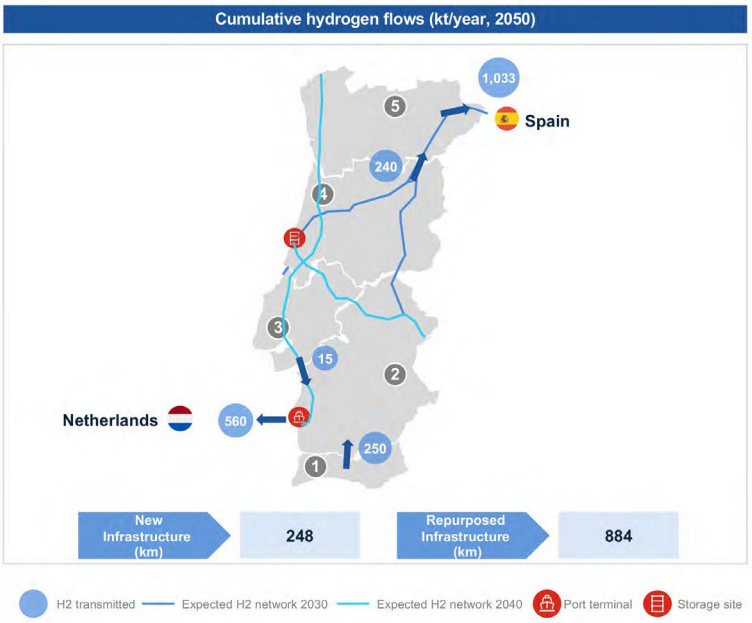
Hydrogen flow summary (kt/year, 2040)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Nouvelle-Aquitaine	205	265	60	Pais Vasco	1,000	Occitanie C.-Val de Loire Storage	828 90 22
2	Bretagne	70	124	54	Pays de la Loire	54	-	-
3	Centre-Val de Loire	86	112	26	P. de la Loire N.-Aquitaine	525 90	Île-de-France	584
4	Pays de la Loire	750	171	579	-	-	Bretagne C.-Val de Loire	54 525
5	Occitanie	220	200	20	Nouvelle-Aquitaine	828	P.-Alpes-Côte d'Azur Storage	757 91
6	Provence-Alpes-Côte d'Azur	91	328	237	Cataluña Occitanie	1,781 757	A.-Rhône-Alpes Corse Storage	2,251 9 41
7	Auvergne-Rhône-Alpes	105	393	288	P.-Alpes-Côte d'Azur	2,251	Bourgogne-Franche-Comté	1,963
8	Bourgogne-Franche-Comté	57	150	93	Auvergne-Rhône-Alpes	1,963	Grand Est	1,870
9	Corse	-	9	9	P.-Alpes-Côte d'Azur	9	-	-
10	Grand Est	109	353	184	Bourgogne-Franche-Comté	1,870	Hauts-de-France Saarland B.Warttemberg Storage	472 1,087 125 3
11	Hauts-de-France	260	468	208	Île-de-France Grand Est	60 472	Belgium Storage	299 25
12	Île-de-France	14	385	371	Centre-Val de Loire	589	H.-de-France Normandie	60 158
13	Normandie	57	215	158	Île-de-France	158	-	-
	Total	2,084	3,173	(1,089)	Spain	2,781	Belgium Germany Storage	299 1,212 182

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

1.3. Regional flows for 2050 period

Figure 28. Regional flows Portugal 2050 (kt/yr)

