

A sketch of place-based and historical characteristics

Hydrogen and History

**Interreg
North Sea**



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1. Understanding regional patterns of innovation

Understanding historical patterns of regional cooperation is crucial for analyzing innovation and economic development. Regional cooperation has historically driven economic integration, fostering innovation through shared resources, knowledge exchange, and collective problem-solving. By examining these patterns, we gain insights into how regions can build competitive advantages, stimulate economic growth, and navigate challenges in a globalized world.

The evolution of the European Union (EU) exemplifies how regional cooperation can lead to significant economic benefits. The creation of the Single Market and the removal of trade barriers encouraged competition, innovation, and economic convergence among member states (Scheller, 1999). These cooperative frameworks have enabled the EU to become one of the world's most dynamic and innovative economic regions.

Professor L. Horlings emphasizes the importance of regional identities and collaboration in driving sustainable economic development. Her research highlights how regions that leverage their unique assets and engage in cooperative networks are better positioned to innovate and achieve long-term growth (Horlings, 2016, 2020). This perspective aligns with the broader understanding that successful regional cooperation hinges on mutual trust, shared goals, and effective governance structures.



Amt für regionale Landesentwicklung
Leine-Weser



The County
Administrative
Board of Skåne

provincie Drenthe

Historical patterns reveal that these elements not only facilitate economic integration but also drive innovation by enabling regions to harness collective expertise and resources. The Nordic model, with its emphasis on social welfare and economic coordination, is linked to high levels of innovation and economic resilience (Lundvall, 2007).

In summary, studying historical patterns of regional cooperation, particularly within Europe, is indispensable for understanding the dynamics of innovation and economic development. It provides a blueprint for regions to harness their collective potential, thereby driving sustainable growth in an increasingly interconnected world.

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2. A place narrative for Southeast Drenthe

This part will sketch the social-economic history of the region and provide a high level description of people's mind-set and sense of community. This helps to understanding what 'heritage' can be leveraged and or should be overcome when striving for innovation and economic progress in the region.

2.1. The Industrial Evolution of South-East Drenthe



South-East Drenthe, a region in the Netherlands, has undergone remarkable industrial development from the 19th century to the present. Initially, agriculture was the backbone of the local economy, with traditional farming methods dominating the landscape. However, the early 20th century brought significant change with the advent of peat extraction, which became a critical industry. This shift was supported by national policies aimed at exploiting the region's natural resources for economic growth.

In the 1920s, the Southeast Drenthe region was still under the financial supervision of the state because of the collapse of the peat industry and associated unemployment.

The establishment of AVEBE in 1919, a major player in potato starch production, was an important industrial milestone. National authorities provided essential support through agricultural policies and research grants, which facilitated AVEBE's growth and solidified its role in the regional economy. AVEBE soon became an important, solid employer in the region. The discovery of oil by Shell in Schoonebeek in 1947 was another pivotal moment. National authorities played a crucial role in this development, investing in infrastructure and providing incentives for oil extraction companies. Since 1948 gas was produced in the small field nearby Coevorden and in 1986 a gas treatment plant was constructed in Emmen. This boosted the local economy and gave South-East Drenthe a position in the national energy sector.

After the second world war a miracle took place. In a short time Emmen developed from a farming village into an important, dynamic town in the Northern Netherlands. Southeast Drenthe was designated as an economic stimulus area and Marshall money became available to attract industry. The municipal government of Emmen under the leadership of Mayor Gaarland managed to make these funds available for Emmen. One textile factory after another established itself in Emmen. Confectionary factory "Bendien" was the first big hit. Emmen in the 1950s and 1960s flourished and grew; people spoke of "the miracle of Emmen".

The latter half of the 20th century saw further diversification. We saw the rise of Greenhouse farming in Erica and Klazienaveen and the rise of the chemical industry in Emmen, supported by government investment in industrial infrastructure, research and educational initiatives.



