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Hydrogen Ecosystem and Green Public Procurement in Region Zealand and Denmark

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Table of Contents

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List of Figures

List of Tables

1 Introduction

Green hydrogen is increasingly recognised as a key alternative to fossil fuels in areas where electrification or other renewable solutions are not feasible. It is particularly relevant for hard-to-abate sectors such as heavy industry and heavy transport. In mobility, hydrogen is mainly considered a solution for heavy-duty vehicles (HDVs), where electrification remains challenging and hydrogen-powered vehicles can operate over longer distances and with shorter refuelling times (COM(2025)260final).

By the end of 2024, only around 170 hydrogen lorries and 500 hydrogen buses and coaches were registered across the EU (COM(2025)260 final). Many countries, including Denmark, still lack a sufficient hydrogen refuelling network and an adequate supply of hydrogen trucks. The absence of both infrastructure and demand has created a “chicken-and-egg” problem, where neither side develops without the other. In Denmark, the market for hydrogen HDVs is still at a standstill, with no new vehicle registrations reported in 2024 (Eurostat, EAFO, 2025).

This report analyses hydrogen strategies at the regional, national, and EU levels to identify bottlenecks and challenges related to the adoption of hydrogen-fuelled HDVs in Region Zealand and Denmark. The aim is to assess how current strategies and policies support or hinder the development of a hydrogen ecosystem and looks at current developments in the industry, with a focus on hydrogen used for transportation (COM(2025)260final).

2 Aim and Method

This analysis examines the current state of the hydrogen ecosystem in Denmark, with a particular focus on Region Zealand. It aims to identify key challenges and opportunities in the development and adoption of hydrogen technologies, especially in heavy-duty transport and within the context of green public procurement (GPP).

The report takes a holistic approach, combining policy and strategy analysis with an overview of the hydrogen value chain and market developments. It evaluates how national, regional, and EU strategies interact, and to what extent these frameworks support Denmark's and Region Zealand's transition toward a hydrogen-based economy.

The analysis consists of three main parts: Firstly, the hydrogen ecosystem and strategies are analysed, including mapping and assessing hydrogen and Power-to-X (PtX) strategies at the regional, national, and EU levels, and identifying gaps and dependencies in the Danish hydrogen value chain. Secondly, procurement frameworks at the regional, national, and EU levels are examined and are evaluated to determine how these can drive demand for green hydrogen and hydrogen-fuelled mobility solutions. Thirdly, current market trends, bottlenecks, and development barriers are identified, and a SWOT analysis summarises the strengths, weaknesses, opportunities, and threats within the Danish hydrogen ecosystem.

A bottom-up approach is applied, starting from Region Zealand and moving up to the national and EU levels. This allows for an understanding of how local and regional initiatives interact with national policy goals and European frameworks. The analysis draws on official policy documents, recent data from European and Danish energy agencies, and relevant literature to ensure a comprehensive and up-to-date assessment.

3 The Hydrogen Ecosystem

3.1 Hydrogen and PtX Strategies

a. Region Zealand

Strategies for Power-to-X (PtX) and hydrogen are mainly developed at the national and EU levels. Consequently, there is no dedicated regional hydrogen strategy in Region Zealand. However, several private initiatives in the region aim to position themselves as frontrunners in PtX innovation.

One example is the *PtX Cluster Zealand* project, which brought together the companies DynElectro, Unibio, Nordphos, Algiecel, and G2B, in partnership with Ørsted, Evida, Kalundborg Forsyning A/S, DTU, Gas Storage Denmark, Knowledge Hub Zealand, Energy Cluster Denmark, and Erhvervshus Sjælland. The project ran from 2022 to 2023 and received financial support from the Danish Business Promotion Board (*Erhvervsfremmebestyrelsen*) and REACT-EU. At least one company, DynElectro, has since scaled up to industrial production (Erhvervshus Sjælland, 2025).

The project focused on the transition from renewable electricity generation to PtX fuels and explored opportunities to utilise residual products for food production. In addition, it examined the potential value of energy and material flows within the project and identified the need for new infrastructure, such as gas pipelines, at both regional and interregional levels (Erhversstyrelsen, 2025).

b. Denmark

In 2021, the Danish Ministry of Climate, Energy, and Utilities launched an official strategy titled *"The Government's Strategy for POWER-TO-X."* The strategy aims to reduce both Denmark's and global emissions. Specifically, Denmark seeks to replace 70 per cent of the fossil fuels accounted for in its national CO_2 balance with PtX fuels. Beyond domestic goals, the strategy also envisions exporting PtX fuels to help reduce emissions worldwide.

These are the government's four objectives for promoting PtX in Denmark (KEFM, 2021, p. 4):

1) *Power-to-X must be able to contribute to the realisation of the objectives in the Danish Climate Act.*
2) *The regulatory framework and infrastructure must be in place to allow Denmark's strengths to be utilised and for the Power-to-X industry to operate on market terms in the long run.*
3) *The integration between Power-to-X and the Danish energy system must be improved.*
4) *Denmark must be able to export Power-to-X products and technologies*

The Danish Government aims to establish 4–6 GW of electrolysis capacity by 2030 to boost Power-to-X (PtX) production, support exports, and contribute to national and international climate goals. To drive this, a DKK 1.25 billion PtX tender for hydrogen production is proposed, alongside further funding of over DKK 2 billion for green research, innovation, and regional initiatives. Investments include support for industrial scaling, hydrogen value chains, green fuels research, and the creation of local commercial beacons, such as one in South Jutland focused on green energy. Overall, the strategy aims to reduce hydrogen production costs, stimulate job creation and economic growth, and enhance Denmark's position as a leader in green technologies (KEFM, 2021, pp. 4-6).

The PtX strategy encompasses a wide range of PtX products. In addition to hydrogen, it includes e-methanol and green ammonia for fertilisers. All products are intended to be CO_2-neutral, meaning they must be produced either from renewable energy, from sustainable biomass, or through carbon captured directly from the atmosphere (KEFM, 2021, p. 9).