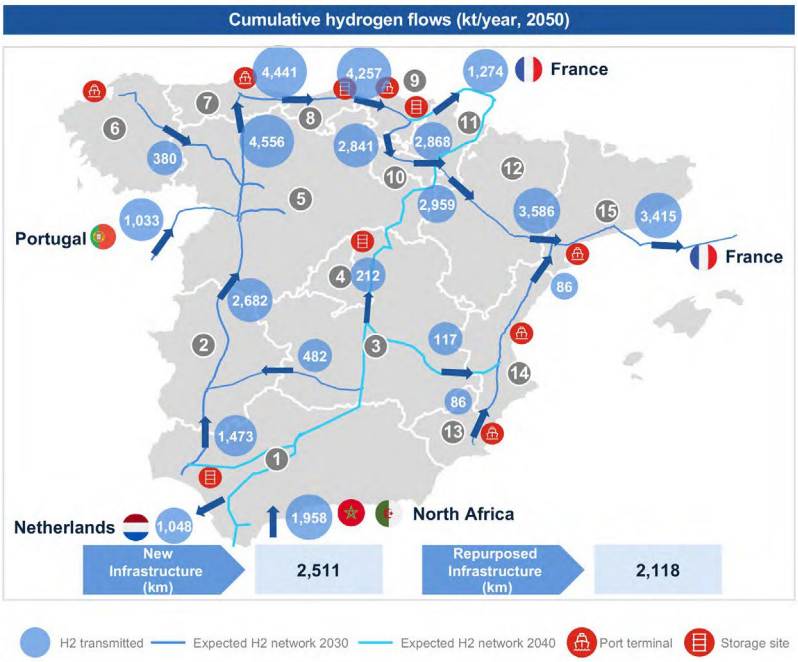


Hydrogen flow summary (kt/year, 2050)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Algarve	252	2	250	-	-	Alentejo	250
2	Alentejo	382	87	295	Algarve Lisbon	250 15	Netherlands	560
3	Lisbon	131	116	15	-	-	Alentejo	15
4	Centre	382	142	240	-	-	North	240
5	North	894	101	793	Centre	240	Castilla y Leon	1,033
	Total	2,041	448	1,593	-	-	Netherlands Spain	560 1,033

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

Figure 29. Regional flows Spain 2050 (kt/yr)

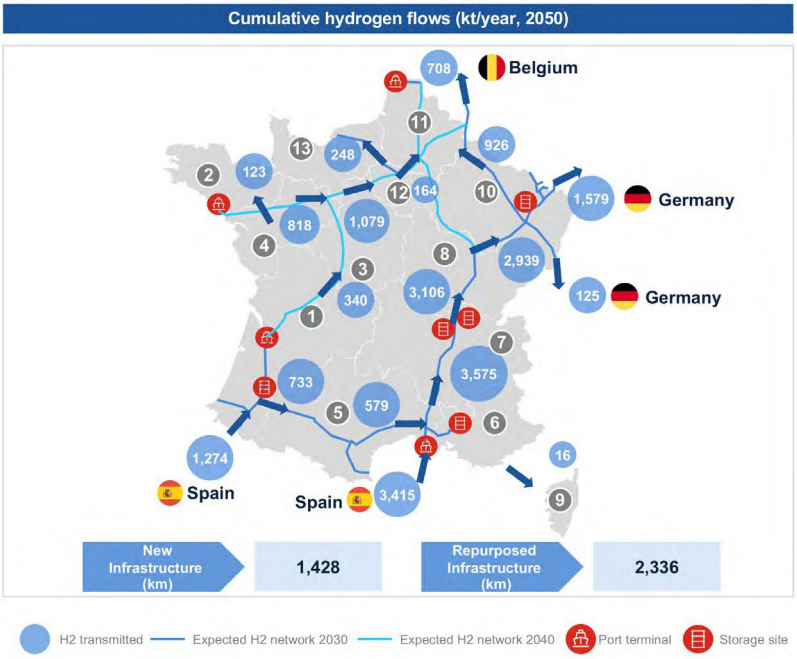


Hydrogen flow summary (kt/year, 2050)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Andalucía	877	306	571	North Africa	1,958	Extremadura Netherlands Storage	1,473 1,048 8
2	Extremadura	770	44	726	Andalucia C. La Mancha	1,473 482	C. y Leon	2,682
3	C. La Mancha	998	135	863	-	-	Madrid Extremadura C. Valenciana Storage	212 482 117 52
4	Madrid	7	219	212	C. La Mancha	212	-	-
5	C. Y Leon	634	173	461	North Extremadura Galicia	1,033 2,682 380	Asturias	4,556
6	Galicia	594	214	380	-	-	C. Y Leon	380
7	Asturias	58	173	115	C. Y Leon	4,556	Cantabria	4,441
8	Cantabria	3	154	151	Asturias	4,441	País Vasco Storage	4,257 33
9	Pais Vasco	18	135	117	Cantabria	4,257	La Rioja N.-Aquitaine Storage	2,841 1,274 24
10	Navarra	157	66	91	La Rioja	2,868	Aragon	2,959
11	La Rioja	50	23	27	País Vasco	2,841	Navarra	2,868
12	Aragon	743	116	627	Navarra	2,959	Cataluña	3,586
13	Cataluña	156	413	257	Aragon	3,586	P.-Alpes-Côte d'Azur	3,415
14	C. Valenciana	144	261	117	Murcia C.La Mancha	86 117	Cataluña	86
15	Murcia	177	91	86	-	-	C. Valenciana	86
	Total	5,386	2,523	2,863	Portugal North Africa	1,033 1,958	Netherlands France Storage	1,048 4,689 117