Cross-border trade with Germany intensified, benefiting from national trade agreements and regional development programs aimed at enhancing economic exchange. This trade was supported by national policies that improved transportation infrastructure and fostered economic cooperation with neighboring countries. The region must become a logical part of the national and trans-European transport network.

Despite all development, the economy of this region remained vulnerable. In 2006 the Mayor of Emmen, Mr Bijl, suggested to create a second, regional 'Marshall Plan' to mitigate high unemployment rates in South-East Drenthe. Today, government support for so-called brede welvaart (broad welfare) in the region is offered by the *Regio Deal Zuid- en Oost-Drenthe II*.

South-East Drenthe is a dynamic blend of historical agricultural roots and modern industrial advancements. The role of national authorities has been pivotal throughout this evolution, from early support for the industrial transformation after the peat production to driving the introduction of greener technologies in chemistry, food, and agriculture with a focus on creating knowledge hubs such as newly founded Greenwise campus. In general, strengthening economic-social structures in the region remains high on the agenda.

2.2. Understanding the mentality of Southeast Drenthe

Southeast Drenthe in the Netherlands, offers a unique insight into the mentality shaped by its historical and geographical context. Known for its serene landscapes and close-knit communities, the mentality of its people is deeply influenced by a blend of historical experiences, economic patterns, and geographical proximity to Germany.

Historically, the region's identity was shaped by the extensive peat bogs that once covered the area. In the 17th and 18th centuries, the local economy revolved around peat extraction, a labor-intensive process that required resilience and communal effort. The harsh conditions of peat harvesting, combined with the isolation of the rural environment, fostered a strong sense of self-reliance and a pragmatic approach to life. This era instilled a mentality characterized by perseverance, practicality, and a tight-knit community spirit.

The economic downturns and poverty of the 19th and early 20th centuries also played a role in shaping the local mentality. The decline in peat production, coupled with limited industrial development, left many in Southeast Drenthe struggling economically. This period of hardship contributed to a mentality marked by thriftiness and a resourceful attitude towards limited resources.

Geographically, Southeast Drenthe's proximity to the German border has influenced local attitudes and behaviors. The region's historical interactions with Germany, particularly during World War II, created a unique cross-cultural dynamic. The borderland's history of cross-border trade and exchange has fostered a mentality of

openness and adaptability, alongside a cautious pragmatism.

Today, the people of Southeast Drenthe exhibit a mentality deeply rooted in their historical experiences. They are known for their resilience, community-oriented nature, and a strong sense of local identity. This mindset is a reflection of their historical struggles, economic challenges, and geographical positioning, creating a rich tapestry of values that continue to define the region's character.



Peat production near the village of Nieuw-Weerdinge. Source: private archive.

2.3. A royal visit to Emmen

The King of the Netherlands paid a visit to Emmen with his family, to celebrate Kings Day on Saturday 27 April 2024. The identity, people and position of Emmen was presented during a festive tour around town. It was a beautiful, positive day as the king reflected back in his speech at the closure of the event:

'Emmen become part of my heart, this is where I come away from'

King Willem-Alexander expressed gratitude in Emmen for the celebration of King's Day. "The lists and polls don't add up. Emmen is a very strong city, where everything happens."

The expression "this is where I come from" – has been inspired by the song of musician Daniel Lohues, who sings his folksongs in the regional dialect Nedersaksisch.





