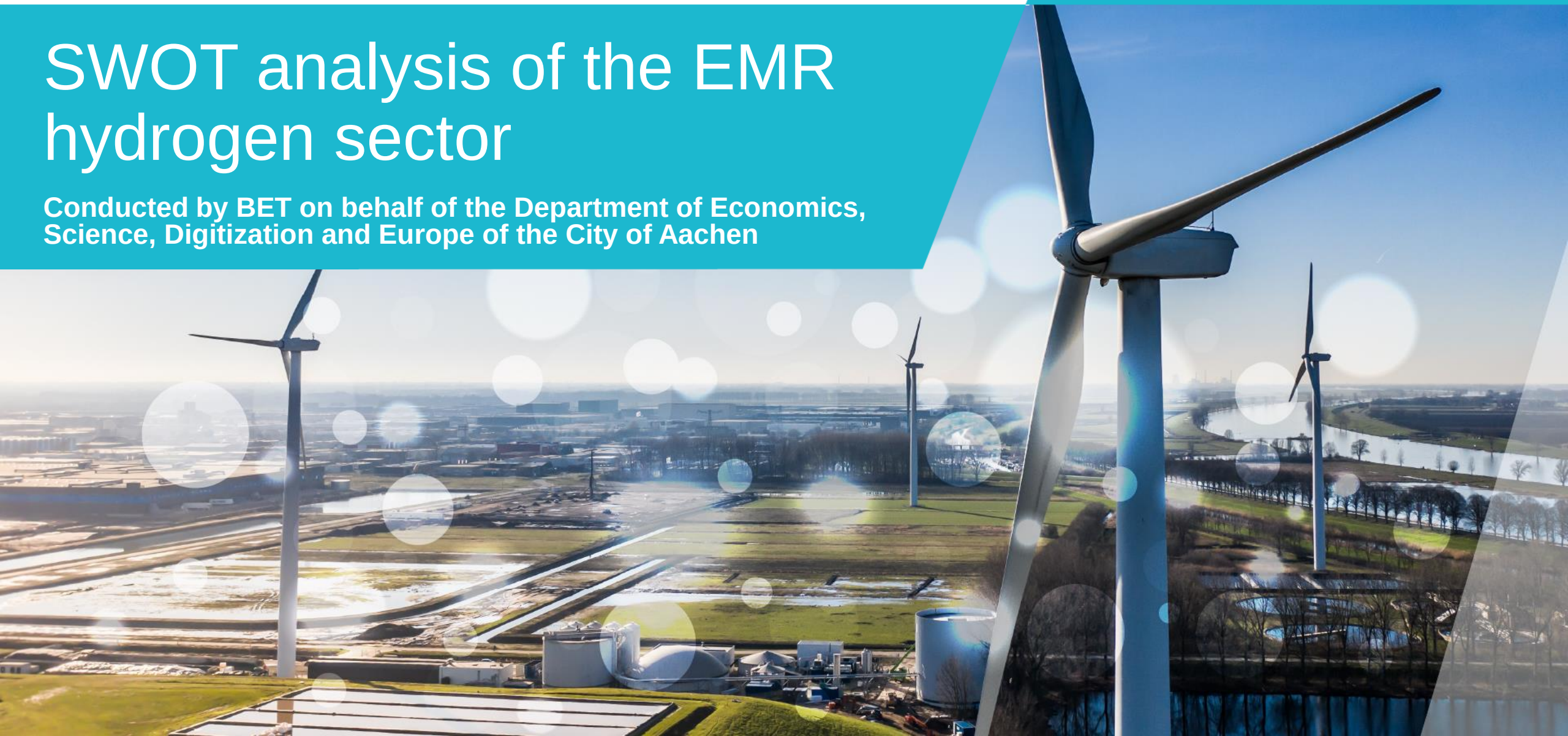
Interreg Euregio Meuse-Rhine
EMR BOOSTER H2
EUROPEAN UNION European Regional Development Fund

B E T

SWOT analysis of the EMR hydrogen sector

Conducted by BET on behalf of the Department of Economics, Science, Digitization and Europe of the City of Aachen



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A SWOT analysis for companies in the Euregio Meuse-Rhine Region on the subject of hydrogen has been conducted

