

Interreg

Euregio Meuse-Rhine

**EMR
BOOSTER H2**



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Deliverable 1A

Mapping of regional
strengths in the field
of
green hydrogen

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Introduction

Within the Euregio Maas-Rhein area, a high variety of documents addressing green hydrogen have been created over the last years. Among others, visions, regional and national plans, roadmaps and R&D studies have been developed to gather information about the current status and future developments in the field of hydrogen. But all this information has not yet been linked to each other. Therefore, mapping and integrating all of the available information is a very important step to promote the hydrogen developments in the Euregio Maas-Rhein area on a shared basis.

In order to structure the information, the document in hand analyses the existing and directly related regional plans, roadmaps, and other documents related to hydrogen. By connecting the documents of the three involved partner countries, they should be used as a basis for the development of the cross-border collaboration in the field of hydrogen. Additionally, with the help of the document in hand currently existing white spots will be clarified and cross border opportunities identified in a holistic manner. The implementation of more tangible and valuable hydrogen projects in the region will be accelerated in line with the ambitions of the aforementioned documents.

The mapping results give us a first insight in what is happening in the hydrogen field in the region and will feed into the work of the subsequent work of the EMR H2 Booster.

The existing documents dealing with hydrogen and formulated with a direct relevance for the Euregio Maas-Rhein Region will be analyzed by different aspects. First of all, the analysis takes a closer look on the regional focuses of Germany, the Netherlands and Belgium to compare the countries approaches. Afterwards the mentioned advantages, which are named in the analyzed documents, will be listed. Several documents mention requirements mainly of structural and political nature, which need to be fulfilled to guarantee a successful development concerning green hydrogen. Those requirements will be approached in the following chapter. Additionally, the Analysis will throw light on concrete projects and quantitative goals stated for the Euregio Maas-Rhein Region. Conclusively the cross-border ambitions which are formulated for the region will be examined. A short summary of the identified white spots will be given.

The document in hand is the first part of the deliverable of work package 1 in the Interreg Project *EMR H2 Booster* and will be completed by the second part of the deliverable in

September. The second part will give an overview about the institutions involved into hydrogen in the Euregio Rhein-Maas Region.

Analysis

Regional Focus

The European Commission published a dedicated Hydrogen Strategy. The document outlined hydrogen as a key element of a cost-effectively decarbonized energy system which should primarily be used to decarbonize hard-to-abate sectors, such as industry, heavy duty transport or shipping.

Policy makers across all borders of the EMR region have recognized the importance of hydrogen for the sustainable development of their economies and strategies have been developed for the Netherlands, Belgium and Germany as well as for regions within these countries.

In the following table the topics, which are mentioned in the documents developed in the three countries, are listed. The table does not only take the national strategies but all relevant documents developed for the regions into account. Those topics, which are mentioned in several documents are highlighted in bold type.

Netherlands	Belgium	Germany
<ul style="list-style-type: none"> • Mobility • Industry (Chemistry) • Energy Sector • Economy • Climate • Agriculture • Built Environment 	<ul style="list-style-type: none"> • Mobility • Industry • Energy Sector • Infrastructure • Storage of H2 • Concrete end applications • Built Environment 	<ul style="list-style-type: none"> • Mobility • (Energy intensive) Industry • Energy Sector • Entrainment of the region • Heat market • Built

1. Germany

Germany presented its Hydrogen Strategy in June 2020, immediately accompanied by a budget of 9 billion euros. The German government expects a demand of between 90 to 110 TWh in 2030, a significant part of which will have to be imported from regions with more plentiful renewable resources to produce this amount of hydrogen. A demand analysis of the association of supra-regional gas transmission companies in Germany (FNB Gas) predicts an even higher demand of 231 TWh in 2032 and 598 TWh in 2050 for the entirety of planned projects.

In November 2020 the national strategy was followed-up by a regional strategy from the State of North Rhine-Westphalia (NRW), the Hydrogen Roadmap. It puts an emphasis on employing hydrogen as a tool to make NRW a viable industry and business location for the future. The 2022 coalition-agreement of north rhine-westphalian administration dedicates an entire chapter to hydrogen. It declares hydrogen as indispensable to achieve the climate goals in NRW and calls for a deployment of hydrogen in all industrial processes that cannot be electrified. A discussion paper commissioned by the chambers of commerce in NRW lines out market opportunities and fields of action for a successful ramp-up of a hydrogen economy. In total, 9 documents are considered in the following analysis, which cover a broad range of topics. The most mentioned topic is the mobility sector, which should benefit from the developments of green hydrogen in several ways. The use in the industry sector is mainly mentioned related to the energy intensive industry. A list of the documents with the target region in Germany is shown in Annex 1.

2. Netherlands

The Netherlands already mentioned hydrogen in the "Climate Agreement" and the "Programmatic Approach to Hydrogen for the Energy Transition" of 2019, before publishing a national Hydrogen Vision in March 2020. The vision document indicates both the environmental benefits of hydrogen as well as the economic opportunities for the Netherlands to serve as a trading hub for this internationally traded commodity to be. In July 2021, the workplan of "Nationaal Waterstof Programma" (National Hydrogen Programme) was presented and further defined in the Hydrogen Roadmap Limburg. As well as in the German documents there are a lot of different topics addressed in the Dutch documents. Especially the mobility sector is mentioned several times as highly relevant in the further development and usage of hydrogen. The use of hydrogen in the industry is approached as well, mainly laying focus on the chemistry branch. A list of the documents with the target region in the Netherlands is shown in Annex 2.

3. Belgium

In Belgium, hydrogen was mentioned in the coalition agreement of September 2020, indicating the ambition to be a forerunner on the topic. Additionally, several policy letters confirmed high ambition. A national hydrogen strategy was published in October 2021. The Flemish Hydrogen vision dates from November 2020, and was reinforced by the creation of a "Hydrogen Taskforce".