Foto source: Marcel Juraan de Jong

Hier kom ik weg - Daniel Lohues

Je moeten der van haoln
Dat is wat ik doe
Bekend terein vrumd genug
Hoe 't rök en vuuld hoe het lek en klinkt
Elke straote ken ik elke bocht
Jij woont hier ver vandaan zeggen ze elders in het land
Dan zeg ik insgelijks u ook a'j 't zien van dizze kant

Hier kom ik weg veur mien hiele leben
Ben 'k met dizze horizon verweben
Hier kom ik weg hier stiet ons huus
Bliikbaar kom ik daar altied weer terecht
Hier kom ik weg

Hier bennen die paar mensen
Zunder wie 't niks is
Bekend gedrag vrumd genug
De wiede wereld is der wel
Via draod en golven

Waormet ik vaak
Naor gruuner grös heb zocht
Naor de verste verten
Wul ik altied wel hen
Mar dat gevuul dreijt zich weer um
Zo gauw as ik daar ben

Ruumte smoort de drokte
Stilte gef rust
Ben me der nie alle dagen
Hielmaol van bewust
Hoe graag ik hier mag wezen
Gruuntesoep met worst
Leven hier helpt net zo goed
As drinken tegen de dörst

Hier kom ik weg hier stiet ons huus
Bliikbaar kom ik daar altied weer terecht
Hier kom ik weg



3. Hydrogen as sustainable energy solution

3.1. A position in the hydrogen mix

Hydrogen plays a pivotal role in the transition to a sustainable energy mix, offering a versatile solution to meet diverse energy needs while reducing carbon emissions. As a clean energy carrier, hydrogen can be produced from renewable sources, such as wind or solar power, through processes like electrolysis. This green hydrogen can then be used in various applications, from powering fuel cell vehicles to generating electricity and heating.

One of hydrogen's key advantages is its ability to store and transport energy efficiently, addressing the intermittency of renewable sources. It can serve as a bridge to decarbonize sectors where direct electrification is challenging, such as heavy industry, long-haul transportation, and large-scale energy storage. Moreover, hydrogen's role in producing synthetic fuels and chemicals further supports its integration into the existing energy infrastructure.

Incorporating hydrogen into the energy mix complements other renewable technologies, such as wind and solar, creating a more resilient and flexible energy system. By leveraging hydrogen's potential, we can advance toward a low-carbon future, enhance energy security, and drive sustainable economic growth.

3.2. Market barriers

The adoption of hydrogen in transport faces several key barriers. **High Production Costs** are a major hurdle; hydrogen production, particularly green hydrogen, is expensive compared to conventional fuels. **Infrastructure Development** is also a challenge, as the lack of refueling stations and supply chains for hydrogen hampers the convenience of hydrogen vehicles. For **Heavy Vehicles**, such as trains and ships, the **Storage and Handling** requirements are complex due to hydrogen's low energy density and need for cryogenic temperatures or high-pressure tanks. **Energy Efficiency** issues further complicate matters; hydrogen involves energy losses through production, storage, and conversion, making it less efficient than direct electric use. **Technological Readiness** remains a concern, with hydrogen fuel cell technology still in development and not yet cost-effective at scale. **Regulatory and Safety Concerns** also pose obstacles, as new standards and safety protocols are required to handle hydrogen safely. Together, these barriers slow the widespread adoption of hydrogen, although advances in technology and infrastructure could mitigate these challenges in the future.

3.3. Hydrogen for Trains

Here are the most notable examples for operational hydrogen-powered trains currently in service:



1. Alstom Coradia iLint (Germany)

Operational Status: The Alstom Coradia iLint is the world's first hydrogen-powered passenger train in regular commercial operation. It began service in September 2018 on regional lines in Lower Saxony, Germany.

Details: The Coradia iLint operates on non-electrified routes, offering a zero-emission alternative to diesel trains. It has been running successfully, with a range of up to 1,000 kilometers (620 miles) on a single tank of hydrogen. The train has been used by the regional railway company LNVG (Landesnahverkehrsgesellschaft Niedersachsen).

2. Alstom Coradia iLint (Austria)

Operational Status: Following its success in Germany, the Coradia iLint was tested and later operated in Austria. It ran on regular passenger services in the southern regions of Austria for a three-month trial starting in September 2020.

3. Alstom Coradia iLint (The Netherlands)

Operational Status: The Coradia iLint was also tested in the Netherlands, where it operated on the Groningen-Leeuwarden line in early 2020. These were successful tests and while not fully integrated into regular service, they demonstrated the train's operational capabilities.