PtX production, especially the electrolysis to produce hydrogen, is very energy-intensive and expensive. Therefore, it is a challenge for the industry to become competitive with fossil-based fuels or direct electrification. But especially the sectors that cannot be electrified will likely rely on hydrogen to become CO2-neutral. In 2021, the Danish Energy Agency forecasted the following prices for PtX fuels for the next decade in Denmark, in comparison to fossil fuels and biofuels. They also predicted that in the longer term, prices are likely to decrease (KEFM, 2021, pp. 12-13).

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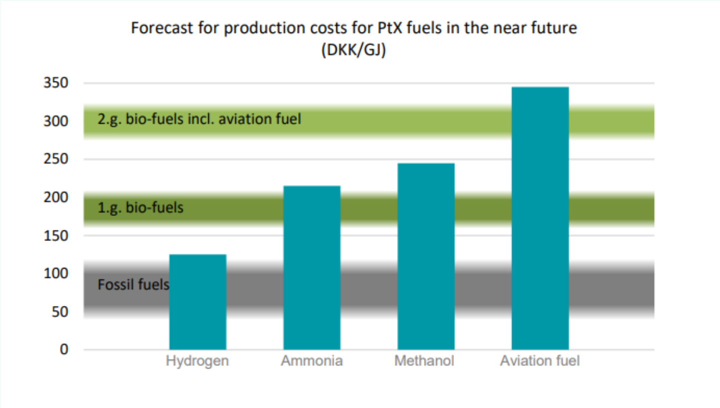

Figure 3. Forecast of production costs for Power-to-X fuels in the near future. Ranges for market prices of fossil fuels and biofuels are also shown, where ILUC effects on the price are not factored in.
Source: The Danish Energy Agency

Figure 1: Forecast of production cost for PtX fuels in the near future. Source KEFM (2021), p.14

PtX as a solution for hard-to-abate sectors

The report highlights that direct electrification, e.g. cars powered by batteries, is the most efficient way to use energy generated from renewable resources, such as wind energy. However, some hard-to-abate sectors, such as heavy industry or heavy transport, are not easily electrified, so hydrogen can come in as a solution where direct electrification is not possible. It is estimated that around 80 per cent of national transport can be electrified. However, the remaining 20 per cent, including HDV, long-distance flights or shipping cannot be electrified and will require PtX solutions to replace fossil-based solutions (KEFM, 2021, p.10-11).

The strategy states that, while it is safer and cheaper to produce carbon-based PtX (from biomass or CCU), there is a limit to biomass and other renewable carbon sources. Therefore, non-carbon fuels such as hydrogen or ammonia are considered the more long-term solution. Green hydrogen is thus identified as the *'future-proof choice'* (KEFM, 2021, p. 12-14).

c. EU

In 2020, the European Commission launched a hydrogen strategy, which encompasses the whole hydrogen value chain and defines goals for hydrogen production capacity as well as end-use fields.

The EU hydrogen strategy (COM(2020) 301 final)

The hydrogen strategy was launched in 2020 and is called "A hydrogen strategy for a climate-neutral Europe" (European Commission, 2020). It includes a roadmap to 2050, which states that the priority for the EU is renewable hydrogen produced using wind and solar energy, but other forms of low-carbon hydrogen should serve as a short- and medium-term solution. The roadmap consists of three phases:

Three Phases (Roadmap)

2020–2024: The installation of at least 6 GW of renewable hydrogen electrolysers and the production of up to 1 million tonnes of renewable hydrogen.

*2025–2030: Deployment of 40 GW of electrolysers across the EU and the production of up to 10 million tonnes of renewable hydrogen. Additionally, hydrogen should be integrated into industrial clusters, heavy **transport**, and power balancing.*

2030–2050: Achievement of large-scale, economy-wide deployment of renewable hydrogen across all hard-to-abate sectors.

To achieve these goals, the EU foresees different policy tools and mechanisms. Among others, the European Clean Hydrogen Alliance (ECHA) is a public-private platform connecting industry, investors, and governments. ECHA aims at being embedded across the whole hydrogen value chain, from production, transmission, and to end-use, within industry, heating and mobility.

The supporting funds InvestEU and REACT-EU will have increased capacities and will continue to support the hydrogen industry by giving incentives for private investments. To boost demand for green hydrogen, the commission intends to relax rules for hydrogen support schemes for the member states to bring down prices and make green hydrogen a competitive alternative.

The European Commission sees hydrogen as a key option to decarbonise hard-to-electrify transport, including buses, commercial fleets, heavy-duty road vehicles, trains, shipping, and aviation. Its deployment will be guided by fleet demand, supported by regional electrolysers, and incentivised by CO2 targets. Long-term research and innovation under Horizon 2020/Europe, the Fuel Cells and Hydrogen

Joint Undertaking, and the Hydrogen Alliance will strengthen Europe's technological leadership in hydrogen solutions.

3.2 The Danish Hydrogen Value Chain

The European Hydrogen Observatory defines three main stages in the clean hydrogen value chain. The production stage includes renewable hydrogen production from renewable resources such as wind or solar energy, or fossil-based hydrogen production with CSS, as well as the transformation of hydrogen into synthetic fuels and chemicals. The second stage is the distribution stage, including pipelines, shipping, truck transportation and storage of hydrogen. The third stage, the end-use application, entails industry use for i.e. heat or feedstock, for mobility, building heat and power generation.

Figure 2 - The green hydrogen value chain (European Hydrogen Observatory, 2025)

a. Production (Supply side)

Denmark has set a target to achieve an electrolysis capacity of 4–6 GW for green hydrogen production by 2030 (KEFM, 2021, pp. 4–6). In October 2023, the country awarded six projects in its first Power-to-X (PtX) tender, representing approximately 280 MW of electrolysis capacity (Energistyrelsen, 2023). The projects are listed in the appendix.

The International Energy Agency (IEA) provides a database with all Hydrogen production products in its member countries, which was last updated in September 2025 (IEA DATA, 2025). For Denmark, there are 60 projects listed, of which 14 have been decommissioned (mainly in the demo or feasibility study state). This leaves 39 projects that are in different stages of development, which are listed by status in Table 1. Fifteen projects are currently operational, one is under construction, fourteen are in the concept stage, two are in the demo stage, and five are in the feasibility study stage. However, it should be noted that there are likely errors in the data, as at least one project is listed as operational, namely H2Res by Ørested, which is cancelled.