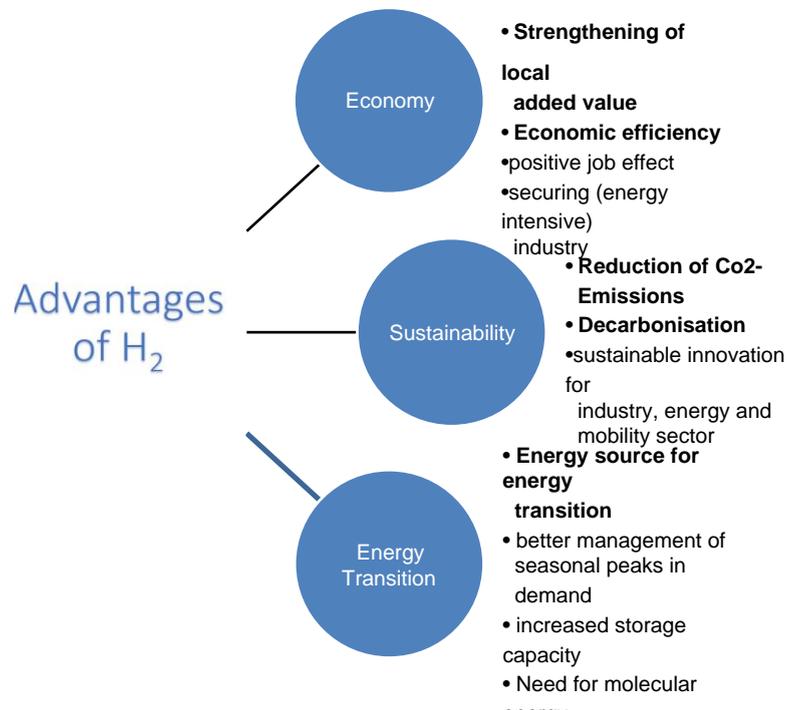
Wallonia, for its part, published a roadmap by the cluster TWEED in 2018 in order to support this sector and analyze the role of hydrogen in the energy transition in its territory. The Walloon government supports the development of the H2 sector. Indeed, the 2019 regional policy statement explicitly states that: "The Government will take initiatives to lay the foundations for the hydrogen and synthetic fuels economy". At the regional level, more than 160 million euros will be dedicated to the development of this new sector as part of the recovery plan. The Walloon Government has agreed on an initial selection of projects at the end of January 2021. Most of the analyzed Belgian documents name the industry and mobility sectors as key sectors for the future use of hydrogen, some documents lay a focus especially on heavy transport. A list of the documents with the target region in Belgium is shown in Annex 3.

Noted Advantages of Hydrogen

Eight of the analyzed documents name several advantages hydrogen is expected to bring for the future. The named advantages can be clustered in three subjects: sustainability, economy and energy transition. In the graphic below the named advantages of hydrogen are summarized. For the subject of sustainability, the main focus of the documents lays on the reduction of CO₂-emissions. Hydrogen is referred to as a sustainable innovation, which can bring decarbonization for industry, energy and mobility sector.

Regarding the Economy in general, hydrogen is expected to strengthen local added value by increasing economic efficiency. Some documents additionally mention a positive job effect and the securing of the industry, especially in the energy intensive industry.

Furthermore, all regions think of hydrogen as a booster for the energy transition, as it can be used as an energy source and molecular energy carrier, which will be needed during the energy transition. It is emphasized in the analyzed documents that hydrogen can be of help to increase the energy storage capacity and improve the management of seasonal peaks in the energy demand. In Annex 4 a list of all mentioned advantages is shown.



Requirements and Claims

In seven of the documents included in this analysis, requirements and claims for the further progression of the hydrogen developments were mentioned. Topics which are addressed most often are the need for funding, improved infrastructure and regulatory frameworks. It is noticeable, that only the German Documents and the concluding document of the Hydrogen Mobility Europe Initiative formulate claims and requirements. A list of all noted requirements and claims can be found down below.

1. Funding

In order to proceed in the development of hydrogen related activities, six of the analyzed documents noted the need for funding and support programs. Five of those are German documents, one of the Hydrogen Mobility Europe Initiative. While in four of the documents only generally the need for financial support is included, two others ask for concrete support options: In the Hydrogen Strategy for the state of North Rhine Westphalia, the continuing and further development of the federal Hydrogen innovation program is claimed. The NRW coalition agreement pledges its support to adjust state-aid laws for investments in hydrogen technology and announces a forthcoming funding scheme to support the hydrogen activities of SMEs. The Viessmann Climate Solutions SE asks for a constant funding program for energy efficient buildings, which also includes hydrogen-capable heating systems. As most of the needs are not specified, it might be necessary to determine the exact needs, which exist in the EMR Region and whether there are better funding options in Belgium and the Netherlands.

2. Regulatory Framework

In five of the analyzed German documents the need for an improved regulatory framework or political standards is mentioned. The German Associations of the Heat Market claim the importance of an expanded definition of gas in the German Energy Act (EnWG). Viessmann Climate Solutions SE at the same time asks for a specified integration of hydrogen in the German Building Energy Act (GEG). In combination with certificates as guarantees of origin for hydrogen and the exclusion from CO₂-pricing, they expect a faster development of the hydrogen market. The initiative H2R Rhineland and the Hydrogen Mobility Europe Initiative describe the general need for an adaption of the regulatory framework, without giving more detailed claims. The state of North Rhine Westphalia sees the need for European standards. The discussion paper of the Chamber of Commerce and Industry approves the idea of a political

debate on Carbon Capture Utilization and Storage as well as the simplification of permissions in the context of hydrogen. It also calls for a clear definition of green hydrogen and a framework that fosters and enables the ramp-up of a hydrogen economy.

3. Infrastructure

Additional claims were made regarding the infrastructure, which is needed to produce, distribute and store hydrogen. Five of the documents considered in this analysis included the need for an improvement regarding infrastructure. The state of North Rhine Westphalia asks the German government and the European Union for a fast development and cost-effective establishment of hydrogen storages and the consideration of infrastructure across all energy systems. At the same time, the initiative H2R Rhineland and the District of Düren see the necessity to implement a bigger pipeline network in order to connect hydrogen facilities. The District of Düren especially mentions the connection with other cities, not only in Germany but also in neighboring countries. The CCI describes the importance of a rapid regulation of hydrogen networks. The Hydrogen Mobility Europe Initiative focuses on the development of the infrastructure in mobility. They suggest to increase the coverage with local refueling stations as well as the increase of their performance and capacity. In addition, the overall availability of vehicles fueled by hydrogen should be improved.