These trains represent the first wave of hydrogen-powered trains in commercial operation, setting the stage for broader adoption as the technology matures and infrastructure develops.

3.4. The opportunity of the Lower Saxony Line

Hydrogen is being actively investigated as part of the development of the Nedersaksenlijn (Lower Saxony Line). This cross-border rail route, which connects Germany and the Netherlands, has been identified as a key candidate for hydrogen-powered trains, especially for the non-electrified sections where traditional electrification would be costly and complex.

The bid book for the Nedersaksenlijn, which outlines the development and operational plans for the route, details the integration of hydrogen technology as a crucial component of the project. The bid book emphasizes the potential for hydrogen trains to provide a sustainable and efficient alternative to diesel engines, aligning with broader goals of reducing carbon emissions and enhancing regional connectivity.

Specifically, the bid book highlights how hydrogen trains could help overcome challenges associated with electrifying the entire line. It outlines plans for hydrogen refueling infrastructure and the expected benefits of using hydrogen as a clean fuel source, such as reduced environmental impact and improved operational efficiency.

The Nedersaksenlijn's development represents a significant step in demonstrating the viability of hydrogen in cross-border rail transport, potentially setting a precedent for similar initiatives across Europe.



4. Leine-Weser region

This chapter offers a place-based and historical sketch of the region Leine-Weser in Germany as the context which shapes innovation and patterns of collaboration. Moreover, it explains the origin and driving forces of the Leine-Weser Hydrogen network.

4.1. Historical Background of the Leine-Weser region

The Leine-Weser region does not have a uniform history, but arose from various administrative reforms and administrative mergers. Today, the region consists of the districts of Diepholz, Hameln-Pyrmont, Hildesheim, Holzminden, Nienburg/Weser, Schaumburg and the Hannover region.

Large parts of it, specifically Diepholz, Hameln-Pyrmont, Hannover, Nienburg/Weser, have their origin in the Kingdom of Hannover, which emerged from the Congress of Vienna in 1814 as the successor to the Electorate of Brunswick-Lüneburg¹. This had been an electorate of the Holy Roman Empire since 1692 and was ruled in personal union with Great Britain from 1714 to 1837. In the Austro-Prussian War of 1866, the Kingdom of

¹ More information on the historical congress in Vienna can be found on <https://www.thecollector.com/congress-of-vienna-redrawing-europe/>

Hannover was on the side of Austria and, after the defeat, became part of the Kingdom of Prussia as the Prussian Province of Hannover and thus part of the German Empire after 1871. In 1885, the administrative district of Hannover was created.

Hildesheim was originally part of the Bishopric of Hildesheim, which had existed since 815 as the Diocese of Hildesheim. It was not until 1802 that the Bishopric lost its sovereignty and became a part of Prussia, with the Congress of Vienna it then also became part of the Kingdom of Hannover as the administrative district of Hildesheim, which existed from 1885.

The present-day district of Schaumburg goes back to the County of Schaumburg-Lippe, which joined the German Confederation as a principality in 1815 and became a federal state of the German Empire in 1871. After the First World War, the region existed as the Free State of Schaumburg-Lippe within the Weimar Republic and was taken over by the German Reich under National Socialism in 1933 and thus remained in existence until 1945.

Holzminden, on the other hand, was part of the Duchy of Brunswick and was created in 1832 as a separate district in the duchy. Until 1945, it was part of the Free State of Brunswick.

After the Second World War, all these individual parts were merged into the newly created state of Lower Saxony from 1946 onwards, including the administrative districts of Hannover and Hildesheim. In 1978, as part of a district reform, the administrative district of Hannover was supplemented by the districts of Hildesheim and



Holzminen, so that for the first time today's Leine-Weser region - at that time still known as the administrative district of Hannover - appeared.