Introduction

- Within the scope of the Interreg project "EMR H2 Booster", a consortium of nine euregional partners has joined forces to drive innovative development in the field of green hydrogen in the Euregio Meuse-Rhine.
- The area of operation of the "EMR H2 Booster" (Euregio Maas-Rhein H2-Booster) consortium consists of the Dutch and Flemish Limburg, the Aachen region and Liège.
- The working area of the "EMR H2 Booster" (Euregio Maas-Rhein H2-Booster) consortium consists of the Dutch and Flemish Limburg, the Aachen region, Liège and the German-speaking community of Belgium.
- In the course of this ongoing project, a study is to be carried out to record the strengths, weaknesses, opportunities and threats of the economy in the Euregio Meuse-Rhine region with regard to hydrogen.
- For this purpose, this study analyzes the documents already published in the course of the EMR H2 Booster. In addition, relevant studies by third parties that have focused on the affected region will also be considered. Furthermore, any stakeholders in the region along the value chain will be analyzed and classified along the SWOT matrix.

Regions involved in the project [1]

[1]: Illustration is taken from the document "Hydrogen Roadmap for the Euregion Meuse-Rhine".

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Within the framework of this project, 10 studies or reports were examined in detail

Overview of the analyzed studies

[1]: Zukunftsagentur Rheinisches Revier (2020)

An Energy System of the Future for the “Rheinisches Revier”

[3]: Stadt Aachen (2022)

Hydrogen guideline for the city of Aachen

[5]: Interreg Euregio Meuse-Rhine Booster H2 (2023)

Current state of the H_2 economy in the Euregio Meuse-Rhine (EMR)

[7]: Interreg Euregio Meuse-Rhine Booster H2 (2022)

Deliverable 1B: Mapping of industrial players in the field of green hydrogen

[9]: Hydrogen industrie cluster (2020)

A 2025-2030 Flemish Hydrogen Strategy

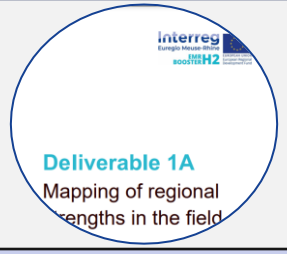
[2]: IHK NRW (2021)

Impulse paper on hydrogen opportunities for the economy in NRW

[4]: Zukunftsagentur Rheinisches Revier (2022)

Hydrogen value chain in the “Rheinisches Revier”

[6]: Interreg Euregio Meuse-Rhine Booster H2 (2022)

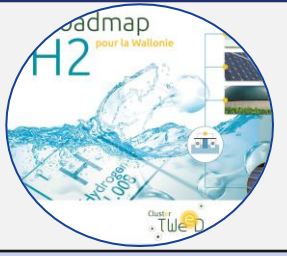


Deliverable 1A: Mapping of regional strengths in the field of green hydrogen

[8]: LIOF, Province Limburg (2022)

Hydrogen roadmap Limburg 1.0

[10]: Cluster Tweed (2018)



Hydrogen Roadmap for the Wallonia region

The profiles of the studies examined are intended to provide an insight into the major fields of research and the key findings gained

Profile: study 1

In 2020, BET and the Bergische Universität Wuppertal were commissioned by the Zukunftsagentur Rheinisches Revier to conduct a study entitled "An energy system of the future for the Rhenish coalfield".

Major fields of research:

- The Rheinische Revier region will be particularly affected by the coal phase-out. Therefore, the change of the energy system there will be investigated.
- Possible negative consequences or opportunities of change are analyzed and possible options for action are explored.

Key findings:

- The expansion of renewable electricity generation as well as the conversion and storage of energy in the RR will play an important role in the future.
- However, RES-E generation will only be able to substitute a part of the lignite electricity, so that an import demand will remain in the future.
- Imports of hydrogen and synthetic energy sources will be necess-ary, but on a smaller scale than oil and gas are currently imported.

Profile: study 2

In 2021, the Chamber of Industry and Commerce (IHK) in North Rhine-Westphalia commissioned BET to write the impulse paper "Hydrogen - Opportunities for the Economy in NRW". Within this publication potentials and challenges for the utilization of hydrogen are evaluated.

Major fields of research:

- Potential fields of application for hydrogen in NRW
- Required actions to support the future availability of hydrogen for north rhine-westphalian industry and commerce

Key findings:

- If produced from non-fossil resources, hydrogen has the potential to speed up decarbonization
- Therefor a massive expansion of renewable energy production is required
- Local actors currently have an advantage in know-how compared to global competitors which should be preserved and extended by creating a strong domestic market
- The further ramp-up of a north rhine-westphalian hydrogen economy requires supportive actions in the fields of regulation and policy

The profiles of the studies examined are intended to provide an insight into the major fields of research and the key findings gained

Profile: study 3

The Department VI - Housing, Social Affairs and Economy of the City of Aachen has entrusted BET with the compilation of the “Hydrogen Guideline for the City of Aachen” in 2022.