Provide funding	<ul style="list-style-type: none"> • Viessmann: support of hydrogen as energy carrier by subsidies, federal subsidies for efficient buildings must remain constant, subsidies for hydrogen-capable heating systems must be included • District of Düren: financial cooperation/ subsidies • CCI: Transparent support programs for hydrogen • Hydrogen mobility Europe: regulatory framework and fundings need to be adapted • NRW: Continue and further develop the Hydrogen and Fuel Cell Technology national innovation
Develop regulatory framework	<ul style="list-style-type: none"> • German associations of the heat market: Uniform regulatory framework through an expanded definition of gas in the Rhineland. Develop financing options and funding programs • EnWG • Viessmann: hydrogen must be specified in the Building Energy Act, Guarantees of origin, exclusion from CO₂ pricing • H2R: Adapt regulatory framework • NRW: develop european standards
Improve infrastructure	<ul style="list-style-type: none"> • NRW: quick and cost-effective establishment, development of hydrogen storage, consider energy efficiency of infrastructure across Europe: adaption of regulatory framework • H2R Initiative: pipeline network for distribution • CCI: Rapid regulation of hydrogen networks • Düren: hydrogen pipelines connecting Düren with other german and EU cities (e.g. Netherlands, region Rhein-Ruhr)
Reduce costs	<ul style="list-style-type: none"> • German Accosations of the heat market: use of blue hydrogen to reduce costs during the market of ramp up • Initiative H2R hydrogen Rhineland: reduce life cycle costs • Region of Düren: reduction of life cycle costs • Hydrogen mobility Europe Initiative: cost reduction for end users
Expand renewable energies	<ul style="list-style-type: none"> • Hydrogen Roadmap North Rhine-Westphalia: implementation of RED II • German Accosations of the heat market: Expansion of renewable energies • District of Düren: expansion of hydrogen networks ramp-up and climate neutrality
Support the Economy	<ul style="list-style-type: none"> • NRW: enable energy-intensive industry to be transformed, make hydrogen projects ready for investment • Düren: support + expert advices for players in hydrogen, support of economy and growth • CCI: implement suitable competitive conditions • Initiative H2R Hydrogen Rhineland: generate economies of scale, develop new business models
Provide supply & demand	<ul style="list-style-type: none"> • Hydrogen Mobility Europe: mapping of demands in detail to increase investment safety • NRW: design gas-based supply security • Viessmann: provide a mandatory quota for the integration of CO₂-free gaseous energy sources • German associations of the heat market: implementation of H2-Readiness as a standard
Strengthen cooperation	<ul style="list-style-type: none"> • NRW: international markets for hydrogen and power to liquids • Initiative H2R Hydrogen Rhineland: promote cooperation, multiply and communicate knowledge • CCI: expansion of international partnerships and development of international markets, strengthen information exchange
Establish a definition of green hydrogen	<ul style="list-style-type: none"> • German associations of the heat market: establish cross-sectoral definition of renewable energy • CCI: binding definitin of green hydrogen
Ensure technology-neutrality	<ul style="list-style-type: none"> • Hydrogen Roadmap North Rhine-Westphalia: guarantee technology-neutral approach by German Government and EU commission • CCI: ensure openness in technology

Timing for projects and milestones

In the analyzed documents a total of 143 goals with a specific timing for the start or the end of the project have been formulated. While some milestones have already been reached, others are planned up to the year 2050. For the analysis in hand the goals were clustered to various subject. The topics with the highest numbers of goals are the mobility sector with 51 goals, the hydrogen infrastructure and production with 39 goals and the industry sector with 22 goals.

4. Employment

For the future employment in relation to the hydrogen development, only the “Wasserstoffoffensive Kreis Düren” (hydrogen offensive of the District of Düren) notes concrete goals for the target region of the district Düren in North Rhine Westphalia, Germany. The strategy paper aims for 800 new jobs in 2030 and 1200 new jobs in 2050.

5. Households

Concerning Households, again only the District of Düren formulates a total of six goals, which should either be started or finished between the year 2021 and 2027. The goals mainly address the preparation for a hydrogen district and the supply of a public building with hydrogen.

6. Industry

The industry sector is with overall 22 goals in all project regions one of the top three topics, which is specified by milestones and goals. The timing of the goal attainment is planned between 2022 and 2030. The milestones mainly attend to demonstrations and pilot projects, which should be performed in various branches. The most specific goal is set by the TWEED Cluster, which wants to supply 50 % of the industry in Wallonia, Belgium with hydrogen by 2025.

7. Knowledge

Goals for the development of knowledge in the field of hydrogen were formulated for the target regions Rhineland, the District of Düren and Dutch Limburg. In total there are seven milestones, which mark the beginning or the end of a project between the years 2020 and 2025. While the District of Düren is mainly concentrating on the quick establishment of informational workshops and institutions to educate the public, the “Hydrogen Roadmap Limburg” with the target region Dutch Limburg, aims to gather knowledge about the industries necessity for the use of hydrogen.

8. Mobility

For the subject of mobility, a total of 51 goals were put on record in all of the three project regions. With the milestone which should be reached between 2024 and 2050, the goals of this category are planned on longer term than the goals of all other categories, which aim to be completed by 2045 latest. In this category, the goals were largely very concrete, as they give for example specific numbers of vehicles, which should be fueled on hydrogen by 2050. The Roadmap for Wallonia aims for a total of 35 % of cars, 40 % of busses and 50 % of trucks in Wallonia to be fueled by hydrogen until 2050. In comparison, in the Flemish Hydrogen Strategy a total number of vehicles is defined to be fulfilled by 2030: 15000 passenger cars, 200 waste collection vehicles and many more. The Hydrogen Roadmap for North Rhine Westphalia too gives total numbers: more than 400 trucks and 500 busses by 2025. Again, the District of Düren is trying to reach their goals on short term: for example, they plan to introduce the first hydrogen train for the Rurtalbahn network by 2024.

9. Infrastructure

For the topic area of Infrastructure summarizes those goals, which are about the production and distribution of hydrogen. In the region, 39 goals and projects were developed. The projects have their milestones, which means the beginning or the end, between the year 2020 and 2045. The most ambitious goals were set by TWEED for the region Wallonia: they plan to be able to supply 100 % of the industry in the region of Wallonia with hydrogen by 2025. In the same year, North Rhine Westphalia wants to connect the first supra-regional hydrogen pipelines and operate a 100 megawatt electrolysis plant, to supply the industry with hydrogen. At the same time, the Belgium Hydrogen strategy plans for 150 megawatt production until 2026. In the Hydrogen Roadmap of Limburg, the implementation of one or two research projects is planned for 2025. A planned length of hydrogen pipelines is planned in the Roadmap of North Rhine Westphalia: 1300 km by 2030, of which 240 km should be located in North Rhine Westphalia itself.

10. Regulations

In the Belgian Hydrogen Strategy, three milestones for the development of regulations were set. The first one which should have been reached in 2021 was the Implementation of a framework ensuring an optimal planning of energy transport networks. In 2023 the Belgium government plans an Adaptation of the legal and regulatory framework for hydrogen transport activity by

pipes. Additionally, they plan to participate in the development of a European voluntary certification scheme by 2025.

In none of the other documents, which were part of this analysis, goals were set for the development of regulations concerning hydrogen.

11. Research

For Research there were three goals set. For Belgium, the Belgian hydrogen strategy plans the support of research projects in the context of the Energy Transition Fund and Call for Innovation in Hydrogen, which were introduced by the federal state. The goal is set for 2021. For the region of Wallonia, there were formulated two additional milestones: The first one plans the methanation combined with biogas for 2025, the second a pilot project for synthetic fuel in 2035. There were no concrete goals about research in the Netherlands or Germany.