These district governments were then dissolved again in 2004 in the course of administrative modernization, followed by so-called government representations, which existed until 2014.

With this year, with another reform, so-called regional state representatives were appointed, who were to be responsible for different sub-regions of Lower Saxony. One of these sub-regions is the Leine-Weser region, now also called that for the first time, with today's districts.

4.2. Innovation as a joint effort of business, science and authorities

As described, the Leine-Weser region is not a uniform historically grown structure, but above all an administratively compiled region. At the same time, it covers an area of 9060 km² with 2.1 million inhabitants.

To present the historical development of hydrogen at this level would probably exceed the approach of the EHRIN project, especially since the Office for Regional Development is one of many actors in this field and a presentation from this perspective would probably not be fair to everyone. For these reasons, the topic is examined in such a way that an overview of the complexity of the actors in the field of hydrogen is given and how

the topic has developed within and with the Office for Regional Development Leine and Weser region.

Innovation is often driven by science and business. With the Gottfried Wilhelm Leibniz University in Hannover, there is an extremely strong player in the field of hydrogen. In addition, there are other research institutions such as the Hannover University of Applied Sciences or the Weserbergland University of Applied Sciences that are active in this topic. Within Lower Saxony, there is clearly a strong research centre, especially in the Hannover region, also in the field of hydrogen. There are also a number of internationally active companies based in the Hannover region.

At the same time, however, there is also the state administration of Lower Saxony, which has been addressing the issue for some time, here there are four different ministries that are promoting hydrogen in different areas and different perspectives.

On the one hand, the Lower Saxony Ministry of Economic Affairs, Transport, Housing and Digitalisation has its own network, organises events and has published thematic funding guidelines in the past. The Lower Saxony Ministry for the Environment, Energy and Climate Protection initiated the development of the Lower Saxony Hydrogen Network and also acted as a thematic funding guideline provider. The Lower Saxony Ministry for Federal and European Affairs and Regional Development also occupies this topic, and at the same time the Office for Regional Development Leine-Weser is subordinate to this ministry. As another part of the state administration, the Ministry of Science and Culture is of course not least present in the topic.



At the same time, however, there are also parallel structures that certainly influence the development of hydrogen technology in Lower Saxony. For example, the aforementioned Lower Saxony Hydrogen Network is an actor that works together with the Lower Saxony Employers' Associations (UVN), the Lower Saxony Work and Life Education Association, the German Trade Union Confederation and Invest in Lower Saxony and cooperates with Niedersachsen.next and the Lower Saxony Energy Research Centre.

Of course, the ministries at the level of the Federal Republic of Germany and corresponding organizations at the national level also exert overarching influence.

It is therefore clear that the field of actors in Lower Saxony and the Leine-Weser region is extremely multi-layered and complex. Knowing this is important in order to be able to understand the development within the Office for Regional State Development.

The office itself was created in 2014 as a regional part of the state administration of Lower Saxony. In addition to various activities such as rural village development, land consolidation, domain administration, regional planning, foundation supervision and urban development funding, there is also regional development as a topic here. The latter once again contains very different topics, which are formulated in the Regional Action Strategy of Leine-Weser, ranging from business and science to the labour market, mobility to services of general interest, the protection of regional natural and cultural landscapes and integration and social participation.

At first glance, it is noticeable that hydrogen is not a topic in its own right, but it can still have an impact on various areas.

In fact, until 2019, hydrogen technology was absolutely not an issue for the office and in this context, development really started from scratch.

4.3. Towards the establishment of a Hydrogen network

Since 2017, the office has been one of 13 partners in the Interreg project “Green Passenger Transport in Rural Areas – G-PaTRA” in the North Sea region. In September 2019, the project partners then visited the Norwegian partner in Trondheim. This visit ultimately proved to be the initial spark for the own activities in Leine-Weser, as the Norwegian partner presented the business case of hydrogen-powered ferries in Trondheim Fjord, including energy generation and electrolysis on the island of Smola, which is located off the fjord. The presentation of the project and the possibilities of hydrogen technology were sustainably impressive, so that after returning to the office, the idea of understanding this topic itself as part of regional development and promoting it for the Leine-Weser region solidified within the office.