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Status	Number of projects	Partly renewable	Renewable
Operational	15	1	6
Under construction	1	1	1
Concept	14	0	9
Demo	2	0	1
Feasibility study	5	1	3

Table 1 - Number of projects by status, partly renewable and renewable energy sources (IEA Data, 2025)

The European Hydrogen Observatory (2025), on the other hand, finds 11 operational hydrogen production plants in Denmark. The data sources give slightly different data on the project in operation, which shows that data on hydrogen production is not entirely reliable and should be handled carefully. The projects from the European Hydrogen Observatory could all be confirmed by researching them individually; therefore, the projects from this database are presented in Table 2.

Name	City	Start year	Capacity MW/MWel	End-use

European Energy - Kassø (phase 1)	Aabenraa	2025	52,5	Methanol
HySynergy (Phase 1)	Fredericia	2025	20	Refining
Reddap (REnewable Distributed & Dynamic Ammonia Plant)	Lemwig	2024	10	Ammonia
HyBALANCE	Hobro	2020	1,5	Mobility
Strandmøllen A/S - Ejby	Ejby	2015	0,5	Mobility
Nature Energy Glansanger	Glansager	2023	6	Methanol
GreenHy Scale (Phase 1) GHS test	Spoettrup (Spøttrup)	2023	6	Methanol
Gron Brint	Hjørring	2024	5	Blending
European Energy - Maade/Måde/Esbjerg (Phase 1)	Maade/Måde/Esbjerg	2024	3	-
ESTECH Odense	Sonderso	2024	2	Fuel

Table 2 - Figure 3: Hydrogen production projects (European Hydrogen Observatory, 2025).

b. Distribution (Transport, Storage, and Infrastructure)

Infrastructure

After delays and rescheduling, the Danish government has voted for more support at the beginning of 2025 to accelerate the offtake of the hydrogen pipeline, so supply to Germany can start by 2030. The realisation of this is, according to the Danish Ministry of Climate, Energy and Utilities, largely dependent on the German steel industry. The hydrogen supplied from Danish producers through the pipeline must meet the corresponding German industry demand (KEFM, 2025). The pipeline connects current and upcoming production facilities to heavy industry and other offtakers in Germany.

The Danish-German Hydrogen network pipeline, in partnership with Energinet (Denmark) and Gasunie (Germany), is planned to be ready for use in 2030. The 85 km long pipeline is onshore and provides subsidies for capacity bookings. Additionally, the Hydrogen Island project by Copenhagen Infrastructure Partners is currently in the concept stage. The 275 km long offshore pipeline supplies hydrogen from offshore wind energy to the mainland (IEA DATA, 2025). Figure 2 shows the hydrogen pipeline throw Denmark down to the Northern German city Flensburg.

Figure 3 - Denmark's hydrogen backbone (State of Green, 2025).

Storage

There are currently two projects in the final stage before the investment decision (FEED stage). The Green Hydrogen Hub Caverns have a total storage capacity of 240 GWh and are expected to be in use by 2027 and 2028. Gas Storage Denmark, Corre Energy, and Eurowind Energy are behind this project (IEA DATA, 2025).

Ports

Another important part of the distribution link is port capacity for shipping and storing hydrogen. In demand there are currently no ports listed in the IEA database for hydrogen or ammonia storage and transportation. However, there are three ports listed that provide methanol infrastructure. The port of Frederikshavn is already operational while methanol infrastructure from Hanstholm port and Rønne port are under construction (IEA DATA, 2025).

c. End-Use Applications (Demand)

Table 3 shows the Danish projects that have mobility as an end-use listed. This includes projects that produce hydrogen with the (intended) use of hydrogen in road, off-road, rail, maritime or aviation. There are many projects that have been discontinued over the last years. Some projects are still in the feasibility study phase and planned to open in the upcoming years.

Project name	Location	Date online	Status
H2KT - Hydrogen Energy Storage in Nuuk	Nuuk	2010	Pilot
H2 Logic HRS with onsite electrolysis Aalborg	Aalborg	2013	Discontinued
H2 Logic HRS with onsite electrolysis in Vejle	Vejle	2013	Discontinued
H2 Logic HRS with onsite electrolysis Holstebro	Holstebro	2013	Discontinued
H2 Logic 3 HRS with onsite electrolysis in Copenhagen	Copenhagen	2013	Discontinued
HyBALANCE	Hobro	2020	Discontinued
HRS Aalborg	Aalborg	2020	Discontinued
Brande Hydrogen project	Brande	2021	DEMO
GreenHyScale	Skive	2026	Feasibility study
HySynergy, phase 2	Fredericia refinery	2027	Feasibility study
H2 Energy Europe Esbjerg green hydrogen	Esbjerg	2028	Feasibility study
Green CCU Hub Aalborg	Aalborg	2028	Feasibility study
HySynergy, phase 3	Fredericia refinery	2030	Feasibility study
Blue Seal	Hobro		Feasibility study

Table 3 - Danish Hydrogen Project with mobility end-use (IEA DATA, 2025). Note, some projects have several end-use applications.

Other end-uses in Denmark include: Ammonia (2 projects), Methanol (12 projects), other Ind (high temperature heat) (4 projects), Power (2 projects), Synfuels (2 projects).

d. Policy, Regulation and Finance

In Denmark, the main policy and financial actors in the hydrogen industry include political entities such as Energistyrelsen, which has come forward with a national PtX strategy in 2021 (KEFM, 2021), or on the European level, the Commission, which has launched a regulation on alternative fuel infrastructure in 2023 (Regulation (EU) 2023/1804).

e. Summary Hydrogen Value Chain Denmark

Figure 5 provides an overview of the different stages in the value chain and examples of actors in each part of the chain. Note that this is not a complete list but gives examples of the most prominent actors.