Major fields of research:

- Hydrogen is an important building block for achieving the climate neutrality targeted in Aachen by 2030. The extent to which hydrogen could be used in Aachen in the various application sectors is analyzed, to achieve the climate neutrality targeted in Aachen by 2030

Key findings:

- In the development of a hydrogen economy, Aachen can also draw on a strong landscape of actors in the fields of science and industry.
- Aachen needs at least 777 gigawatt hours of hydrogen per year to become climate-neutral.
- A key risk for the development of a hydrogen economy in the city of Aachen is whether the required green hydrogen can be procured and made available in time, given the city's ambitious goals.

Profile: study 4

In 2022, the Zukunftsagentur Rheinisches Revier commissioned umlaut with the written version of the short study “Hydrogen Value Chain in the Rheinisches Revier”. The study aims to derive recommend actions for the local administration based on analysis of status quo & future potentials.

Major fields of research:

- Status quo analysis of technologies and local players in the field of technology development and production along the H2 value chain
- H2 demand forecast and exploration of local potentials
- Portrayal of current funding opportunities and governance in the field of H2 research and pilot application projects

Key findings:

- Access to global markets is crucial for the success of local H2 technology producers
- The main potentials of the Rheinisches Revier lay in the fields of R&D, component production and energy sector know-how
- To support the growth the H2 sector, the creation of local networks and simplified access to funding opportunities is required

The profiles of the studies examined are intended to provide an insight into the major fields of research and the key findings gained

Profile: study 5

In the course of the EMR Booster H2, the hydrogen roadmap "Current state of the hydrogen economy in the Euregio Meuse-Rhine (EMR)" was prepared in the period October 2022 to May 2023.

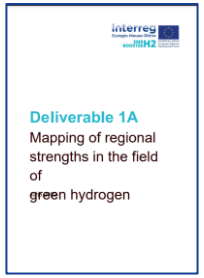
Major fields of research:

- The aim of the study was to present the ramp-up of the hydrogen economy in the Euregio Meuse-Rhine (EMR).
- Among other things, the focus is on the political environment and cross-border cooperation in the region and the mobility sector.

Key findings:

- One of the biggest key aspects of the study is that EMR will have to rely on hydrogen imports via pipelines in the future, as local production capacity is very limited.
- Hydrogen infrastructure along highways and waterways are important to build along EMR strengths that exist today.
- In the future, cross-border cooperation between SMEs and R&D centers will be of enormous importance. Only through this and increased political support can the H2 ramp-up succeed.

Profile: study 6



In the course of the EMR Booster H2, the report: "Deliverable: 1A Mapping of regional strengths in the field of green hydrogen" was prepared in June 2022.

Major fields of research:

- The main focus of this report is to collect and bundle all documents that have dealt with green hydrogen in the region in the recent past.
- This is an important step, especially to better coordinate the initiatives of the three countries concerned and to promote cross-border cooperation.

Key findings:

- In all the Euregio regions studied, the focus is on the industrial and mobility sectors, although developments in the mobility sector are often even more advanced.
- At the current time, there does not appear to be any hydrogen-related, international cooperation in the Euro Meuse Region. However, all regions and many stakeholders have expressed interest in such cooperation.

The profiles of the studies examined are intended to provide an insight into the major fields of research and the key findings gained

Profile: study 7

In the course of the EMR Booster H2, the report: "Deliverable: 1B Mapping of industrial players in the field of green hydrogen" was prepared in September 2022.

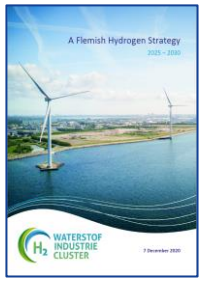
Major fields of research:

- The primary objective of this document is to gather all relevant institutions and their hydrogen competences related to the industrial sector in the region.

Key findings:

- Overall, there is a wide variability of active or at least interested actors and stakeholders from the field of industry around the topic of hydrogen.
- At this point in time, the discussion seems to be focused in the urban areas of the Euregio Rhine-Meuse Region. Possibly there are other actors and stakeholders for the ramp-up of hydrogen that are localized in rural areas and do not yet have knowledge of the potentials they could realize through hydrogen.
- Corresponding educational work still needs to be done here.

Profile: study 8



With the Flemish Hydrogen Strategy 2025-2030 in 2020, the hydrogen industrie cluster has implemented an ambitious but realistic plan for establishing Flanders as a global hydrogen player.