12. Built Environment

While the Belgian regions focus on Research and Regulations, the Flemish Hydrogen Strategy states 7 goals for the built environment, which should be reached between 2025 and 2030. For 2025, a roadmap for potential hydrogen applications is planned. In 2030 there should be an upscaling of hydrogen applications, accompanied by the providing of heating units, which are compatible with a 50 % hydrogen blend. Additionally, there are plans to implement more than 5000 micro-power-heat-couplings by 2030, which are fueled by hydrogen.

Cross border activities

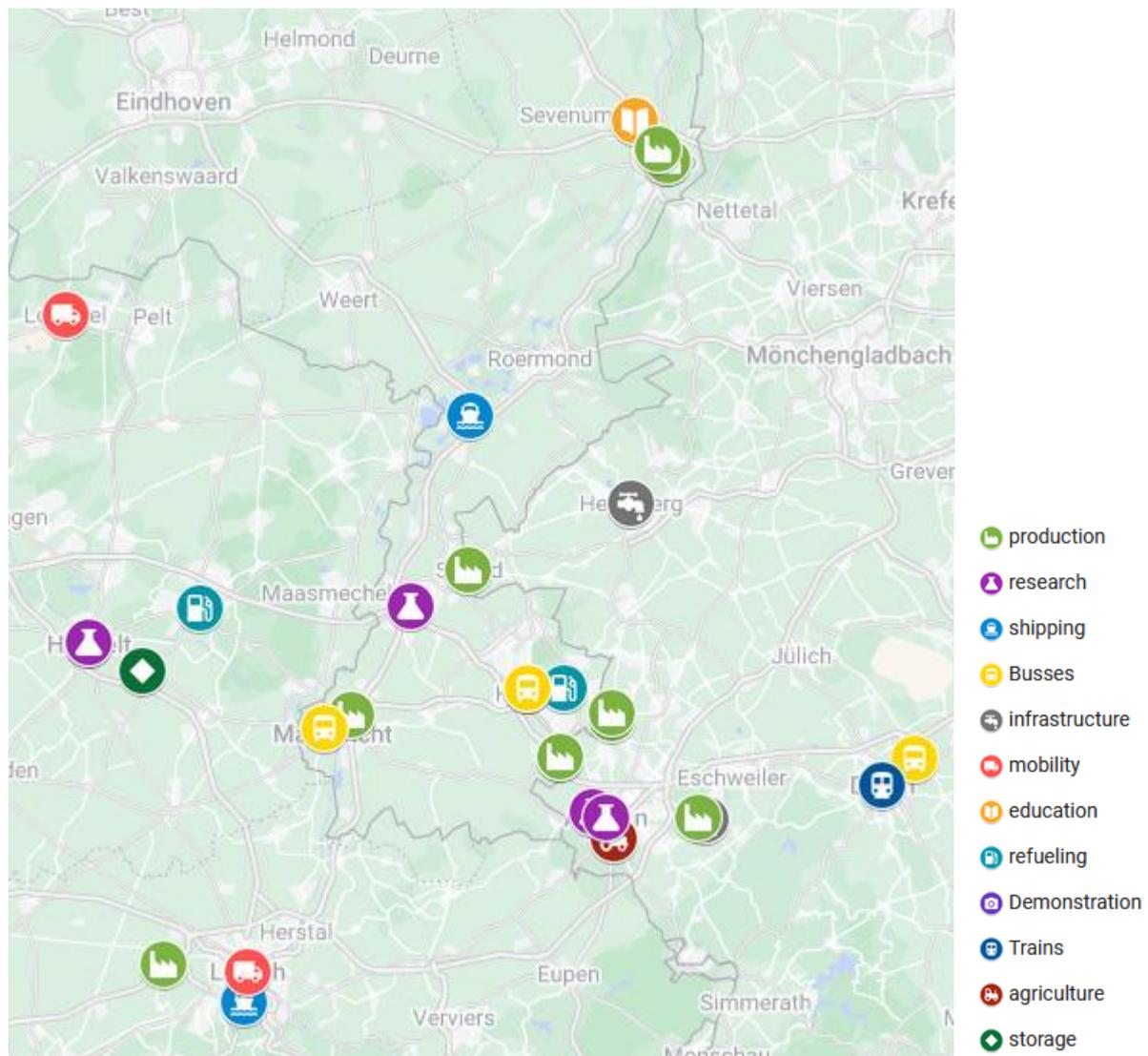
The Project EMR H2 Booster aims to strengthen the cross-border activities in the field of hydrogen. Conclusively, this analysis also takes a closer look at the cross-border projects and visions, which are planned or wished in the analyzed documents. In total, six of the analyzed documents explicitly mention the importance of future cross-border activities and/ or note their intention to increase the cross-border cooperation in the future.

The Hydrogen Roadmap for the region of Limburg was deliberately formulated in line with the goals which were set by neighboring regions at national and provincial level, to ensure the possibility of future cooperation. Especially the infrastructural developments, like the positioning of fueling stations, is planned to be decided in cooperation Flanders and North Rhine Westphalia. The National hydrogen strategy for Germany emphasizes the importance of an intensive international cooperation and strong partnerships in the field of hydrogen. The NRW Roadmap, the discussion-paper of the chambers of commerce and industry as well as the NR coalition-agreement all outline the necessity of international and regional co-operations and partnerships to ramp-up a hydrogen economy. At the same time, the Flemish hydrogen strategy claims the objective to import hydrogen from the neighboring regions, which brings the need for cooperation. The Belgian hydrogen strategy, too, formulates the need of international partners for the import of renewable energies in the molecular form of hydrogen from other European countries. The refueling study, which was performed by POM Limburg, is planned to be expanded to the whole Euregio Rhein Maas region in the future. In the District of Düren the need for a pipeline network, which not only connects German, but also European cities, is noted as an essential need for future developments in hydrogen. This emphasizes the importance of cooperation, especially in the topic of infrastructure.

The documents make the need for cross border cooperation very clear. This shows the importance of the EMR H2 Booster and the validity of the euregional project focus, which is very important for the future development of the hydrogen infrastructure in the future. Nonetheless, no concrete goals with compulsory deadlines were mentioned in any of the documents. This shows the need for further analysis of what the status quo in the partner countries is and where the future needs may lay. The development of tangible milestones for the further cooperation is strongly recommended during the further project progression.

Active projects in the region

To get an overview over the current projects, which are implemented or planned for the Euregio Maas Rhein region, the project team created the map below. The known projects were clustered in twelve categories which are shown in different colors and symbols in the map. Most of the projects refer to the industry or mobility sector and by this fit the goals and ambitions which are written down by the regions in the analyzed projects. Only few projects reach to improve the hydrogen infrastructure, so it might be necessary to check the need of additional euregional projects to meet the formulated requirements. As all three countries are involved in research projects a collaboration across borders might bring additional ideas and innovations regarding hydrogen. In the further development of the EMR Hydrogen Booster those projects will be analyzed in more detail, to decide on a basis on which projects could concretely benefit from the Booster activities and the support of the project partners.