Link in Value Chain	Actors	Role	Main Dependencies
Production	CIP, Topsoe, Everfuel, Ørsted, European Energy, Electrochaea, Plug Power, Green Hydrogen Systems, Vestas, Siemens Gamesa, Hypro Denmark	Wind energy production, PtX, electrolysis solutions	Offshore wind / Ptx auctions, grid capacity, technology maturity, cost curves
Distribution	Energinet, Gas Storage Denmark, Port Authorities (Esbjerg, Frederikshavn, Hirtshals, Aalborg), Everfuel Logistics, European Hydrogen Backbone initiative (EHB)	TSO, storage, export, logistics, distribution, cross-border coordination	Supply and Demand, legal permitting
End-use application	DFDS, Mærsk, Scania, Volvo, Arla, (German steel industry)	Maritime transportation fuels, HDV fuels, food industry heat processes	Long-term contracts, price competitiveness
Policy, Regulation and Finance	Energistyrelsen, European Commission and CINEA, EIFO, Brintbranchen	Public policy, financing, and industry organisations	Political mandates, partnerships with private sector

Table 4 - Overview of the Danish hydrogen value chain

4 Green Public Procurement

This section of the analysis looks at the green public procurement strategies of Region Zealand, Denmark, and the EU. Public procurement is a main tool through which governments can stimulate market demand and boost an industry to attract private investment. According to the EU, around 14 per cent of EU GDP is generated by public procurement (COM(2017)0573final). Green public procurement is thus an effective tool to stir investments towards renewable energy sources and boost the demand for renewable fuels such as green hydrogen. The following section looks at green public procurement strategies from the regional to the national to the EU level. The focus is mainly on hydrogen use for mobility, as this is identified as the main field of interest for publicly procured hydrogen.

4.1 Region Zealand

Region Zealand has launched a strategy at the beginning of 2025 for the green transition called “Grøn Fremtid 2035” (Grøn Fremtid 2035, 2025). The strategy is mainly targeting decarbonisation in the health sector as it is the main responsibility of Danish regions to manage the health system. The goal is to reduce CO2 emissions by 50 per cent by 2035. Within transportation, which accounts for around 12% of Region Zealand’s CO2 emissions in 2023, the strategy foresees an emissions reduction of 75 per cent. Additionally, it includes a reduction of CO2 for the suppliers by actively choosing suppliers with lower CO2 emissions. This will likely also include a higher demand for suppliers with lower transportation emissions.

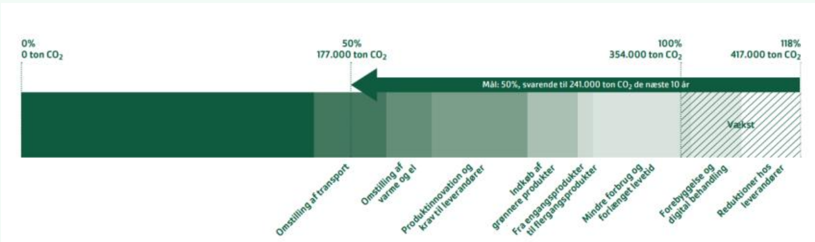

Figure 4 - Emission reduction by sector in Region Zealand (Grøn Fremtid 2035, 2025, p. 6).

The strategy aims to significantly reduce CO2 emissions from passenger and goods transportation by transitioning to low emission vehicles. Another important part of the strategy includes cooperation with Flextrafik, a flexible public transport offer by Movia, which is used for patient transportation. Their strategy is to have all their vehicles fully electrified by 2030. Region Sjælland sees a challenge with electrifying special vehicles, such as ambulances, because of concerns about range and reliance. They state that they are focusing on the development of the market for this (Grøn Fremtid 2035, 2025).

Overall, the strategy for transportation seems to focus mainly on electrification. However, hydrogen is mentioned as a solution. Additionally, it is stated that the region is still looking for alternatives to electric transportation for special vehicles such as ambulances. The strategy also highlights the importance of cooperation and innovation to find new solutions for emission reduction in all areas. This includes "international networks and EU projects", as well as public-private partnerships. In 2023, the five Danish regions entered into an ambitious strategy for green hospitals. The strategy sets the direction for the 50% target, which not only Region Zealand is working towards, but which the entire Danish hospital system must achieve by 2035 (Grøn Fremtid, 2025).

4.2 Denmark

On the country level, Denmark launched a strategy for green public procurement in 2020 called "Green Procurement for a Green Future" (Ministry of Finance, 2020). It aims at reducing Denmark's greenhouse gas emissions by 70 per cent in 2030. The strategy entails three focus areas:

1. **Green Action Now**, which includes a focus on more sustainable food and the life cycles of purchased products.
2. **Long-term Green Development** includes the transition to an entirely emission-free public vehicle fleet by 2030. This is supervised by the Secretariat for Green Procurement in the Danish Environmental Protection Agency. The Charter for Good and Green Procurement sets practical guidelines on this.
3. **Green Knowledge and Tools** entail annual calculation and projection for the public procurement climate footprint, and guidelines are adjusted.

Overall, the strategy sets clear emission reduction goals but stays quite vague about how these are achieved. Especially within transportation, there is no clear roadmap or specific targets on how to reduce emissions.

Currently, the public procurement of Denmark accounts for around 12 million tons of CO2eq emissions. Around 1 million tons of this stems from the transportation of goods and people. Reducing this remains a challenge, and the solutions are not clearly laid out in the strategy.

4.3 EU

The EU Green Public Procurement strategy consists of voluntary criteria and non-voluntary requirements. The voluntary requirements help national governments to set criteria for national and regional green public procurement, while the requirements are mandatory for all public procurement across the EU.

EU green public procurement criteria for road transport (SWD(2021) 296 final)

The criteria for road transport aim to encourage public procurement of zero-emission hydrogen vehicles. It includes promoting the use of renewable hydrogen rather than fossil-based hydrogen for heavy-duty vehicles. To be eligible, hydrogen must be produced from renewable sources. This implies that fuel-cell electric vehicles qualify only if they have a supply of hydrogen produced with renewable sources generated on-site, meeting at least 15% of the vehicle fleet's demand. In general, across the different types of transportation categories, the recommendations are rather on the maximum amount of CO2 and pollution that can be emitted by vehicles. It is not specified which kind of fuel should be used to achieve the targets.