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: *ENTSOG, Hydrogen Infrastructure Map, BIP analysis.*

Figure 30. Regional flows France 2050 (kt/yr)



Hydrogen flow summary (kt/year, 2050)

ID	Regions	Supply	Demand	Local NB	From	Imports	To	Exports
1	Nouvelle-Aquitaine	254	418	164	Pais Vasco	1,274	Occitanie C.-Val de Loire Storage	733 340 37
2	Bretagne	78	201	123	Pays de la Loire	123	-	-
3	Centre-Val de Loire	100	179	79	P. de la Loire N.-Aquitaine	818 340	Île-de-France	1,079
4	Pays de la Loire	1,212	271	941	-	-	Bretagne C.-Val de Loire	123 818
5	Occitanie	266	329	63	Nouvelle-Aquitaine	733	P.-Alpes-Côte d'Azur Storage	579 91
6	Provence-Alpes-Côte d'Azur	116	478	362	Cataluña Occitanie	3,415 579	A.-Rhône-Alpes Corse Storage	3,575 16 41
7	Auvergne-Rhône-Alpes	1 129	598	469	P.-Alpes-Côte d'Azur	3,575	Bourgogne-Franche-Comté	3,106
8	Bourgogne-Franche-Comté	66	233	167	Auvergne-Rhône-Alpes	3,106	Grand Est	2,939
9	Corse	-	16	16	P.-Alpes-Côte d'Azur	16	-	-
10	Grand Est	191	497	306	Bourgogne-Franche-Comté	2,939	Hauts-de-France Saarland B.Warttemberg Storage	926 1,579 125 3
11	Hauts-de-France	283	640	357	Île-de-France Grand Est	164 926	Belgium Storage	708 25
12	Île-de-France	17	684	667	Centre-Val de Loire	1,079	H.-de-France Normandie	164 248
13	Normandie	63	311	248	Île-de-France	248	-	-
	Total	2,775	4,855	(2,080)	Spain	4,689	Belgium Germany Storage	708 1,704 197

Results calculated as the average of the maximum and minimum supply and demand scenario for each Member State.
Source: ENTSOG, Hydrogen Infrastructure Map, BIP analysis.

2 Regional Net Balance data tables

Table 4. Portugal Hydrogen Minimum Scenario Domestic Net Balance (kt/yr)

Portugal New NECP	2030			2040			2050		
	Production	Demand	Net	Production	Demand	Net	Production	Demand	Net
Alentejo	31.8	52.0	(20.2)	186.4	81.5	104.9	332.2	79.0	253.2
Algarve	22.1	1.2	20.9	124.4	1.9	122.5	218.9	1.8	217.1
Centro	49.2	81.0	(31.8)	212.0	134.4	77.6	331.5	128.7	202.8
Lisbon	11.2	41.8	(30.6)	64.1	112.2	(48.1)	113.5	99.1	14.4
Norte	75.0	58.1	16.9	436.4	95.5	340.9	776.5	91.6	684.9
TOTAL	**189.3**	**234.1**	**(44.8)**	**1,023.3**	**425.5**	**597.8**	**1,772.6**	**400.2**	**1,372.4**

Table 5. Spain Hydrogen Minimum Scenario Domestic Net Balance (kt/yr)

Spain New NECP	2030			2040			2050		
	Production	Demand	Net	Production	Demand	Net	Production	Demand	Net
Andalucia	215.4	89.8	125.6	510.6	271.2	239.4	718.0	288.6	429.4
Aragon	200.4	43.8	156.6	446.7	100.6	346.1	608.2	110.1	498.1
Asturias	17.5	75.7	(58.2)	36.5	146.9	(110.4)	47.8	164.1	(116.3)
Cantabria	0.9	57.7	(56.8)	2.0	133.3	(131.3)	2.6	145.7	(143.1)
Castilla La Mancha	250.2	38.6	211.6	585.0	119.8	465.2	816.8	127.2	689.6
Castilla y Leon	183.7	49.4	134.3	391.4	153.3	238.1	519.2	162.7	356.5
Cataluña	43.9	199.2	(155.3)	95.0	347.4	(252.4)	127.3	393.9	(266.6)
Comunidad Valenciana	39.4	84.8	(45.4)	86.8	229.2	(142.4)	117.5	246.4	(128.9)
Extremadura	167.7	12.0	155.7	431.2	39.6	391.6	630.0	41.8	588.2
Galicia	211.9	81.1	130.8	365.2	185.3	179.9	485.9	202.8	283.1
La Rioja	14.1	4.4	9.7	30.6	20.6	10.0	41.1	21.2	19.9
Madrid	1.5	33.8	(32.3)	4.0	201.5	(197.5)	5.8	204.9	(199.1)
Murcia	40.1	25.9	14.2	100.4	80.5	19.9	144.9	85.4	59.5
Navarra	45.1	22.7	22.4	96.4	57.4	39.0	128.3	62.1	66.2
Pais Vasco	5.1	39.7	(34.6)	11.1	119.7	(108.6)	14.9	127.4	(112.5)
TOTAL	**1,436.9**	**858.6**	**578.3**	**3,192.8**	**2,206.3**	**986.5**	**4,408.3**	**2,384.3**	**2,024.0**