Conclusion

The analysis of documents related to hydrogen in the Euregio Maas Rhein Region shows a high variety of focus topics, target regions and actual goals. The main focus for all regions seems to be the industry and mobility sector, while the progress in the mobility sector seems to be overall more advanced than the developments in the industry sector. Furthermore, hydrogen is often seen as an important sustainable innovation in the energy sector.

The advantages noted in the analyzed documents can be clustered in three focus topics: Economy, Sustainability, Energy transition. For those three subjects, highly differentiated advantages are mentioned throughout the different documents.

Although some of the documents included in the analysis mention the need and the importance of a cross border cooperation, especially when it comes to the import of hydrogen and the planning and building of infrastructure, there seem to be no specific international cooperation in the Euregio Maas Rhein Region at the moment. This is although all regions declare interest in cooperating with each other. This emphasizes the importance of the activities in the project consortium, which aim to strengthen the hydrogen industry in the region.

It appears that mainly German documents include the formulation of specific claims, which mainly concentrate on the improvement of the regulatory framework, the increase of funding and the development of the hydrogen infrastructure.

Altogether, the industry seems to be as important as the mobility sector as an application field for hydrogen in the near future in the Euregio Rhein Maas Region. To boost the numerous, already existing activities in the region, it will be an important task for the project team to support the cooperation across city, state and country borders and to define clear objectives, which will add value to the current hydrogen developments. Through match making, the players of hydrogen should be connected to develop the hydrogen applications to a higher and by this future proof extend.

To deepen the knowledge about the hydrogen players of the Euregio Rhein Maas Region, there will be a second part of this analysis, which concentrates on the SMEs, research institutes and other stakeholders engaged in hydrogen in the region. This Part B of the Deliverable 1 will be completed in September this year.

1. Target Region: Germany

filename	institution	last	target	main subjects	main goals
Bedarfsanmeldung_Wasserstoff	FNB Gas	09/2020	Germany	A total of 488 hydrogen projects report a demand of nearly 600 TWh in the year 2050 > Required electrolysis capacity exceeds targets of the National Hydrogen Strategy almost 6 times > Distribution system operators indicate large demand for hydrogen	2050: expected demand:598 TWh expected supply: 56 GWeI
Wasserstoffoffensive Kreis Düren	Kreis Düren	10/2020	Region of Düren	> production > mobility > households > industry > entrainment of the region	concentration on very concrete short-term goals instead of an unspecific long-term plan 2050 targets: > about 1200 new jobs vision: Use hydrogen as early as possible wherever it can make a contribution to climate protection. Furthermore, the local added value should be strengthened, acceptance and security of supply should be
	BET/ CCI NRW	04/2020	North Rhine-Westphalia	requirements for market ramp up of hydrogen as an environmental friendly energy source	none
Hydrogen Roadmap North Rhine-Westphalia	Ministry of Economic Affairs, Innovation, Digitalization and Energy of the State of North Rhine-Westphalia	11/2020	North Rhine-Westphalia	> energy intensive industry > mobility (buses, trucks) > energy sector (gas turbines)	2030 targets: Industry : > Pilot plant for the complete substitution of natural gas by hydrogen for heat generation in glass production > Integrated use of synthetic fuels and CCU in the tile and brick industry in an industrial scale plant > Demonstration project for a hydrogen-fired rotary kiln in foundry technology > Development and evaluation of processes to integrate hydrogen in cement industry > Implementation of the projects from the „Aufbruch in die Zukunft“-initiative by Unternehmer nrw > Expansion of hydrogen-based steel production Mobility: > 11,000 fuel cell trucks over 20 tons > 200 filling stations for trucks and cars > 1,000 fuel cell waste bins > 3,800 fuel cell buses for public transport Energy & infrastructure - 1,200 kilometers of hydrogen pipelines in Germany; 240 kilometers of which are in North

The national hydrogen strategy	The Federal Government / Germany	06/2020	Germany	<ul style="list-style-type: none"> > intensify international cooperation and partnerships on hydrogen > make use of economy opportunities > using hydrogen as an option for decarbonization 	<ul style="list-style-type: none"> > Assuming global responsibility > Making hydrogen a competitive option > Developing a domestic market for hydrogen technology in Germany, paving the way for imports > Establishing hydrogen as an alternative for other energy sources > Making hydrogen a sustainable base material for the industrial sector > Enhancing transport and distribution infrastructure > Fostering science, mobilizing skilled labor > Shaping and accompanying transformation processes > Strengthening German industry and securing global market opportunities for German firms > Establishing international markets and cooperation for hydrogen > Regarding global cooperation as an opportunity > Building up and securing the quality assurance infrastructure for hydrogen production, transport, storage and use, and building trust
	Viessmann Climate Solutions SE	04/2022	Germany	<ul style="list-style-type: none"> > implementing H2 readiness as "no-regret"-option in the heat market > heat market as a driver for the H2 economy 	<p>Integration of the heat market in the German energy transition</p> <p>-> use of potentials in addition to the goals of the Hydrogen Roadmap of the German Federal Government</p> <p>none</p>
Positionspapier - Wasserstoff als tragende Säule der Wärmewende	Associations of the heat market	01/2022	heat market in North Rhine-Westphalia	<ul style="list-style-type: none"> > hydrogen for the heat market > reduction of CO2-emissions by transforming the heating systems for SMEs and private households > transition of the heat market as an instrument to reach German climate and 	
H2R Wasserstoff Rheinland - Feinkonzept zum Wettbewerb "Modellregion Wasserstoff-	Initiative H2R hydrogen Rhineland	08/2020	Rhineland	<ul style="list-style-type: none"> > reduction of CO2 in the mobility sector > Create incentives for market mobilization of hydrogen technology 	<p>primary goal: make a contribution to climate protection with hydrogen mobility</p> <p>> hydrogen production: Successively replace by-product hydrogen with hydrogen imports via pipelines</p> <p>hydrogen distribution:</p> <p>> increase the number of hubs and hydrogen filling stations to make the pipeline more accessible</p> <p>hydrogen usage:</p> <p>> implement hydrogen busses, cars, trucks and ships</p> <p>> 2025: exploit hydrogen potential of public transport</p>
	CDU, GRÜNE	06/2022	North-Rhine Westfalia	Political framework for hydrogen on state level in Germany	<ul style="list-style-type: none"> > climate neutral industry land > Equal opportunities in a country of education > Security in an open society > Social cohesion in times of change > Generational responsibility: finances and