The Clean Vehicles directive (Directive (EU) 2019/1161)

This directive introduces emission thresholds for vehicles to be classified as 'clean', however, only for light-duty vehicles. For heavy-duty vehicles the directive states that clean heavy-duty vehicles should use alternative fuels as defined by Directive 2014/94/EU. When vehicles run on liquid biofuels, synthetic, or paraffinic fuels, public authorities must ensure that only these fuels are used. Fuel additives are allowed (e.g., ethanol-based ED95), but mixing with fossil fuels is prohibited.
The directive gives specific minimum targets of the share of clean heavy-duty vehicles that are mandatory for each member state, depending on their relative income level. For Denmark, as a high-income country, this is displayed in Table X. Green hydrogen as a fuel is not mentioned in this directive, however, it falls under alternative green fuels.

Country: Denmark	Trucks (category N2 and n3)		Buses (vehicle category M3) (*)	
	From 2 August 2021 to 31 december 2025	From 1 January 2026 to 31 december 2030	From 2 August 2021 to 31 december 2025	From 1 January 2026 to 31 december 2030
	10 %	15 %	45 %	65 %

Table 5 - Minimum procurement targets for the share of clean heavy-duty vehicles in the total number of heavy-duty vehicles (Directive (EU) 2019/1161).

***The Alternative Fuels regulation* (REGULATION (EU) 2023/1804)**

The Alternative Fuels Regulation (AFIR) was launched in 2023 and provides a framework for member states for the deployment of alternative fuels infrastructure. It provides a common framework and binding targets for member states with the aim of developing and homogenising hydrogen infrastructure across the EU.

The focus of the strategy is to ensure the availability, accessibility, and interoperability of refuelling hydrogen infrastructure. While the focus lies upon heavy- and light-duty vehicles, the strategy applies to road, maritime, inland waterways, and aviation. It also demands that all member states submit a national progress report, which are expected to be launched between 2026-2028 REGULATION (EU) 2023/1804).

The AFIR regulation sets specific targets for 2030 for recharging infrastructure for hydrogen-powered and electric cars HDV, as presented in Figure 8. The recharging infrastructure is included in the infrastructure goals for the TEN-T European corridors as well as urban infrastructure.

Scope	Minimum capacity requirement	Distance requirements
TEN-T core	At least 3600 kW of aggregated power output in one dedicated HDV recharging pool, with at least two points of at least 350 kW.	Every 60 km in each direction of travel
	Minimum capacity of 1 tonne per day of hydrogen refuelling stations for lorries and cars, equipped with at least a 700 bar dispenser.	Every 200 km
TEN-T comprehensive	At least 1500 kW of aggregated power in one recharging pool with at least one point of minimum 350 kW	Every 100 km in each direction of travel
Urban nodes	Recharging points with a minimum of 150 kW each and with an aggregated power output of at least 1800 kW	

	One hydrogen refuelling station for cars and lorries	
Safe and secure parking	At least four recharging stations of at least 100 kW in all safe and secure parking areas	

Table 6 - Recharging requirements for 2030 according to the AFIR regulation (REGULATION (EU) 2023/1804).

5 Trends and Developments

5.1 EU

A report by Ey and Hyvolution from January 2025 (Ey & Hyvolution, 2025) concludes that the hydrogen policy framework of the EU is comprehensive but not clear enough. In addition to the policy framework, funding projects have been put in place to support the development of the hydrogen ecosystem in the EU. However, the report finds that the funding schemes are often complex and take a lot of time to be in place. They see that Europe has great preconditions for a full hydrogen supply chain, but support for developing multi-stakeholder ecosystems, large capacities and the necessary infrastructure is not sufficient until now. While many projects are starting to develop, the report identifies delays in project development over the past years, mainly due to problems of long-term offtaker commitment and difficulty in securing financing for CAPEX-intensive projects.

The IEA (International Energy Agency) draws similar conclusions for Europe in their 2025 "Global Hydrogen Review" report (IEA, 2025). It finds that Europe's hydrogen sector is expanding but is still early-stage. Many projects lack firm commitments, and some face delays or cancellations. While EU targets for renewable hydrogen remain ambitious, progress depends on addressing high costs, limited infrastructure, and uncertain demand. Traditional industrial uses will dominate in the short term, with emerging applications such as mobility growing slowly.

a. Mobility

The uncertainty of demand for hydrogen is particularly prevalent in the transport industry. The European Commission (COM(2025)260final) finds that a major challenge with hydrogen-fuelled vehicles is the technology uncertainty in the industry. There are currently three competing hydrogen fuel technologies on the market. Each has different advantages and requires different types of refuelling stations, which creates high uncertainty and a lack of investment. Figure 9 shows the different fuels and their advantages and disadvantages.

Technology	Advantages	Disadvantages
Fuel cell vehicles running on compressed hydrogen	Currently predominant technology, most efficient	High purchase and operational costs
Liquid hydrogen	Longer range	More expensive, less efficient
Hydrogen internal combustion	Cheaper to produce and easier to manage technology	Lower purchase costs but higher operational costs

Table 7 - Comparison of hydrogen fuelled vehicle technologies (COM(2025)260final).

Technology uncertainty creates challenges in scaling up the market, for both vehicle producers and refuelling station suppliers, creating a 'hen and egg problem', where poor infrastructure prohibits truck producers from scaling up, and the lack of larger production of one of the technologies by producers creates uncertainty about which refuelling stations should be invested in.

There is generally a high demand for green fuelled HDV, as countries have to adhere to EU targets, as well as, often, even more ambitious national and regional targets, as in the case of Denmark and Region Zealand. However, as hydrogen investments remain risky and expensive, the market for electric HDV is growing, even though challenges such as insufficient grid connectivity and inconvenient charging requirements remain (COM(2025)260final). With more investment and clarity, this is a gap that hydrogen technology could fill. However, at the end of 2024, only around 170 hydrogen lorries and 500 hydrogen buses and coaches were registered in the EU. In Denmark, there are no hydrogen lorries or buses registered. Other countries such as Germany, France and the Netherlands had some more registrations, but in the past year, the amount of newly registered vehicles decreased again in these countries, showing a highly unstable market demand.