Table 6. France Hydrogen Minimum Scenario Domestic Net Balance (kt/yr)

France	2030			2040			2050		
	Production	Demand	Net	Production	Demand	Net	Production	Demand	Net
Auvergne-Rhône-Alpes	15.7	108.2	(92.5)	37.0	379.7	(342.7)	60.3	581.3	(521.0)
Bourgogne-Franche-Comté	9.3	38.2	(28.9)	20.0	145.4	(125.4)	31.0	227.3	(196.3)
Bretagne	12.2	26.5	(14.3)	24.6	121.0	(96.4)	36.6	196.8	(160.2)
Centre-Val de Loire	14.6	26.1	(11.5)	30.6	109.4	(78.8)	46.6	174.9	(128.3)
Corse	-	0.6	(0.6)	-	8.8	(8.8)	-	16.2	(16.2)
Grand Est	29.4	123.1	(93.7)	59.9	337.8	(277.9)	89.3	477.7	(388.4)
Hauts-de-France	47.4	175.2	(127.8)	91.9	445.8	(353.9)	132.3	611.9	(479.6)
Normandie	10.1	70.3	(60.2)	20.1	206.7	(186.6)	29.5	299.7	(270.2)
Nouvelle-Aquitaine	30.8	64.5	(33.7)	72.6	257.7	(185.1)	118.8	407.6	(288.8)
Occitanie	34.4	39.5	(5.1)	77.8	195.3	(117.5)	124.2	322.7	(198.5)
Pays de la Loire	50.4	40.7	9.7	265.4	166.7	98.7	566.9	265.2	301.7
Provence-Alpes-Côte d'Azur	12.8	104.2	(91.4)	32.1	315.3	(283.2)	54.3	461.5	(407.2)
Île-de-France	2.2	42.8	(40.6)	5.0	380.4	(375.4)	8.1	678.7	(670.6)
TOTAL	**269.3**	**859.9**	**(590.6)**	**737.0**	**3,070.0**	**(2,333.0)**	**1,297.9**	**4,721.5**	**(3,423.6)**

Table 7. Benelux and Germany Hydrogen Minimum Scenario Domestic Net Balance (kt/yr)

Rest of the countries of the corridor	2030			2040			2050		
	Production	Demand	Net	Production	Demand	Net	Production	Demand	Net
Benelux	1,388.7	2,037.5	(648.8)	2,194.0	3,794.4	(1,600.4)	3,450.3	4,952.3	(1,502.0)
Germany	-	2,535.2	(2,535.2)	-	4,967.0	(4,967.0)	2,138.0	7,134.1	(4,996.1)
TOTAL	**1,388.7**	**4,572.7**	**(3,184.0)**	**2,194.0**	**8,761.4**	**(6,567.4)**	**5,588.3**	**12,086.4**	**(6,498.1)**

Table 8. Portugal Hydrogen Maximum Scenario Domestic Net Balance (kt/yr)

Portugal New NECP	2030			2040			2050		
	Production	Demand	Net	Production	Demand	Net	Production	Demand	Net
Alentejo	92.5	56.2	36.3	268.8	93.0	175.8	432.6	94.2	338.4
Algarve	64.2	1.3	62.9	179.5	2.1	177.4	285.0	2.1	282.9
Centro	143.1	87.6	55.5	305.8	153.6	152.2	431.6	155.7	275.9
Lisbon	32.4	45.0	(12.6)	92.4	130.2	(37.8)	147.7	132.1	15.6
Norte	217.9	62.8	155.1	629.5	109.2	520.3	1,011.0	110.7	900.3
TOTAL	**550.1**	**252.9**	**297.2**	**1,476.0**	**488.1**	**987.9**	**2,307.9**	**494.8**	**1,813.1**