Major fields of research:

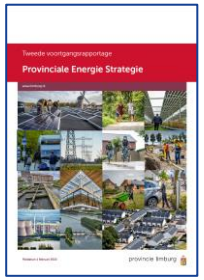
- The paper offers a more concrete interpretation of the ramp-up of the hydrogen economy in Flanders response to the Flemish Government's notice of 13 November 2020, the 'Vlaamse Waterstofvisie'.

Key findings:

- Hydrogen technology is very high on the international political agenda at the moment and the hydrogen industry is very well represented in Flanders.
- Industrial companies located in Flanders already consume gray hydrogen. Replacing this with green hydrogen is one of the most effective and simple measures and provides for a direct H2 base demand.
- The RE capacities in Flanders are limited, therefore hydrogen will have to be imported in the future.

The profiles of the studies examined are intended to provide an insight into the major fields of research and the key findings gained

Profile: study 9



In the course of the second progress report of the provincial energy strategy, which was published on February 1, 2022, a number of hydrogen-related issues are also being addressed.

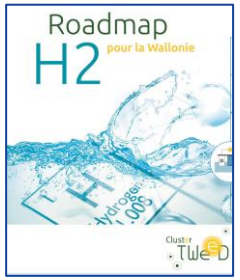
Major fields of research:

- Within the study, hydrogen requests are being collected. Among other things, 3 hydrogen filling stations are to be built in Limburg in the short term.
- In addition, points are addressed to the Limburg Hydrogen Coalition that are intended to accelerate the ramp-up of hydrogen.

Key findings:

- In principle, the Limburg region sees the future in green hydrogen. However, blue hydrogen is also under discussion for the preliminary ramp-up.
- For the future supply of the region with sufficient hydrogen, the connection to the H_2 backbone and the availability of storage facilities in relevant sizes are targeted.
- The use of hydrogen is envisaged not only in the industrial sector but also in the transport sector.

Profile: study 10



The Tweed cluster operates in the renewable energy sector in the Wallonia region of Belgium. In 2018, the Hydrogen Roadmap for Wallonia was created to describe the role of hydrogen in the region.

Major fields of research:

- Within the framework of the study, the strategic vision of hydrogen ramp-up in Wallonia should be realized. In particular, the possible future role of hydrogen for the achievement in Wallonia should be elaborated.

Key findings:

- Air Liquide already has a hydrogen pipeline network of more than 50 km, with 613 km located in Belgium.
- The amount of renewable electricity needed to produce green hydrogen for the potential application-sectors (mobility, industry) is significant. There could be a certain dependence on imports.
- At the time the study was compiled, many business cases relating to hydrogen were not economically viable without subsidies. However, this could change due to expected cost degressions and rising CO2 prices.

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In this section, the Euregio Meuse-Rhine will be subjected to a SWOT analysis with regard to the topic of hydrogen

Methodology used regarding the SWOT analysis

Fundamental approach

A SWOT analysis is a tool for status quo examination and strategy development. In order to determine EMR's current conditions for the nascent hydrogen economy and to derive recommendations, the next slides identify EMR's strengths, weaknesses, opportunities and threats. In the process, a matrix structure will be established and subsequently filled. In doing so, various perspectives will be taken.

The perspectives are the following:

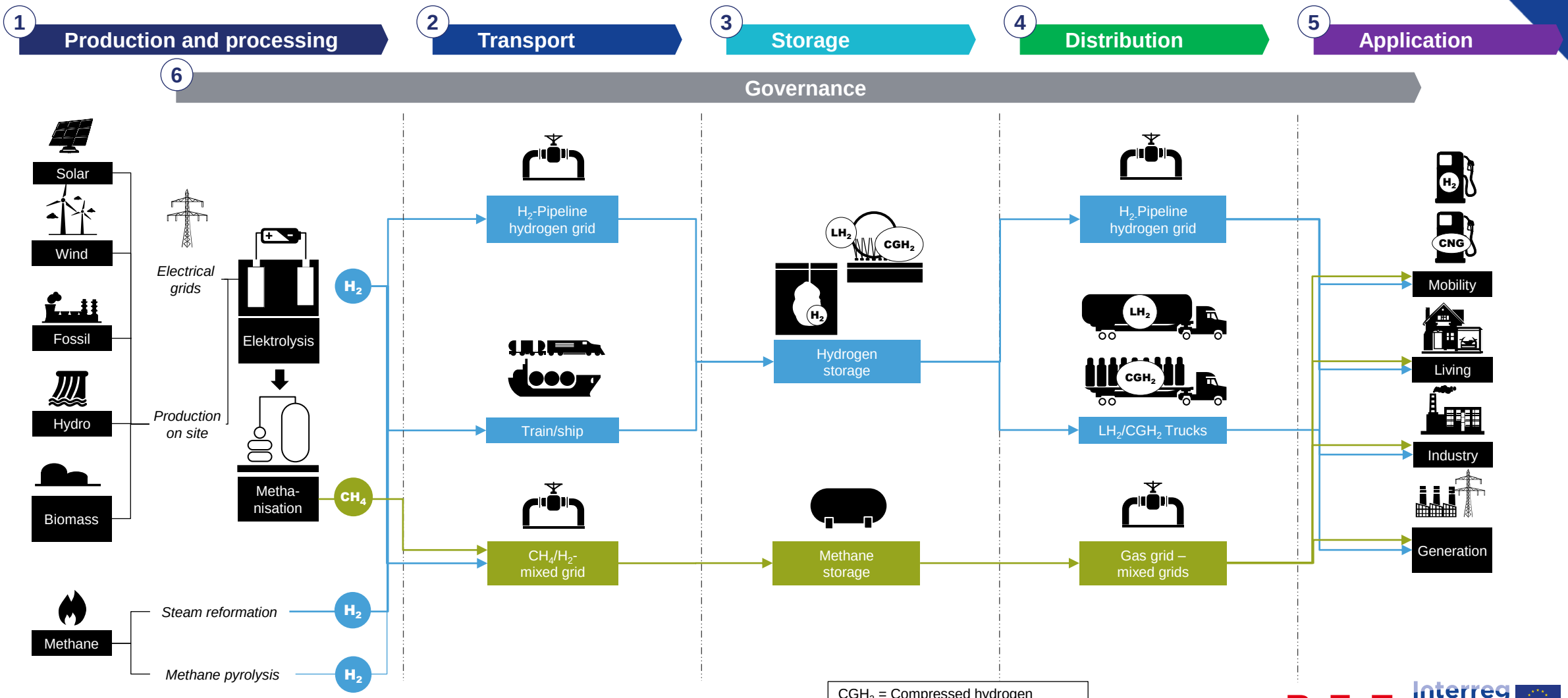
Stages of the hydrogen value chain

- In the first part of the analysis, the SWOT analysis is carried out from the EMR's point of view along the individual stages of the hydrogen value chain:
  - Production & processing
  - Transport
  - Storage
  - Distribution
  - Application
  - Governance
- A detailed presentation of this can be found on the following slide.

Hydrogen suppliers & service providers

- In addition to the obvious actors in the course of a hydrogen ramp-up (direct purchase or production of H2), there are also actors and stakeholders with indirect links to hydrogen.
- Among others, these can be suppliers of components, parts or modules that are used to a certain extent in the individual stages of the hydrogen value chain.
- The EMR is screened for such suppliers, service providers or R&D centers with a relevance to hydrogen and undergoes a SWOT analysis on this basis.

The SWOT analysis will subsequently be carried out along the individual stages of the hydrogen value chain



In the following, a SWOT analysis of the value creation stage production & processing of the EMR hydrogen sector is carried out

SWOT analysis: “production & processing”

Strengths

- Capable (natural) gas- and electricity-infrastructure.
- Potential for expansion of regenarative energies in the south of Limburg and the region of wallonia
- Water availability in EMR is very stable compared to possible international production sites (e.g., North Africa)

Weaknesses

- Insufficient local potentials of renewable energies to covert future hydrogen demand of the region by electrolysis.
- Lack of large-scale energy storages (electricity)

SWOT

Opportunities

- Locations of green hydrogen production may differ from those of generation facilities (delegated act). EMR has numerous sites with high-capacity electricity connections.
- Increase of electrolysis capacities in EMR due to expected rise in demand
- Construction & rededication of H_2 pipelines enables feed-in of locally produced hydrogen

Threats

- Until 2030 only moderate ramp-up of H2-production expected because of high costs and further development needed
- To date, comparatively few on-site hydrogen generation projects planned in the EMR region
- Comparatively high hydrogen import dependency to be expected
- More frequent droughts endangering future water supply

In the following, a SWOT analysis of the value creation stage transport of the EMR hydrogen sector is carried out

SWOT analysis: “transport”

Strengths

- Approx. 900 km hydrogen pipeline network that conects large hydrogen production plants and end-users across various sectors of Belgium, Netherlands and France (600km in Belgium).
- All three gas pipeline operators from the EMR (Fluxys, Gasunie, OGE) have published planes for deploying retrofitted and new hydrogen pipelines by 2030.