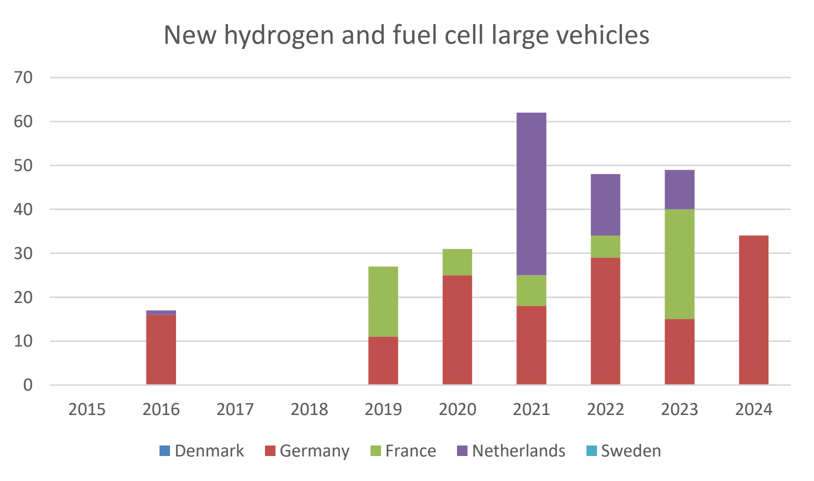

Figure 5 - New hydrogen and fuel-cell by country since 2015 (Eurostat, EAFO, 2025)

b. Refuelling Infrastructure

While there are clear targets formulated by the European Commission, especially when it comes to hydrogen refuelling infrastructure, the Danish refuelling hydrogen infrastructure is especially poorly developed compared to other countries in the EU. The EU identified that an important step in the development of hydrogen-fuelled vehicles is the availability of refuelling infrastructure. Figure 11 shows a map by *The European Hydrogen Refuelling Station Availability System*, which shows the availability of refuelling stations and their respective capacity.

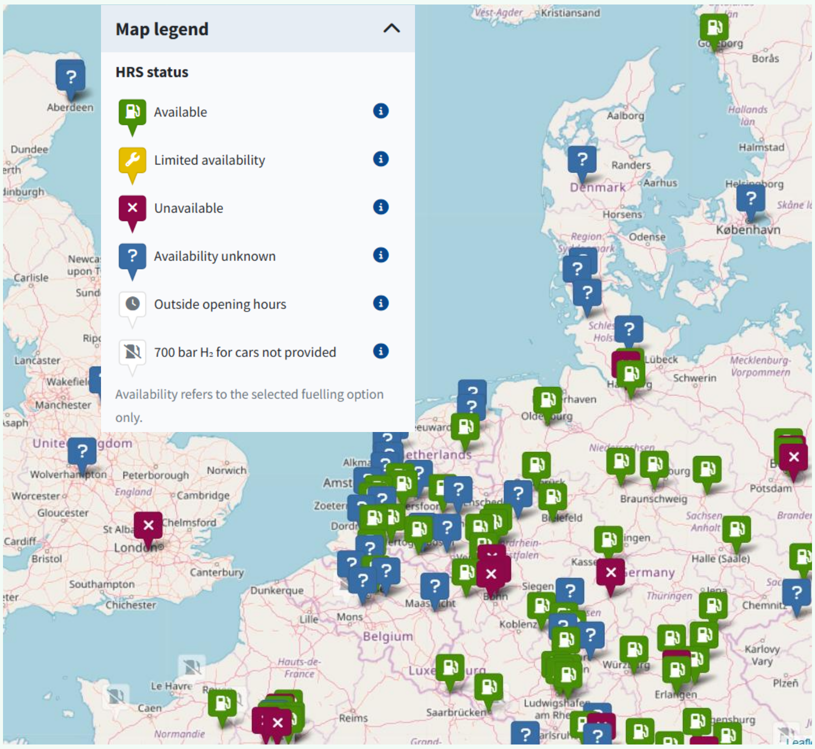

Figure 6 - Availability of hydrogen refuelling stations (h2stations, 2025).

c. Break-even Prices

In order for renewable hydrogen fuels to reach scale for HD trucks, the technology must be competitive with fossil fuel-based solutions. In Figure 12 the break-even prices across different mobility sectors for renewable hydrogen across Europe are shown. The break-even price for heavy-duty trucks is significantly higher than for the maritime industry and steel-making applications.

The break-even price is the end-use price of renewable hydrogen at which it reaches cost parity with the fossil fuel benchmark, considering hydrogen end-use technology. The end-use price is the cost incurred by the final off-taker, covering hydrogen production, compression, liquefaction, transport, distribution, and storage. Renewable hydrogen is assumed to be produced through low-temperature water electrolysis. The fossil fuel benchmark refers to the commonly used fossil-based fuel and technology in selected applications. Fossil fuel-based baselines include Very Low Sulfur Fuel Oil (VLSFO) for maritime applications, coking coal for primary steel making, diesel for heavy-duty trucks, and hydrogen from SMR with natural gas for oil refining.

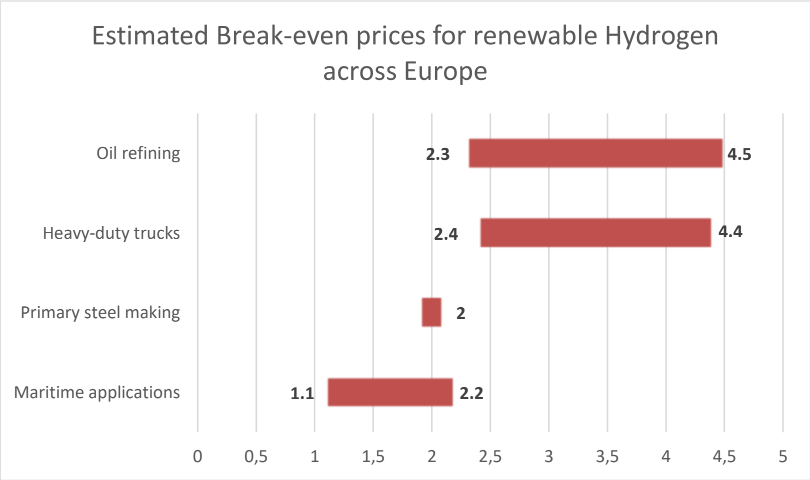

Figure 13: Break-even price of hydrogen fuels across different sectors in mobility across Europe, Data source: European Hydrogen Observatory Prices, 2024.