2. Target Region: Netherlands

file	institution	last	target	main subjects	main goals
Flemish Hydrogen Vision	Dutch government	11/2020	Flanders	<ul style="list-style-type: none"> > innovation > economy > energy, climate, mobility 	<ul style="list-style-type: none"> > Flanders as European leader in hydrogen > rollout of hydrogen in Flanders > achieve necessary technological breakthroughs in the field of hydrogen technology > five strategic objectives: <ul style="list-style-type: none"> > Strengthening the Flemish research base in the field of hydrogen > Strengthening the Flemish industrial ecosystem > Stimulating the use of hydrogen (H2) and the application of H2 technologies > Internationalization with a focus on neighboring countries
	LIOF, Province Limburg	06/2022	Dutch Limburg	<ol style="list-style-type: none"> 1) Production of green hydrogen 2) Transport of hydrogen via a main pipeline network (backbone) 3) Regional hydrogen storage and conversion 4) Stimulating the use of hydrogen in industry and mobility (especially heavy and long-distance transport (trucks, refueling installations, inland shipping and public transport)) 5) For the transition period: use of blue hydrogen (most hydrogen from methane with CO2 capture (CCS)) <p>The hydrogen strategy of the Province of Limburg is in line with these goals.</p> <p>Three core clusters are of economic importance to Limburg. It has therefore been decided to focus the actions of the Hydrogen Roadmap Limburg 1.0 mainly on these economic core clusters: Chemistry/industry, Mobility (transport & logistics), Agro (horticulture, biomass, manure, etc.) and further supplemented with projects in the built environment.</p> <p>Concrete goals have been set for the six focus areas mentioned. These goals can give direction to the many initiatives and projects that are or will come in Limburg.</p>	<p>H2 knowledge infrastructure: In 2022, it will be assessed for all LEA/industrial companies whether hydrogen offers potential for sustainability (focus on stone, ceramics, glass and aluminum factories) By 2025, all municipalities in Limburg will have basic knowledge of the potential and limitations of hydrogen production and use, and knowledge will be exchanged and developed around hydrogen at Euregional and EU level.</p> <p>H2-production: Between 2023 and 2027, decentralized production and storage (see also H2 as energy storage/conversion) will be applied on a small scale at locations where there is a demand for hydrogen and hydrogen can contribute to regionally balancing the energy network (congestion) Until 2025, work will be carried out on 1 - 2 innovation and research projects for the three core clusters</p> <p>H2 -use industry (raw material or fuel): In 2022-2025 there will be 2-3 pilots at LEA companies for the use of hydrogen at high temperatures (glass, stone and ceramics, aluminum) (if the companies are interested)</p> <p>H2-fuel logistics/transport: Limburg is part of the leading group within the national hydrogen program and in 2025 will have 3 hydrogen filling stations with approximately 180 heavy vehicles that run on hydrogen. This will start with Venlo as an important junction on an important freight corridor. The other locations are at important logistics hubs and in coordination with Germany and Belgium. Up to approximately 6 filling stations</p>

3. Target Region: Belgium

file	institution	last	target	main subjects	main goals (qualitative + quantitative)
Flemish Hydrogen Strategy	Hydrogen Industry Cluster	12/2020	Flanders	The Hydrogen Industry Cluster (Waterstof Industrie Cluster or WIC), coordinated by WaterstofNet, worked on a Flemish hydrogen strategy for 2025 and 2030. This is a bottom-up vision based on the concrete ambitions of hydrogen companies. In the hydrogen strategy, objectives are formulated for all parts of the hydrogen chain, ranging from the production and import of hydrogen, to transport and distribution to concrete end applications. The WIC	
Roadmap H2 Tweed Overview	Tweed	06/2018	Liège	- Mobility - Industry	2050 Mobility > car 35% > bus 40% > trucks 50%? Storage NC (2025: balancing/strategic reserve) > H2 injection 100% > H2 for industry 100%
Roadmap H2 Tweed VF corrigée	Tweed	06/2018			
Study refueling station Limburg	POM Limburg			Locations for refueling stations are proposed, based on spread of logistical companies and	The goal is for private companies to pick up our suggestions and build refueling stations in the whole
	Belgian Government	10/2021	Belgium	> renewable hydrogen (production by electrolysis) > use of hydrogen for decarbonization > hydrogen in Industry, Transport, Buildings, Flexibility of electricity grid	Pillar 1 – Positioning as an import and transit hub in Europe for renewable molecules > By 2025: Development of a European voluntary certification scheme and a register for RFNBOs, supported in the context of the Energy Transition Fund > Since 2021: Looking for international partners for the import of renewable energy to Europe under the form of renewable molecules > In 2022: Support to the hydrogen import infrastructure via the Restart and Transition Pla Pillar 2 – Becoming a leader in hydrogen technologies > In 2021: Support to research and pilot projects on hydrogen technologies in the context of the two R&D funds that the Federal State has (Energy Transition Fund and Call for innovation in hydrogen supported by the European Funds on recovery and resilience) > By 2026: A limited electrolysis capacity of minimum 150 MW, supported by Belgium's national recovery and resilience plan, focused on technological innovation > In 2022: Financing of a hydrogen test infrastructure via the Restart and Transition Plan Pillar 3 – Establishing a robust hydrogen market > In 2021: Implementation of a framework ensuring an optimal planning of energy transport networks > By 2026: Commissioning of 100 to 160 km of the first open-access hydrogen transport pipelines to complete the existing network, co-funded by Belgium's national recovery and resilience plan. By 2030, Belgium has the ambition to connect the import hub to neighboring countries via the open-access hydrogen network in order to realize its international positioning as an import and transit hub for renewable energy in Europe > In 2022-2023: Adaptation of the legal and regulatory framework for hydrogen transport activity by pipes.

					<p>> Continuous interactions with the sector, research institutes and citizens to keep this hydrogen strategy up to date with the evolution of the issues and needs</p>
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4. List of advantages named in the analyzed documents

filename	institution	last	target	noted advantages of hydrogen
Flemish Hydrogen Strategy	Hydrogen Industry Cluster	12/2020	Flanders	<p>Economic opportunities for the region through the development of a domestic market for Flemish hydrogen companies.</p> <p>Carbon neutrality goals: The need for sustainable technologies to support the energy transition. And the need for molecular energy carriers: "Liquid and gaseous energy carriers will remain essential as fuel for applications where electricity (stored in batteries, for example) is either insufficient or impractical. Molecules are also still required by process manufacturing to synthesis chemical products and materials. Finally, liquid and gaseous energy carriers are essential for the large-scale energy storage and transport required to ensure that the supply and demand of energy remain balanced everywhere and at all times."</p>
	LIOF, Province Limburg	06/2022	Dutch Limburg	<p>At EU, national- and provincial level, but also in the neighboring regions (North Rhine-Westphalia and Flanders), hydrogen is seen as an important part of the energy transition, for which more or less concrete goals have been set. The hydrogen strategy of the Province of Limburg is in line with these goals. Limburg has a good starting position with regard to the intended H2 infrastructure, with the H2 backbone and the Delta corridor. Especially because the import of hydrogen is important</p>