Weaknesses

- Import routes other then hydrogen pipelines do not seem suited for large scale hydrogen transport.
- Currently no concrete plans to connect the region to hydrogen transport networks for the period before 2030.

SWOT

Opportunities

- Part of the current gas network can be used to connect large scale hydrogen productions with end users. For example 800 km H2 transport grid planned in NRW
- The conversion of the current border crossing for natural gas at Eynatten to hydrogen could create an important axis for the cross-border hydrogen transport
- High market potential for manufacturers of high quality steel tubes, welding technology innovators and construction companies
- EMR is an important future transit region for all means of transport becaus of its central location

Threats

In some cases, the transport of hydrogen synthesis production such as ammonia on water bodies is not without risk. In particular, the transport of ammonia is not allowed through cities because of the dangers.

In the following, a SWOT analysis of the value creation stage storage of the EMR hydrogen sector is carried out

SWOT analysis: “storage”

Strengths

- Local manufacturer of carbon fiber hydrogen storages NPROXX with sites in Heerlen (NL) and Jülich (D)

Weaknesses

- EMR has a very limited supply of large scale hydrogen storage facilities (salt mines etc.)

SWOT

Opportunities

- Existing natural gas storages (caverns) in Epe and Xanten. These are not located in the area considered but are nevertheless important for stabilizing the supply after the eventual reallocation to hydrogen.

Threats

The profitability of hydrogen storage on a very large scale is still subject to high uncertainties.

In the following, a SWOT analysis of the value creation stage storage of the EMR hydrogen sector is carried out

SWOT analysis: “distribution”

Strengths

- Connection to major European inland shipping routes.
- Especially in the netherlands there is parallel gas-infrastructure because of L-gas and H-gas situation. Potential to use L-gas infrastructure for hydrogen.
- EMR as whole has comparatively dense gas-distribution grid which could be switched to hydrogen.

Weaknesses

- Already high level of occupancy of transport infrastructure.
- Import routes other then hydrogen pipelines do not seem suited for large scale hydrogen transport.

SWOT

Opportunities

- No mention of opportunities in the studies covered.
- Expected high hydrogen demand equals some demand for distribution of h2.

Threats

Depending on the size of the lines to be rededicated and the speed of ramp-up, timely rededication, including all necessary work, represents a very large uncertainty factor

- High cost for switch of natural gas infrastructure to hydrogen.

In the following, a SWOT analysis of the value creation stage storage of the EMR hydrogen sector is carried out

SWOT analysis: “application”

Strengths

- The main realization of all documents and studies examined is that the potential for hydrogen use and consumption in EMR in the future is very high. Especially in the industry and mobility sectors.
- Among others, the steel and chemical industry is an important hydrogen anchor customer.
- In some of the regions investigated, hydrogen buses and trucks are already being used successfully in pilot projects.
- In Germany and Belgium, subsidy programs exist for the installation of H2 refueling stations and trucks.

Weaknesses

- Currently only a small percentage of hydrogen filling stations is suitable for trucks (for example only 3 out of 21 H2 filling stations in NRW in 2021).
- Hydrogen technologies, especially those based on renewable energy sources, can be expensive compared to conventional alternatives.

SWOT

Opportunities

- Funding opportunities for the purchase of emission free commercial vehicles are open for H_2-powered vehicles. European funding should reduce the gaps in the funding costumes of individual countries.
- The Mheuse/Rhine ecosystem accounts for more traffic then the rest of europe combined. H2 can be key pillar for decarbonising the inland vessels
- The EMR has opportunity for building an ecosystem of competences to become a leader in H_2 inland waterway transport.

Threats

- Urgent need for hydrogen due to the ambitious climate protection targets: If availability of H2 increases less quickly than demand, certain industries could migrate to other regions.
- Hydrogen holds great potential, but there are still technical challenges to overcome (e. g. improving the efficiency of electrolysis & addressing hydrogen storage and transportation issues).
- Failure to overcome these challenges may hinder the widespread adoption of hydrogen technologies and limit the success of the strategy.