The European Hydrogen Observatory also provides estimations for specific countries. From the consortium countries, France has the highest production cost for green hydrogen with 7.4 Eur/kg and Denmark has the lowest with 5.5 Eur/kg. However, the break-even estimation is also the lowest for Denmark and the highest for France.

The price per kilogram at refuelling stations is around €13 per kilogram at German H2 mobility stations (h2stations, 2025a). This shows that the production price is significantly lower than the consumption price. Reasons for the relatively high consumption prices could be the low scale of the industry, as well as low competition and expensive technology. This also indicates, however that there is a high potential for the market to develop further and supply green hydrogen at a much lower price.

Country	Total production costs (2024) in Eur/Kg	Break-even price estimation HD trucks (2024) in Eur/Kg
Sweden	6.4	4.7
Denmark	5.5	3.1
Germany	6.5	4.2
Netherlands	5.2	4.4
France	7.4	4.8

Table 8 - Total production costs of renewable hydrogen and estimated break-even prices for HD trucks application. Data source: European Hydrogen Observatory Prices, 2024.

5.2 Denmark

To get a closer look at the Danish hydrogen ecosystem, the following three sections look at the main value chain links and identify gaps between the ambitions and procurement targets and the current state of the Danish hydrogen market.

Production

Despite several production projects being decommissioned in early stages of development, Denmark still has a considerable number of projects in operation or under development. The optimal conditions and the strong market for wind energy provide a good base for green hydrogen production. The successful tender auction in 2023 shows that, with adequate state support, the market is ready to operate PtX facilities.

Recent studies have drawn increasing attention to offshore hydrogen production, suggesting that for large-scale offshore wind projects, transporting hydrogen molecules via pipelines could be more cost-effective than transmitting electricity through HVDC cables. Specifically, the research indicates that when offshore wind farms are located far from the coast, building offshore hydrogen production and pipeline transport systems becomes economically preferable to sending power to shore for hydrogen generation on land (Danish Energy Agency, 2025, p. 38).

Transmission

Transmission infrastructure is lagging behind, with the first Danish hydrogen pipeline being anticipated to be in place by 2030. The Danish-German Hydrogen network pipeline is a promising project that connects Danish production capacities with German demand in hard-to-abate heavy industries. Additionally, the so-called Energy Islands, a large PtX project, is also testing to transport hydrogen through offshore pipelines.

There has been a lack of commitment to hydrogen infrastructure, as the support scheme for the hydrogen pipeline was not politically confirmed until this year. This had great repercussions throughout the whole value chain. This lack of commitment was partly a reason why the auction for the biggest offshore wind tender North Sea I failed last year. Producers were uncertain if the electricity could be used for hydrogen production as they could not enter into agreements with offtakers, which would ensure a minimum value for the tender (Bach Nielsen, 2024). This shows that, in this early stage of development, the hydrogen value chain is highly vulnerable, and a lack of support for one part of the value chain can lead to a collapse of the entire chain.

Demand

A report by Energinet & Gasunie (2023) predicts that the demand for hydrogen to be very low in Denmark compared to its production potential. Therefore, export opportunities to, i.e. Germany or Sweden and other countries are extremely high. These countries have large industrial sectors with hard-to-abate industries, where green hydrogen is expected to be able to replace fossil fuels. However, today Denmark is still a hydrogen net importer, with the largest trade volumes coming from Germany (European Hydrogen Observatory Trade, 2024).

Currently, Denmark is not using its potential in the industry and in the long term, Energinet & Gasunie expect a 90 per cent export share in Danish green hydrogen production. In 2023, the German-Danish Offtake Declaration on green hydrogen was signed by companies and chambers of commerce. However, the German industry remains hesitant when it comes to offtake agreements (Ingeniøren, 2025). This creates a problem for Danish producers as they are not willing to buy capacity in the hydrogen pipeline, which is tendered in 2026.

Domestically in Denmark, the main demand sector for hydrogen is expected to be transport and mobility, especially HDVs such as lorries, buses and coaches. However, the adaptation of hydrogen-fuelled HDVs is going especially slowly in Denmark as EU data shows (Eurostat, EAFO, 2025). In 2024, there was not a single newly registered hydrogen vehicle in Denmark, and the recharging infrastructure is very poorly developed. Denmark is lacking reliable hydrogen refuelling stations, especially for heavy-duty vehicles, and the status of the few registered ones is unclear. This is likely to be blamed on a lack of commitment in public infrastructure investments, as well as the technology uncertainty in the sector. The European Commission finds that there is a need for public investment in hydrogen refuelling stations, as the current costs and safety requirements are currently still too high for private investors (COM(2025)260final).

While Denmark is struggling to scale up green hydrogen fuel for road transport, the maritime industry might be another main stakeholder in the market. In May 2025 it was announced that the largest commercial e-methanol plant was opened in Kassø, Southern Denmark. This plant provides e-methanol to Mærsk container ships. This has been celebrated as a milestone in decarbonising maritime transport through PtX solutions.

5.2.1 SWOT Analysis of the Hydrogen Ecosystem in Denmark

While green hydrogen production is scaling up in Denmark, and many companies show long-term interest in the market, there are major challenges to be addressed in the transmission of hydrogen and, above all, on the demand side. It has been shown that unreliable investments and a lack of demand can cause disruptions along the whole value chain, threatening the development of the green hydrogen industry and thus the decarbonisation of industry and transportation. Figure 12 presents a SWOT analysis of the Danish Hydrogen Ecosystem, summarising the findings of the analysis.