It turned out to be a happy coincidence that the district of Schaumburg, as part of the Leine-Weser region, received recognition and funding as a HyStarter region from the federal government’s HyLand funding program in November 2019, as one of only nine regions in the whole of Germany. An initial cooperation in the sense of mutual exchange and support quickly developed. A similar cooperation was subsequently established with the



Hannover Region, which has been pursuing its own efforts since 2020 and, among other things, employed a hydrogen manager, launched its own regional funding programme and launched the “Generation H2” regional network.

In addition, direct project collaborations developed in various parts of the Leine-Weser region. However, it became clear in all these approaches that hydrogen technology is still a pioneering field in project implementation in large parts, unexpected questions, legal requirements and sometimes high electricity costs for electrolysis delay projects and sometimes have a considerable influence on the implementation time.



Smola boat (source: G-PATRA project)

But with these first steps, the complex field of actors described above was also opened up and it also became clear that this places considerable capacity demands on the office if the topic is to be seriously pursued.

In the midst of these considerations, an opportunity for cooperation arose at the beginning of 2021, which permanently changed the work of the office in this field. In discussions with the Hannover Chamber of Industry and Commerce, it became clear that both houses had a common interest in this issue and at the same time were aware of the capacity problem.

In a joint exchange, the idea of a separate Leine-Weser hydrogen network supported by the region was born, accompanied and supported by the Chamber of Industry and Commerce and the Office for Regional Development. As part of the annual summer trip of the state representative, the house leaders presented this idea to the public in July 2021.

Subsequently, intensive discussions were held with all districts of the Leine-Weser region about the goals and implementation of such a network in order to create a common level. These talks were partly simple and partly complex, as financial claims were also associated with the creation. All in all, however, it was possible to achieve that the entire region was willing to pull together. Above all, the district of Nienburg with its representation, the Climate Protection Agency Mittelweser, was a strong and indispensable partner here.



Foundation of Hydrogen Network Leine-Weser 11 July 2022 (source: office for regional development Leine-Weser region)



On 11.07.2022, all partners involved signed a joint cooperation agreement for the establishment of the Leine-Weser Hydrogen Network at a ceremony in front of around 70 guests in the presence of Lower Saxony's Minister for Federal and European Affairs and Regional Development, Birgit Honé.

This was also associated with the submission of a funding application at the federal level to raise funds for the creation of jobs as a boost for the new network. The wish and hope were that operational work could then begin by mid-2023.

Unfortunately, however, the Leine-Weser hydrogen network also had to realize that some things in project development are outside its own sphere of influence. Although there was a good application in terms of content, accompanied by 54 letters of support from municipalities and companies in the region as well as the Lower Saxony Ministry for the Environment, Energy and Climate Protection and the Lower Saxony Ministry for Federal and European Affairs and Regional Development, the evaluating body needed almost 2 years, until July 2024, to issue a positive funding decision.

Everyone is probably aware of the disadvantages of such a long waiting time and without the already established exemplary cooperation of the actors in the Leine-Weser region, it would probably have put a premature and unpleasant end to all the plans sought.

Thanks to the cooperation that has been established, however, 4 regional thematic events have already been held in the Leine-Weser region in 2023. With this background, the Office for Regional Development Leine-Weser



Network meeting July 2023 (source: the office for regional development Leine-Weser region)



was able to become an active project partner in the Interreg project “Excellent Hydrogen Regions in Europe – EHRIN”. In 2024, a hydrogen demand survey was also developed for the Leine-Weser region, which was completed by more than 200 participants during its duration. A large number of discussions were initiated and conducted in the region and a draft of a joint action strategy was drawn up.