In the following, a SWOT analysis of the value creation stage governance of the EMR hydrogen sector is carried out

SWOT analysis: “governance”

Strengths

- Capable public actors, politics understand need for action as demonstrated by the development of these roadmap documents.
- Ambitious climate protection goals of the city enable hydrogen to play a central role in the energy system
- Geographical proximity and good political and economic links to industrial centers with H2 ambitions (Stolberg, Düren, Liège and Maastricht)
- Currently: Favorable political climate

Weaknesses

- Tedious approval processes for renewable energy projects and funding
- Insufficient utilization of funding opportunities in general and for H2-projects due to tedious communication and a lack of transparency

SWOT

Opportunities

- Existing funding opportunities for different kinds of hydrogen-projects, e.g. R&D, application.
- Closer cross-border cooperation of small and medium-sized enterprises in the hydrogen sector leads to a richer ecosystem and should be increasingly promoted. For this purpose, the "Francorchamps hydrogen initiative" was launched
- Public stakeholders could consider organizing a prospective exercise at the level of the euro region
- Promoting promote market ramp-up by development of common standards

Threats

Buerocratic hurdles may diminish or erradicate profitability of H2 business cases.

- Lack of regulatory certainty for companies, that want to use H2 can lead to a delay of the H2 ramp-up ("wait and see").
- Absence of a guidance framework poses inherent risk that developments will be fragmented and uncoordinated.

In the following, a SWOT analysis of the value creation stage Other of the EMR hydrogen sector is carried out

SWOT analysis: “miscellaneous”

Strengths

- Worldwide leading research and qualifacation institutions from academic and industrial sectors are situated within the EMR. This ensures a good availability of highly qualified future employees and economic growth.

Weaknesses

- Until now, available funding opportunities have been little used for H2-projects
- Insufficient utilization of funding opportunities in general and for H2-projects due to tedious communication and a lack of transparency
- Low awareness of the local strengths outside the region

SWOT

Opportunities

- Structural change and energy transformation with high level of social acceptance.
- In principle, the establishment of companies along the hydrogen value chain could open up a multitude of new job opportunities in the region.

Threats

- Regional differences in electricity price influences distribution of technology/applications.
- High dependance on energy imports

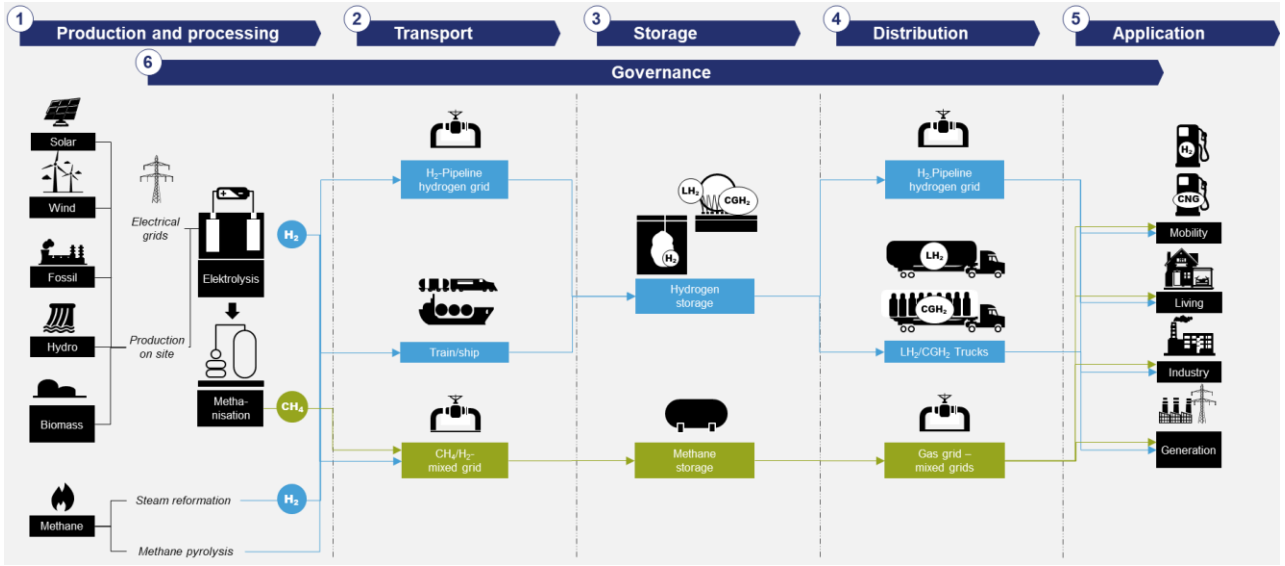
An additional SWOT analysis is carried out in the field of suppliers & service providers