SWOT DANISH HYDROGEN ECOSYSTEM

STRENGTH - Ideal conditions for hydrogen production due to strong renewable energy industry - Strong energy market - High ambitions for green transition at EU, national and local level - Ideally located for export opportunities to countries with large hard-to-abate industry sectors	**WEAKNESSES** - Government strategies around hydrogen are vague on all levels - Unclear political incentives for the demand side - Production largely dependent on demand from abroad, especially Germany - The hydrogen mobility market is stuck in a 'hen and egg' problem - Often lack of long-term offtaker commitment
OPPORTUNITIES - Support schemes in PtX and pipeline tenders boost the market and can help with upscaling - Use in health sector through region's GPP - Public sector can act as offtaker through GPP and bring stability to demand side - Large export opportunities - Maritime industry demands green fuels	**THREATS** - Electric vehicles keep being more financially competitive for HDVs - Technological uncertainty hinders demand and refuelling infrastructure in the HDV industry - Low commitment to hydrogen infrastructure investments - GPP is unspecific and not targeted towards hydrogen - Competition from other countries if the market does not scale up soon

Figure 7 - SWOT analysis of the Danish hydrogen ecosystem

6 Conclusion

Despite Denmark being an optimal producer country for green hydrogen, the industry is struggling and remains highly risky and costly. The main problem in the Danish hydrogen ecosystem seems to be the demand side. Unclear incentives in the transmission infrastructure have previously been a problem; however, the Danish government has now sent clear signals to the market with the final decision on the Danish-German hydrogen pipeline. However, the unstable demand on both the German side and domestically is still a major threat to the development of the industry. As most of Denmark's hydrogen production is based on export, demand from abroad is crucial for scaling up the industry.

For transportation, hydrogen seems like a promising technology for HDV and maritime shipping in Denmark. However, technology uncertainty and a lack of public commitment to building refuelling stations have halted the industry's development. Currently, there seems to be a situation in which neither the refuelling infrastructure side nor the HDV demand side is making a move towards a clear path for technology and investment.

While the EU as a whole is struggling to scale up the market as fast as anticipated, Denmark is performing particularly poorly, with no refuelling stations and low commitment to hydrogen fuel technology in public procurement. Currently, electric vehicles are still cheaper, and the main focus of public procurement in Region Zealand and Denmark generally lies on this. However, the technology has limits due to grid capacity limitations and non-applicability to all HDVs due to range or reliability. Hydrogen-fuelled HDV can solve many of these problems, but initial investments are currently too high, so public industry boosts are necessary to make the market competitive. Green public procurement can play a strategic role in this, to boost demand by targeting hydrogen technologies specifically. Currently, GPP strategies are very general and technology-neutral on all levels, from regional to EU. A clear direction would give certainty and clear investment incentives to the market.

This analysis mentions the Danish maritime industry only briefly; however, this industry could be further investigated as an end-user. Denmark has a big shipping industry, and shipping companies are looking more and more into alternative, sustainable fuels.

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8 Appendix

Production (Supply side)
Example of Danish stakeholders

Company/Organisation	Project/Role
Copenhagen Infrastructure Partners (CIP)	Power-to-X and hydrogen projects (e.g., HØST PtX Esbjerg, Bornholm Energy Island consortium)
Ørsted	Offshore wind + hydrogen integration (e.g., Green Fuels for Denmark, FlagshipONE with Liquid Wind) PROJECT FAILED
Topsoe	Electrolyser and catalyst technology (SOEC) and ammonia/fuel synthesis
Everfuel	Hydrogen production, distribution, and refuelling network
European Energy	Renewable energy developer with PtX ambitions (e.g., Kassø, Holstebro projects)
Green Hydrogen Systems	Danish electrolysis solutions
Vestas	Renewable power suppliers with PtX partnerships
Siemens Gamesa	Renewable power suppliers with PtX partnerships

Distribution (Transport, Storage, and Infrastructure)
Example of Danish stakeholders

Company/Organization	Project/Role
Energinet	National TSO, leading the development of the Danish hydrogen backbone ("Syvtallet") and cross-border links to Germany
Gas Storage Denmark	Hydrogen and CO_2 storage development (e.g., underground caverns)
Port Authorities – Esbjerg, Frederikshavn, Hirtshals, Aalborg	export, logistics, bunkering hubs

Everfuel Logistics	Distribution network for hydrogen transport
European Hydrogen Backbone (EHB) initiative (collaboration with German TSO Gasunie Deutschland)	Cross-border coordination

End-Use Applications (Demand)
Example of Danish stakeholders

Company/Organisation	Project/Role
DFDS	Maritime end-user
Mærsk	Maritime end-user
Scania	HDV end-user
Volvo	HDV end-user
Arla	They are looking into replacing natural gas for heating pumps in milk powder production

Winners PtX auction 2023
The six winning projects:

Project	Elektrolyses capacity	Status
European Energy / Vindtestcenter Måde K/S (Esbjerg)	9 MW	Active (Opened in October 2024)
European Energy / Kassø PtX Expansion ApS (Rødekro)	10 MW	Active (opened in May 2025)
Electrochaea / Biocat Roslev (Rybjerg)	10 MW	In progress
European Energy / Padborg PtX ApS	150 MW	In progress (delayed)
Plug Power Idomlund Denmark (Holstebro)	100 MW	Active (opened in April 2025)
HyproDenmark/Everfuel	? MW	In progress (delayed)

H2ignite | Interreg North Sea | Co-funded by the European Union

Project Title:	Igniting H2 Transport Innovation Ecosystems in the North Sea Region
Acronym:	H2ignite
Call:	Call 4C (FA)
Priority:	Priority 1. Robust and smart economies in the North Sea Region
Priority specific objective:	Developing and enhancing research and innovation capacities and the uptake of advanced technologies
Start date:	01/09/2024
Duration:	36 Months
Website:	www.interregnorthsea.eu/h2ignite
Consortium:	Ministerium für Landwirtschaft, ländliche Räume, Europa und Verbraucherschutz (MLLEV) - Germany Kiel Institut für Weltwirtschaft – Leibniz Zentrum zur Erforschung globaler ökonomischer Herausforderungen (IfW) - Germany Europa-Universität Flensburg (EUF) – Germany Hafen Hamburg Marketing e.V. (HHM) - Germany Region Sjælland (STRING) – Denmark DFDS A/S (DFDS) – Denmark Københavns Universitet (UCPH) – Denmark Pôlénergie (POL) - France Provincie Drenthe (Drenthe) - Netherlands Lindholmen Science Park AB (LSP) – Sweden Volvo Technology Corp. (VTEC) - Sweden