Wasserstoffoffensive Kreis Düren	Kreis Düren	10/2020	Region of Düren	<ul style="list-style-type: none"> > important energy source for energy shift > eco-credentials by implementation as broad as possible > strengthening of local added value > guarantee economic efficiency > local value chain, bundled in one region
	Hydrogen Mobility Europe Initiative	2020	Europe	<ul style="list-style-type: none"> > environmental advantages > energy security > economic development > services for a greener grid > energy storage
	Ministry of Economic Affairs, Innovation, Digitalization and	11/2020	North Rhine-Westphalia	<ul style="list-style-type: none"> > reduction of CO2 emissions > maintain + expand sustainable jobs > creation of value in NRW
Roadmap H2 Tweed	Tweed	06/2018	Wallonia	<ul style="list-style-type: none"> Transformation of surplus electricity into H2 (short term reinjection >< long term storage) H2 can help decarbonization in <ul style="list-style-type: none"> > Transport(H2-> no CO2 emission, no noise) > Industry (H2 -> raw material converted of petrochemicals / fossil fuel substitution) > Residential heating (The H2 can either be mixed with natural gas (partial decarbonization), or, combined with CO2 from industry, transformed into natural gas (total decarbonization), or
Roadmap H2 Tweed VF corrigée				
Study refuelling station	POM Limburg			Currently only viable option for heavy and long-distance mobility (trucks, buses, specialty vehicles, trains, ships, aviation) due to heavy weight of batteries and shorter ranges.
The national hydrogen strategy	The Federal Government/ Germany	06/2020	Germany	<ul style="list-style-type: none"> key role in energy transition: > broadly applicable energy source > energy storage medium which allows supply-based and flexible storage > hydrogen plays a key role for sector coupling
	Viessmann Climate Solutions SE	04/2021	Germany	<ul style="list-style-type: none"> > better management of seasonal peaks in demand > increased storage capacity > cheap transition possible; brings high acceptance and future proofness > Hydrogen makes a defossilized and climate-neutral heating sector possible and affordable
	Associations of the heat market: BDEW, VKU, DVGW	01/2022	heat market in North Rhine-Westphalia	<ul style="list-style-type: none"> > low entry threshold in the heat market (Existing gas infrastructure and end applications can be used for a mixture with up to 20 % Hydrogen) > decarbonization of industrial and commercial ultimate consumers > lower costs through use of existing gas networks > Social compatibility and acceptance of the energy transition
	Initiative H2R hydrogen Rhineland	08/2020	Rhineland	<ul style="list-style-type: none"> > indispensable energy source > hydrogen as key to coupling the energy sectors of transport, power and heat supply as well as industry > counteraction to climate change > reduction of traffic emissions
Flemish Hydrogen Vision	Dutch government	11/2020	Flanders	<ul style="list-style-type: none"> sustainable innovation > part of industrial supply > part of energy supply > sustainable mobility

Belgian view and strategy	Belgian Government	10/2021	Belgium	> achieve european climate neutrality goals
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Wasserstoffoffensive Kreis Düren	Kreis Düren	2030	
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Knowledge

document	target region	year	goal
H2R Wasserstoff Rheinland - Feinkonzept zum Wettbewerb "Modellregion Wasserstoff-Mobilität NRW"	Rhineland	2020	finalization of the detailed concept
Wasserstoffoffensive Kreis Düren	Kreis Düren	2021	application-related workshops in the field of hydrogen and implementation of at least one workshop
	Kreis Düren	2021	establishment and integration of the H2 workshop
	Kreis Düren	2021	implementation of the hydrogen information center
	Dutch Limburg	2022	involvement of industrial companies whether hydrogen offers potential for sustainability (focus on stone, ceramics, glass and aluminum factories)
	Kreis Düren	2022	promotion of the hydrogen information center in national activities
	Dutch Limburg	2025	all municipalities in Limburg will have basic knowledge of the potential and limitations of hydrogen production and use, and knowledge will be exchanged and

Mobility

document	target region	year	goal
H2ME Emerging Conclusion 2020	Europe	2021	45 refueling stations
	Europe	2021	400 cars and vans
	Europe	2021	1000 ~ 50 organisations
	Rhineland	2021	52 hydrogen busses in the bus fleet
Wasserstoffoffensive Kreis Düren	Kreis Düren	2021	the first fuel cell buses in scheduled service of the Rurtalbus
	Kreis Düren	2021	support for nationwide hydrogen filling station infrastructure
	Kreis Düren	2022	evaluation of integration options for passenger cars and light commercial vehicles with fuel cell drives
	Kreis Düren	2023	Use of fuel cell waste collection vehicles
	Kreis Düren	2023	conversion of the first commercial vehicles to hydrogen drive
	Kreis Düren	2024	use of the first fuel cell trains in the Rurtalbahn network
	Flanders	2025	Hydrogen refueling stations
	Flanders	2025	1000 HGVs and vans
	Flanders	2025	multi-fuel hubs for ships
	Flanders	2025	1000 logistics equipment
	Flanders	2025	1000 passenger cars
	Flanders	2025	construction and agricultural vehicle demo project
	Flanders	2025	first train route study
	Flanders	2025	H2 (or derived) inland vessels
	Flanders	2025	waste collection vehicles
	Flanders	2025	1000 busses (3 HRS)
	Rhineland	2025	market ramp-up for private cars due to cost reductions and better access to filling stations
H2R Wasserstoff Rheinland - Feinkonzept zum Wettbewerb "Modellregion Wasserstoff-Mobilität"	Rhineland	2025	new purchase of passenger trains
Hydrogen Roadmap Limburg 1.0	Dutch Limburg	2025	hydrogen filling stations
	Dutch Limburg	2025	heavy vehicles running on hydrogen
	North Rhine-Westphalia	2025	More than 400 fuel cell trucks