With a certain pride in the Leine-Weser region and the self-initiated cooperation, it can be stated today that the Leine-Weser hydrogen network with its supporting partners in the districts of Diepholz, Hameln-Pyrmont, Hildesheim, Holzminden, Schaumburg, Nienburg/ Weser and the Hannover region, together with the Hannover Chamber of Industry and Commerce and the Office for Regional Development Leine and Weser region, is perceived as a competent contact for the topic in the region. Companies and projects actively approach the network and want cooperation and exchange. This effort has been achieved by the region in recent years and with the funding now available and the positions to be filled, the work for hydrogen technology in the Leine-Weser region is to be significantly strengthened once again.

Networks are a driver of innovation and change, also in the Leine-Weser region.





Bid Book for the Nedersaksenlijn: <https://nedersaksenlijn.nl/bidbook/>

Source photo: the Stichting Nedersaksenlijn (2022)

5. Skåne region



City of Malmö. Source: private collection.

5.1. Geography and demographics

Skåne is the southernmost part of Sweden and closest to Europe's mainland. Geographical location establishes Skåne as a link between Europe and Nordic countries. The region is characterized by its extensive coastline and two important ports: Trelleborg and Helsingborg and bridge connection to Denmark. These ports are significant hubs for national and international transportation. In one of these entry points, port of Trelleborg, 1 million long-haul trucks entering Skåne with soon be recorded yearly.

Major part of the land is used for agriculture. The agricultural sector in Skåne is essential not only for Skåne's but also for the whole of Sweden's food security, economic stability, and cultural heritage. At and at the same time Skåne has a high level of urbanization, with over 80% of the population living in urban areas. Region is inhabited by approximately 1.4 million people what makes it one of the most densely populated ones in Sweden. The demographic profile of Skåne is diverse and dynamic, with significant immigrant communities and relatively young population.



5.2. Industrial development of Skåne

Skåne historically was predominantly an agricultural region, and it was the cornerstone of its economy, and this an important part to these days. Industrialization, that started speeding in the early 1900th century saw growth of manufacturing of machinery, chemicals, and rubber industries. Malmö, currently largest urban agglomeration in Skåne, emerged as an industrial hub and Sweden's major shipbuilding centre.

Today, besides agriculture, there is a significant presence of manufacturing industries, where chemical and metal powder companies on the west coast are recognized hydrogen users with fossil-based hydrogen production. The economy is however clearly developing towards knowledge economy. Strong focus on innovation and research is connected to the presence of research institutions, universities in Lund and Malmö, and science parks that foster development. This emphasis on research and innovation has contributed to a thriving startup scene and strong growth of knowledge-intensive industries and the development of cutting-edge technologies.

Sustainability and green initiatives are important to industrial development and Skåne places a strong emphasis on sustainable practices and technologies, aiming to reduce their carbon footprint and contribute to a sustainable future. Skåne has been at the forefront of initiatives related to renewable energy, clean technologies, and sustainable manufacturing processes.

5.3. Socio-cultural description

Skåne has developed a unique and comprehensive approach to fostering development and innovation. This approach is characterized by a strong focus on collaborative networks between academic research and universities, private industries and finally, governmental organisations. This model, known as triple helix, fuels development of new products but is also widely used for any type of development projects. Regional development is thus often driven by tight partnerships, what leads to robust innovation ecosystems. A very important characteristic of many collaborative initiatives in Skåne is co-action (samhandling in Swedish). This concept used in situations when no single actor has got the resources and mandate to solve a problem, where assistance from other independent agents is required and the collective action is needed.

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5.4. Vision on hydrogen as part of the future energy mix.

Skåne is aiming to reduce its carbon footprint by replacing fossil fuels with significant electrification and renewable sources such as wind and solar power, hydropower, biogas and working extensively with transforming of transport sector away from fossil fuels. Hydrogen is seen to play an important part in this transformation and is regarded as a part of energy mix in the region. At the same time Skåne is facing serious limitations of electricity supply, connected to the capacity of the power grid, and production of renewable energy in Skåne is yet limited, the commercial and large-scale hydrogen production can be limited in the nearest future.