SWOT analysis on suppliers & service providers

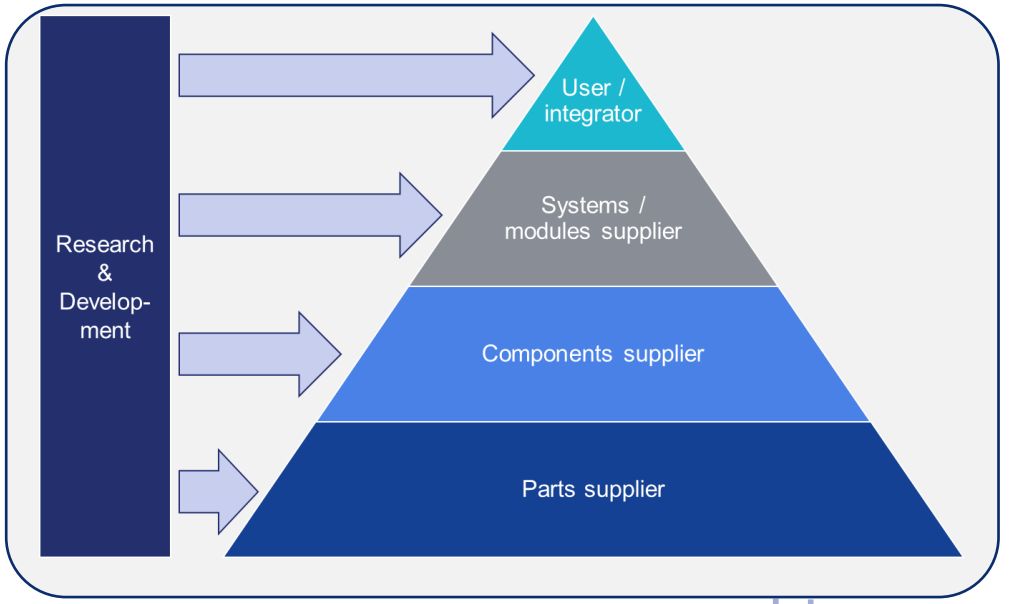
The potential of a region to benefit from the ramp-up of the hydrogen economy is strongly connected with the technical know-how and economic power of local companies as suppliers and service providers

To better understand the starting position of the EMR, a second SWOT analysis is carried out with focus on the hydrogen actor landscape along the different levels of the value creation pyramide from parts supplier to the user / system integrator.

Hydrogen value chain:



Levels of value creation:



In the field of suppliers & service providers a capable actor landscape already exists

SWOT analysis: Hydrogen Suppliers & Service Providers

Strengths

- More than 20 actors in the region already offering H2-related services for R&D, standardization, production and planning.
- Many companies with know-how in the construction of H2 infrastructure, components for different applications, production of H2-system, fuel cells and production technology.
- Availability of qualified employees.
- High potential in the production of compressors, electrolyzers and fuel cells incl. stack components.

Weaknesses

- Three different national regulatory frameworks in the EMR result in additional administrative efforts and require specific juristic know-how in companies.
- Language barrier limits pool of potential employees

SWOT

Opportunities

- High number of business parcs and projects to support companies entering the hydrogen technology market.
- The EMR-based R&D stakeholders are very active in the field of hydrogen and can accelerate the ramp-up.
- Nearly all industry sectors represented by local companies.

Threats

- Risk of moving away of energy intensive industries
- Expansion of renewable energy production hindered by insufficient availability of space and tedious approval processes
- Settling of hydrogen producers not likely due to small potential for renewable energy production
- Market entry barriers for small players and high risk

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Based on the SWOT analysis, pivotal findings have been summarized, and recommendations have been deduced

Summary & recommendations

- EMR combines worldwide leading players in R&D and industrial sectors and a capable infrastructure with an established practice of cross-border cooperation. Nevertheless, a successful ramp-up of a regional hydrogen economy requires further efforts.
- The utilization of funding opportunities must be facilitated by decreasing bureaucratic hurdles to achieve a maximum supporting effect for regional innovation. This requires cross-border efforts of politics and administrations.
- Future hydrogen demand should be enquired for individual industrial clusters. Networks within those clusters facilitate exchange of know-how and experiences among companies. The initiation of such clusters should be supported to raise awareness among existing businesses and industries that hydrogen may be relevant to them in the future.
- A high number of worldwide leading R&D institutions are situated within the EMR. The economic impact of this advantage can be expanded by further supporting the networking between R&D sector and industry along the hydrogen value chain.
- The future hydrogen demand in the region will likely be larger than local production potential. Connection to a hydrogen transmission network will therefore be crucial to ensure reliable supply with hydrogen for all types of applications.

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Project partners

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