Hydrogen Roadmap North Rhine-Westphalia	North Rhine-Westphalia	2025	least 20 truck filling stations
	North Rhine-Westphalia	2025	0 car filling stations
	North Rhine-Westphalia	2025	hydrogen buses for public transport
	North Rhine-Westphalia	2025	the first hydrogen-powered barges
	Wallonia	2025	100 trucks
	Flanders	2030	10 Hydrogen Refuelling stations
	Flanders	2030	500 HGVs and vans
	Flanders	2030	multi-fuel hubs for ships
	Flanders	2030	100 logistics equipment
	Flanders	2030	10,000 passenger cars
	Flanders	2030	construction and agricultural vehicles
	Flanders	2030	train route operational (1 HRS)
	Flanders	2030	H2-powered inland vessels
	Flanders	2030	10 waste collection vehicles
	Flanders	2030	50 busses (10 HRS)
	Dutch Limburg	2030	up to 6 filling stations
	North Rhine-Westphalia	2030	100 fuel cell trucks over 20 tonnes
	North Rhine-Westphalia	2030	filling stations for trucks and cars
	North Rhine-Westphalia	2030	100 fuel cell waste bins
	North Rhine-Westphalia	2030	10 fuel cell buses for public transport
	Wallonia	2030	50% of the cars fueled by hydrogen
	Wallonia	2030	50% of the busses fueled by hydrogen
	Wallonia	2030	50% of the trucks fueled by hydrogen
	Wallonia	2050	50% of the cars in Wallonia fueled by hydrogen
	Wallonia	2050	50% of the busses in Wallonia fueled by hydrogen
	Wallonia	2050	50% of the trucks in Wallonia fueled by hydrogen

Infrastructure

document	target region	year	goal
H2R Wasserstoff Rheinland - Feinkonzept zum Wettbewerb "Modellregion Wasserstoff-Mobilität NRW"	Rhineland	2020	production of green hydrogen in Wesseling
Belgian view and strategy hydrogen	Belgium	2021	work with international partners for the import of renewable energy to Europe under the form of renewable molecules
	Germany	2021	equipment of the latest generation can safely process 20 % hydrogen admixture
	Belgium	2022	completion of the hydrogen import infrastructure via the Restart and Transition Plan
	Belgium	2022	completion of a hydrogen test infrastructure via the Restart and Transition Plan
	Kreis Düren	2022	enable gaseous trailer delivery as a distribution option
	Kreis Düren	2022	completion of the first hydrogen pipeline (conversion or new construction)
	Kreis Düren	2022	replacement and new construction only with H2-ready gas technology
	Rhineland	2023	pilot plant for biomass gasification for the production of green hydrogen
H2R Wasserstoff Rheinland - Feinkonzept zum Wettbewerb "Modellregion Wasserstoff-Mobilität"	Rhineland	2023	Start: Commercial hydrogen production from different types of biomasses
Hydrogen Roadmap Limburg 1.0	Dutch Limburg	2023	Start: decentralized production and storage (see also H2 as energy storage/conversion) will be applied on a small scale at locations where there is a demand for

Roadmap H2 Tweed Overview	Wallonia	2023	Industrial production of H2
	Kreis Düren	2023	Start-up of 8,5 MW electrolysis
	Kreis Düren	2023	Workshops with operators of post-EEG wind turbines
	Kreis Düren	2023	Market-based development of post-EEG wind turbines for H2 production
	Kreis Düren	2024	Ensuring non-discriminatory market access
	Rhineland	2025	Start: building and use of a pipeline for the transport of bigger amounts of hydrogen
Hydrogen Roadmap Limburg 1.0	Dutch Limburg	2025	to be carried out on 1 - 2 innovation and research projects for the three core clusters
	North Rhine-Westphalia	2025	120 kilometers of hydrogen pipeline in Germany, 120 kilometers of which are in North Rhine-Westphalia
	North Rhine-Westphalia	2025	North Rhine-Westphalia connected to the first supra-regional hydrogen lines
	North Rhine-Westphalia	2025	more than 100 megawatt electrolysis plants for industrial hydrogen production
	North Rhine-Westphalia	2025	gas-based electricity and heat generators increasingly developing towards hydrogen compatibility
	North Rhine-Westphalia	2025	Acceleration of the hydrogen projects in the Rhinish mining district
	Wallonia	2025	100 % H2 injection
	Wallonia	2025	100 % H2 for Industry
	Wallonia	2025	100 % H2 injection 2% (wind)
	Germany	2025	to retrofit solutions allow the new gas appliances to be converted from 20 % to 100 % hydrogen
	Kreis Düren	2025	Full utilization of the electrolysis system in the Brainergy Park
	Kreis Düren	2025	Optimal incorporation of liquid organic hydrogen carriers (LOHC)
	Belgium	2026	Production capacity of minimum 150 MW, supported by Belgium's national recovery and resilience plan, focused on technological innovation
	Belgium	2026	Commissioning of 100 to 160 km of the first open-access hydrogen transport pipelines to complete the existing network, co-funded by Belgium's national recovery and resilience plan. By 2030, Belgium has the ambition to connect the import hub to neighboring countries via the open-access hydrogen
	Kreis Düren	2026	Projects in the field of power generation using gas turbines with hydrogen
	North Rhine-Westphalia	2030	Investments in electricity and heat generation plants based on hydrogen
	North Rhine-Westphalia	2030	1 gigawatts of electrolysis capacity in North Rhine-Westphalia
	North Rhine-Westphalia	2030	240 kilometers of hydrogen pipelines in Germany, 240 kilometers of which are in North Rhine-Westphalia
	Germany	2030	40 % of gas appliances on the market are 20 % H ₂ -ready
	Wallonia	2035	Neighborhood 10% H ₂ + cogeneration
	Germany	2040	Gas-based equipment can be converted to 100% hydrogen
	Germany	2045	Within the typical renewal cycles, the majority of the gas heating stock can be converted to 100% hydrogen. The remaining gas boilers will run on renewable

Regulations

document	target region	year	goal
Belgian view and strategy hydrogen	Belgium	2021	
Belgian view and strategy hydrogen	Belgium	2023	Adaptation of the legal and regulatory framework for hydrogen transport activity by pipes. This will start with a public consultation of the market players which will
	Belgium	2025	

Research

document	target region	year	goal
Belgian view and strategy hydrogen	Belgium	2021	Support to research and pilot projects on hydrogen technologies in the context of the two R&D funds that the Federal State has (Energy Transition Fund and Call

Roadmap H2 Tweed Overview	Wallonia	25 Me	
	Wallonia	2035	

The built environment

document	target region	year	goal
Flemish Hydrogen Strategy	Flanders	Hydroge	
	Flanders	Roadma	
	Flanders	5 Plan	
	Flanders	new he	
	Flanders	scaling	
	Flanders	0 Plan	
	Flanders	2030	

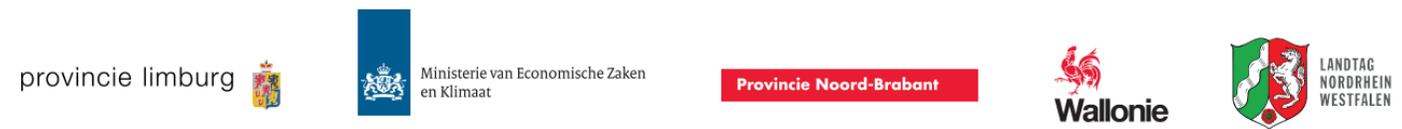
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