However, along investments in renewables such as solar and wind power, small scale hydrogen production units are seen as vital to store and transform the excess energy generated from renewable sources. Stored hydrogen could be converted back to electricity during periods of high demand or low renewable generation, helping to balance the grid when electricity supply cannot meet the demand. Hydrogen could also serve as a long-term, seasonal storage solution, addressing the intermittency of renewable energy and ensuring a stable energy supply throughout the year. Hydrogen produced in small scale production units should be used simultaneously in multiple sectors, creating many benefits and enhancing resilience. Use of hydrogen in transportation is another sector to couple. Skåne is working with decarbonisation of transport sector and hydrogen is seen to play important role there, especially for heavy fleet and transit transport. Being a transit region from Europe to the rest of Scandinavia, Skåne has a major opportunity to employ hydrogen in transport. Building a network of hydrogen refuelling stations across Skåne would support not only the ambitious climatic targets for long-haul

transport, but will also boost the domestic uptake of hydrogen vehicles, catering to both public and private transport needs, complementing electric vehicles where batteries may not be practical.

AB Sjöbohem offers an inspiring example for the applications of new energy solutions including hydrogen for the build environment <https://hydrobust.se/>

There are several actors that are important for development of hydrogen initiatives in Skåne, such as regional authorities, municipalities, and municipality owned energy companies. Their roles differ, where regional authorities can play role in supporting the development and in particular effort of different actors to build interest groups, provide for capacity building, especially enabling networking or knowledge enhancement. Energy companies are these bodies that can be seen crucial in developing hydrogen production sites with systemic sector connections. Municipalities are especially important actors that can enable connections and use for all resulting energy streams: hydrogen, oxygen, heat and water. Initiatives striving for development of hydrogen use in Skåne should thus embrace all these actors simultaneously, paying attention to capacity building as the prerequisite for development.



AB Sjöbohem. Source: private collection



5.5. Obstacles in the realization of the vision.

The hydrogen vision for Skåne is definitively an interesting and important complement to the energy system the region is striving for, however there are several obstacles on the way. The most important is connected to electric energy supply. There are few points of green electricity production in Skåne and they cover only a fraction of electricity needs, what makes the region dependent on supplies from other regions and from abroad. There are even serious limitations to power outtake what can be hindering larger hydrogen production plants from establishing in Skåne. There are however several energy production facilities planned, where especially off shore wind farm can be game changers for Skåne.

The growing interest in hydrogen development, as any other development, is facing the natural and humane opposition to change. The sociocultural barriers that could impact the realization of Skåne's vision for integrating hydrogen into its energy mix relate mainly to public perception and community engagement, cultural attitudes towards energy and technology, and social equity considerations.

Hydrogen technology, hydrogen usage and its benefits and risks are not widely understood by the general public. This gap in knowledge can result in resistance to new projects or misconception about hydrogens safety, which might cause public anxiety and opposition to hydrogen-related infrastructure, such as refuelling stations or production plants.

5.6. Opportunities for hydrogen development in the region.

There are many interesting opportunities for hydrogen development in Skåne and these are related to the geographical location and the existing infrastructure. Skåne serves as a major transit hub for heavy trucks, given its proximity to Denmark and the rest of Europe, and this offers a significant opportunity for development of hydrogen refuelling stations and in parallel local hydrogen production facilities. Moreover, Trelleborg and Helsingborg ports offer key opportunities to integrate hydrogen into maritime transport and logistics. Presence of strong industrial base, with chemical and metal powder companies, utility companies, large agricultural sector and 33 municipalities, offers a substantial opportunity to integrate hydrogen into multiple sectors simultaneously. Promoting small-scale hydrogen projects that are leveraging a growing renewable energy capacity in Skåne is crucial in this context.