Table 9. Spain Hydrogen Maximum Scenario Domestic Net Balance (kt/yr)

Spain New NECP	2030			2040			2050		
	Production	Demand	Net	Production	Demand	Net	Production	Demand	Net
Andalucia	438.5	96.8	341.7	791.0	293.7	497.3	1,036.7	323.7	713.0
Aragon	407.9	47.3	360.6	692.1	110.0	582.1	878.2	122.3	755.9
Asturias	35.6	81.8	(46.2)	56.5	161.8	(105.3)	69.0	181.1	(112.1)
Cantabria	1.9	62.3	(60.4)	3.1	145.7	(142.6)	3.8	162.0	(158.2)
Castilla La Mancha	509.3	41.6	467.7	906.2	129.7	776.5	1,179.5	142.8	1,036.7
Castilla y Leon	374.0	53.2	320.8	606.4	165.8	440.6	749.7	182.6	567.1
Cataluña	89.3	215.5	(126.2)	147.2	384.6	(237.4)	183.8	432.6	(248.8)
Comunidad Valenciana	80.1	91.4	(11.3)	134.5	249.1	(114.6)	169.6	275.5	(105.9)
Extremadura	341.5	12.9	328.6	668.0	42.8	625.2	909.7	47.0	862.7
Galicia	431.3	87.5	343.8	565.8	202.6	363.2	701.7	225.4	476.3
La Rioja	28.6	4.7	23.9	47.4	22.0	25.4	59.3	24.0	35.3
Madrid	3.1	36.0	(32.9)	6.2	214.9	(208.7)	8.4	233.4	(225.0)
Murcia	81.6	27.9	53.7	155.5	87.1	68.4	209.2	95.9	113.3
Navarra	91.7	24.4	67.3	149.4	62.5	86.9	185.3	69.3	116.0
Pais Vasco	10.4	42.7	(32.3)	17.2	129.6	(112.4)	21.6	142.9	(121.3)
TOTAL	**2,924.8**	**926.0**	**1,998.8**	**4,946.5**	**2,401.9**	**2,544.6**	**6,365.5**	**2,660.5**	**3,705.0**

Table 10. France Hydrogen Maximum Scenario Domestic Net Balance (kt/yr)

France	2030			2040			2050		
	Production	Demand	Net	Production	Demand	Net	Production	Demand	Net
Auvergne-Rhône-Alpes	160.4	118.5	41.9	172.1	405.6	(233.5)	197.5	615.1	(417.6)
Bourgogne-Franche-Comté	95.2	41.8	53.4	93.3	154.4	(61.1)	101.4	239.1	(137.7)
Bretagne	123.9	29.0	94.9	114.6	127.1	(12.5)	119.9	204.8	(84.9)
Centre-Val de Loire	148.6	28.5	120.1	142.4	115.5	26.9	152.5	182.9	(30.4)
Corse	-	0.6	(0.6)	-	8.8	(8.8)	-	16.3	(16.3)
Grand Est	299.7	135.1	164.6	278.7	368.1	(89.4)	292.5	517.2	(224.7)
Hauts-de-France	483.0	192.4	290.6	427.8	489.3	(61.5)	433.3	668.5	(235.2)
Normandie	102.5	77.1	25.4	93.5	223.9	(130.4)	96.8	322.2	(225.4)
Nouvelle-Aquitaine	313.6	70.6	243.0	337.9	273.0	64.9	388.9	427.5	(38.6)
Occitanie	350.6	43.1	307.5	362.1	204.3	157.8	406.8	334.4	72.4
Pays de la Loire	513.5	44.5	469.0	1,235.2	176.3	1,058.9	1,856.2	277.6	1,578.6
Provence-Alpes-Côte d'Azur	130.5	114.4	16.1	149.5	340.7	(191.2)	177.7	494.6	(316.9)
Île-de-France	22.2	46.1	(23.9)	23.3	388.8	(365.5)	26.5	689.6	(663.1)
TOTAL	**2,743.7**	**941.7**	**1,802.0**	**3,430.4**	**3,275.8**	**154.6**	**4,250.0**	**4,989.8**	**(739.8)**

Table 11. Benelux and Germany Hydrogen Maximum Scenario Domestic Net Balance (kt/yr)

Rest of the countries of the corridor	2030			2040			2050		
	Production	Demand	Net	Production	Demand	Net	Production	Demand	Net
Benelux	2,533.1	2,095.9	437.2	3,515.9	3,979.9	(464.0)	4,899.1	5,224.0	(324.9)
Germany	594.1	2,704.2	(2,110.1)	2,497.1	5,437.7	(2,940.6)	4,801.1	7,833.6	(3,032.5)
TOTAL	**3,127.2**	**4,800.1**	**(1,672.9)**	**6,013.0**	**9,417.6**	**(3,404.6)**	**9,700.2**	**13,057.6**	**(3,357.4)**

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Category	Title	Source	Year	Chapter 2	Chapter 3	Chapter 4	Chapter 5 y 6
Ammonia	Clean ammonia in the future energy system	Hydrogen Europe	2023	x	x	x	
Electrolysis	IRENA_EPO_Electrolysers_H2_production_2022	IRENA	2022		x		
Electrolysis	Hydrogen Electrolysis in the European Union	European Commission	2022		x		
Energy Scenario	World Energy Outlook 2022	IEA	2022	x		x	
Energy Scenario	World Energy Transitions Outlook: 1.5°C Pathway	IRENA	2022	x		x	
Energy Scenario	New Energy Outlook 2021	BNEF	2021	x		x	
Energy Scenario	Net Zero by 2050	IEA	2021	x		x	
Energy Scenario	Gas Decarbonisation Pathways 2020–2050	Gas For Climate	2020	x		x	
Energy Scenario	Decarbonising Steel: Forging new paths together	Shell	2022	x	x	x	x
Energy Scenarios	A Clean Planet for all - A European strategic long-term vision for a prosperous. modern. competitive and climate neutral economy	European Commission	2018	x	x	x	x
Energy Storage	Technology Data for Energy Storage	DEA	2022		x		
Fuel Cell applications	Fuel Cells and Hydrogen for Green Energy in European Cities and Regions	FCHJU/Clean Hydrogen Partnership	2018	x	x		
H2 Business cases	Tools to support the development of business models	Clean Hydrogen Partnership	-		x		
H2 Business cases	Replicability Tool	HTP	-		x		
H2 Certification	Creating a global hydrogen market: Certification to enable trade	IRENA	2023	x			
H2 Emissions	Carbon Intensity of Hydrogen Production Methods Report	Centre for Innovation and Clean Energy	2023		x		
H2 global trade	Global-Hydrogen-Flows	Hydrogen Council	2022	x	x		x
H2 import	Facilitating hydrogen imports from non-EU countries	Gas For Climate	2022	x	x	x	x
H2 in Aviation	Hydrogen-powered aviation	FCHJU/Clean Hydrogen Partnership	2020			x	
Energy Scenario	Statistical profiles-Algeria	IRENA	2022		x		
Energy Scenario	National Strategy of Energy Transition - Algeria	CREG	2021		x		
Energy Scenario	Electricity production - Morocco	MEM	2022		x		
Energy Scenario	Morocco Renewable Energy Target 2030	IEA	2019		x		
Energy Scenario	National Climate Plan - Morocco	MEM	2020		x		
Energy Scenario	Long-Term Strategies - Morocco	MEM	2021		x		
H2 in Europe	Electricity production - Italy	TERNA	2022		x		
H2 in Europe	National Climate Plan - Italy	Italian government	2019		x		
H2 in Europe	Long-term Strategies - Italy	Tera	2020		x		
H2 in Europe	Electricity production - Netherlands	ENTSOE	2022		x		
H2 in Europe	Climate and Energy Exploration	NEAA	2019		x		
H2 in Europe	CLEAN HYDROGEN MONITOR 2022	Hydrogen Europe	2022	x	x	x	x

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H2 in mobility	Study on impact of deployment of battery electric vehicles (BEV) and fuel cells electric vehicles (FCEV) infrastructure	Clean Hydrogen Partnership	2022			x	
H2 in mobility	Study on Fuel Cells Hydrogen Trucks	FCHJU/Clean Hydrogen Partnership	2020			x	
H2 in trains	Use of fuel cells and hydrogen in the railway environment	FCHJU/Clean Hydrogen Partnership	2019			x	
H2 infrastructure	No-regret hydrogen - Charting early steps for H2 infrastructure in Europe	AGORA-AFRY	2021	x	x	x	x
H2 infrastructure	Analysing future demand. supply. and transport of hydrogen	European Hydrogen Backbone	2021				x
H2 overview	Geopolitics of the Energy Transformation - The Hydrogen Factor	IRENA	2022		x	x	x
H2 production	HE-DVGW Pyrolysis Report	Hydrogen Europe	2022		x		
H2 Production	Global Hydrogen Trade To Meet The 1.5°C Climate Goal: Green Hydrogen Cost and Potential	IRENA	2022		x		
H2 Production	Blending hydrogen from electrolysis into the European gas grid	JRC	2022	x			x
H2 Production	Green hydrogen cost reduction	IRENA	2020		x		
H2 projects	Hydrogen projects database	IEA	2022		x		
H2 Scenario in Europe	Opportunities for Hydrogen Energy Technologies Considering the National Energy & Climate Plans	FCHJU/Clean Hydrogen Partnership	2020	x			
H2 Standards	ROADMAP ON HYDROGEN STANDARDISATION	Hydrogen Europe	2023	x			
H2 Storage	Hydrogen storage for a net-zero carbon future	OIES	2023		x		
H2 Supply Chain	Pathways to Commercial Liftoff: Clean Hydrogen	DOE	2023	x			
H2 Supply Chain	Hydrogen Report 2022	Hydrogen Europe/Revolve	2022	x		x	
H2 Supply Chain	Global Hydrogen Review 2022	IEA	2022	x	x	x	x
H2 Supply Chain	Global Hydrogen Review	IEA	2021	x	x	x	x
H2 Supply Chain	The Future of hydrogen	IEA	2019				
H2 Supply Chain	Global Hydrogen Trade To Meet The 1.5°C Climate Goal: Technology Review of Hydrogen Carriers	IRENA	2022				x
H2 Supply Chain	Global Hydrogen Trade To Meet The 1.5°C Climate Goal: Trade Outlook for 2050 and Way Forward	IRENA	2022	x	x	x	x
H2 Supply Chain	Idrogeno Un vettore energetico per la decarbonizzazione	RSE	2021	x		x	
H2 Supply Chain	Life Cycle Assessment of Hydrogen and Fuel Cell Technologies	FCHJU/Clean Hydrogen Partnership	2020			x	
H2 Supply Chain	Path to hydrogen competitiveness - A cost perspective	Hydrogen Council	2020	x	x	x	x
H2 in Europe	Delegated Act	European Commission	-		x		
H2 in Europe	Renewable Energy Directive	European Commission	-			x	
H2 in Europe	Hydrogen and decarbonised gas market package	European Commission	-				x

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H2 Supply Chain	Hydrogen Roadmap Europe	FCHJU/Clean Hydrogen Partnership	2019	x	x	x	x
H2 Supply Chain	The Future of hydrogen - Annex	IEA	2019		x	x	x
H2 Supply Chain	Hydrogen: A renewable energy perspective	IRENA	2019	x		x	
H2 transport	Assessing the benefits of a pan-European hydrogen transmission network	Gas For Climate	2023				x
H2 transport	Assessment of Hydrogen Delivery Options	JRC	2022				x
H2 Transport	Global trade of hydrogen: what is the best way to transfer hydrogen over long distances?	OIES	2022				x
H2 Transport & Storage	Study on hydrogen in ports and industrial coastal areas	Clean Hydrogen Partnership	2023			x	
H2 Turbines	The path towards a zero-carbon gas turbine	ETN Global	2020			x	
H2 valleys	Hydrogen Valley Platform	Clean Hydrogen Partnership	-		x		
Industry	Technology Data for Industrial Process Heat	DEA	2022			x	
Manufacturing	Study on Value Chain and Manufacturing Competitiveness Analysis for Hydrogen and Fuel Cells Technologies	FCHJU/Clean Hydrogen Partnership	2020	x		x	x
Minerals for H2	Sufficiency. sustainability. and circularity of critical materials for clean hydrogen	Hydrogen Council	2022			x	
Power&Heat	Technology Data for Generation of Electricity and District Heating	DEA	2022		x		
Renewable Fuels	Technology Data for Renewable Fuels	DEA	2022		x		
RES & H2Costs	Projected Costs of Generating Electricity	IEA	2020		x		
Residential Heating	Residential Heat Economics Calculator	IEA	-			x	
Residential Heating	Technology Data for Individual Heating Plants	DEA	2022			x	
Steel	Unlocking the First Wave of Breakthrough Steel Investments	Energy Transitions Commission	2023			x	
H2 in Europe	COM(2022) 230 final. RePowerEU Annex I to III	European Commission	2022		x		
H2 in Europe	SWD(2022) 230 final. Implementing the RePowerEU Action Plan	European Commission	2022		x		
H2 in Europe	COM(2022) 869 final. Revised TEN-E regulation	European Commission	2022				x
H2 in Europe	COM(2020) 301 final. A hydrogen strategy for a climate- neutral Europe	European Commission	2020	x	x	x	x
Industry	Green Hydrogen for Industry	IRENA	2020		x	x	
H2 in Europe	Mainstreaming green hydrogen in Europe	Material Economics	2020	x			
H2 in Europe	Climate Action	European Commission	-		x		
H2 in Europe	Hydrogen Demand	FCHO	-	x		x	
H2 production	Hydrogen Production Costs 2021	Department for business. energy and industrial strategy	2021		x		
H2 in Europe	Climate Strategies and targets- 2050 long-term strategy	European Commission	-			x	
H2 in Europe	National hydrogen strategies	European Commission	-		x	x	
H2 infrastructure	Analysing future demand. supply. and transport of hydrogen	European Hydrogen Backbone	2021				x
H2 infrastructure	European hydrogen infrastructure vision covering 28 countries	European Hydrogen Backbone	2022				x
H2 infrastructure	Five hydrogen supply corridors for Europe in 2030	European Hydrogen Backbone	2022				x
H2 Scenario in Europe	Hydrogen Forecast to 2050	DNV	2022	x	x	x	

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H2 infrastructure	The Hydrogen and Natural Gas. Infrastructure Report	TYNDP	2022				x
H2 infrastructure	The Hydrogen and Natural Gas. System Assessment Report	TYNDP	2022				x
H2 infrastructure	Scenario Report	TYNDP	2022	x			x
H2 in Europe	Spain National Integrated Energy and Climate Plan 2021-2030	Spanish Government	2023		x	x	
H2 in Europe	Spain Hydrogen roadmap	Spanish Government	2020		x	x	
H2 in Europe	Energy consumption in the German industry in 2020	Statistische Ämter	-	x	x		
H2 in Europe	Balance del consumo de energia final	IDAE	-	x	x		
H2 in Europe	Data Base Energy	Eurostat	-	x	x		
H2 in Europe	Market Report	BME	-	x	x		
H2 in Europe	Distribution of the final energy consumption of the industry in France in 2020. by sector	Statista	-		x		
H2 in Europe	Key energy statistics. 2020. For France	EIA	-		x		
Biomethane	Publications from European Biogas Association	EBA	-			x	
Biomethane	The outlook for biogas and biomethane to 2040	IEA	-			x	
Biomethane	Asociacion Española de Biogas	aebig	-			x	
Biomethane	Gas For Climate	Navigant	-			x	
Biomethane	6th European Biomethane Benchmark	SIA PARTNERS	-			x	
H2 in Europe	Clean Hydrogen Alliance	European Commission	-	x	x	x	
H2 in Europe	Clean Hydrogen Partnership	European Commission	-	x	x	x	
Hydrogen Valleys	Hydrogen Valleys	Clean Hydrogen Partnership	-	x	x	x	
H2 in Europe	NCEP - Netherlands	Governments of the Netherlands	2019		x	x	
H2 in Europe	Infrastructure Outlook 2050	TenneT	2022		x		
H2 in Europe	Electricity production - France	RTE	2022		x	x	
H2 in Europe	Wind Strategy	Wind Europe	2022		x	x	
H2 in Europe	National Climate Plan - France	French government	2019		x	x	
H2 in Europe	Energy Pathways - 2050	RTE	2021		x	x	
H2 in Europe	Long-term Strategies - Spain	Spanish government	2019		x	x	
H2 in Europe	Electricity production - Portugal	DGEG	2022		x	x	
H2 in Europe	National Climate Plan - Portugal	Portuguese government	2023		x	x	
H2 in Europe	Long-term Strategies - Portugal	Portuguese government	2019		x	x	
H2 in Europe	Electricity production - Luxembourg	SMARD	2022		x	x	
H2 in Europe	National Climate Plan - Luxembourg	Luxembourgish Government	2019		x	x	
H2 in Europe	Electricity production - Belgium	ENTSOE	2022		x	x	
H2 in Europe	National Climate Plan - Belgium	Belgian Government	2019		x	x	
H2 in Europe	Long-term Strategies - Belgium	Belgian Government	2019		x	x	
H2 in Europe	Electricity production - Germany	SMARD	2022		x	x	
H2 in Europe	National Climate Plan - Germany	German government	2019		x	x	
H2 in Europe	Long-term Scenarios for the Transformation of the Energy System in Germany	Fraunhofer Institute for Systems and Innovation Research	2022			x	
H2 in Europe	Planning status H2 core network	German transmission system operators	2023			x	

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