Hydrogen Action Plan for the Pomeranian Province

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1. Introduction

Protecting the natural environment, and thus ensuring good living conditions on Earth, is one of the key challenges facing civilisation today. Implementing the concept of sustainable development is the widely accepted path to achieving this goal. In this context, a major challenge is the decarbonisation of the economy, the achievement of which depends mainly on changes in energy systems, including the use of zero-emission fuels and green energy. Hydrogen is an element that can undoubtedly be used to power industrial installations and vehicles, while also serving as a source of clean heat and emission-free energy. The development **of the Hydrogen Action Plan for the Pomeranian Province** (Plan/WPD) is an initiative that is part of the process of promoting and implementing hydrogen technologies in the economy and social system.

The methodological assumptions for the preparation of the document were based on guidelines prepared as part of the ***H2CE – Hydrogen Integration for Central Europe*** (H2CE) project, financed by the Interreg Central Europe programme for 2021-2027. As part of the project, strategic planning guidelines were developed: *Guidelines for the development of a hydrogen strategy or action plan H2CE – WP1 Deliverable 1.2.1*. The guidelines indicate the basic elements of the process of preparing hydrogen action plans, covering four key stages, of which the first three will be implemented as part of this study (Figure 1).

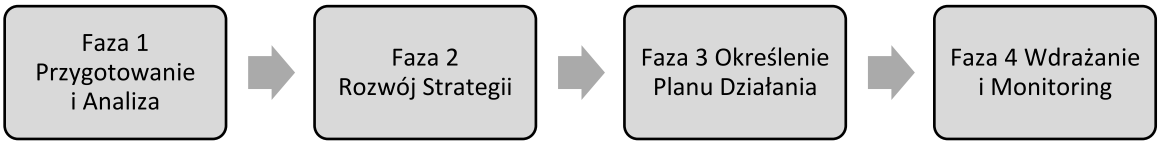


Figure1. Guidelines for strategic planning for the development of the hydrogen sector according to H2CE

Source: H2CE Project

The preparation of this document required a series of analyses and consultations with stakeholders in the hydrogen sector operating in the Pomeranian Province. Of course, their scope of activity is usually much broader, but it is the potential of the region and its future needs that are the central point of reference for defining planned activities and projects aimed at the promotion and facilitation of hydrogen solutions.

The first part of the Plan includes a desktop analysis, which began with the identification of the basic types of hydrogen, with particular emphasis on those categories (colours) that allow for positive changes towards a sustainable economy. Undoubtedly, the most desirable type here is green hydrogen, whose production is based on renewable energy sources. However, attention was drawn to other types, which, on the one hand, may be a transitional solution, and on the other hand, their implementation increases the level of knowledge and experience in the use of this type of fuel.

The following sections of the document analyse potential sources of demand for hydrogen, with industry, transport and thermal energy being particularly important applications.

In the case of industry, the key issue is, on the one hand, the wider use of the element in powering technological processes, and on the other hand, the transition from traditional to green hydrogen. In the transport sector, which is also under strong decarbonisation pressure, hydrogen appears to be an alternative fuel. Of course, only clean types of hydrogen ensure full neutrality. An area of particular interest here is public transport. This is from two key factors: firstly, the use of hydrogen to power buses is a well-known and tested technology, also in Poland. Secondly, the characteristics of public transport vehicles (limited range) allow optimise the entire value chain, in particular the concentration of demand and supply flows. Hydrogen as an energy carrier is also used in thermal energy, where the implementation of a cogeneration system allows for a significant increase in the efficiency of the installation.
The preliminary analyses also included a review of the strategies and plans that determine the process of hydrogen dissemination at European, national and regional levels and regional levels.

Another part of the Plan was devoted to reviewing the region's future hydrogen needs, highlighting the characteristics of individual areas and sectors of economic activity that are susceptible to hydrogen technologies. Of course, their actual use in the future will depend on many factors, including technical, organisational, regulatory and, finally, economic ones.

The analysis of supply possibilities referred to the conditions and factors that will potentially support Pomerania in the process of hydrogen implementation. Key elements include a very large renewable energy production base, in particular the offshore wind farms currently under construction, which will complement the well-developed system of onshore wind power generation and onshore photovoltaic farms. Another important issue is access to water, which is a raw material for hydrogen production through electrolysis. Among the advantages are also seaports, which can naturally become hubs integrating the entire hydrogen value chain. Another noteworthy element is the region's potential for gas storage in salt caverns. Based on such natural storage facilities, and taking into account the plans for the development of trans-European hydrogen pipeline networks, it is possible to plan the development of a hydrogen hub in Pomerania, which would be based on a large-scale, so-called bankable hydrogen storage facility. This type of infrastructure is particularly important in the context of the production and consumption of green hydrogen, the production of which is subject to strong fluctuations over time.

In the second phase of the Plan's development (Strategy Development), the knowledge and opinions of stakeholders in the hydrogen sector were sought, who on a daily basis create and implement various technological and organisational solutions supporting the implementation of the technology. To this end, a series of consultation meetings (6 meetings) was organised, as well as a workshop to discuss the preliminary assumptions and results of the work on the Plan. In order to systematise the issues discussed, the series of seminars was divided into three thematic blocks:

1) Green hydrogen production in the Pomeranian Province,
2) Transport and storage of green hydrogen in the Pomeranian Province,

3) Use of green hydrogen as an energy carrier or fuel and a substrate for storing technological surpluses.

Within these blocks, seminars were organised to discuss several key issues, including:

- the potential for the development of (green) hydrogen production,
- technological challenges for the development of the hydrogen industry,
- land transport powered by (green) hydrogen,
- implementation of (green) hydrogen in ports and maritime transport,
- technologies for the transport and storage of (green) hydrogen,
- development challenges for the Pomeranian (green) hydrogen hub.

The conclusions from the meetings provided excellent material for further work towards defining key implementation tasks. To supplement the information and expand the scope of the consultations, an online survey form was also prepared, asking several basic questions about the directions and conditions for the development of the hydrogen sector. The results of the meetings and the survey are an integral part of the Plan.

The most important stage was to define an action plan, understood as identifying the most important activities and tasks facing the region on the path to the widespread integration of green hydrogen into the economy. In this case, the recommendations were divided into two categories. The first category consists of short-term tasks, with a starting period of 12 months. The second category consists of long-term activities, with a completion date of 2030.

The last part of the document presents a proposal for monitoring activities to assess progress in the implementation of this Plan. In this case, a different approach is indicated for short-term tasks, whose implementation can be reduced to a 0-1 system, and another for medium-term actions, which are by their nature more complex and dependent on a number of external factors.

2. *Specificity and technological requirements of hydrogen production and consumption*

2.1. Hydrogen – production and colours

Hydrogen (H_2) is the simplest and most abundant element. It does not occur in its pure form on Earth, but as a component of chemical compounds, mainly water (H_2O) and hydrocarbons. In order to be used as an energy carrier, it must be isolated using appropriate technologies, which involves energy expenditure. The source of energy used for hydrogen production also defines its 'colour', with the following categories distinguished (Figure 1):

- green – produced by electrolysis from clean electricity generated from surplus renewable energy sources;
- yellow – produced by electrolysis using solar energy;
- pink or purple – produced by electrolysis powered by nuclear energy;
- blue – produced mainly from natural gas through steam reforming with the simultaneous use of *carbon capture and storage (CCS*) processes;
- turquoise – produced by pyrolysis of methane obtained from natural deposits;
- grey – produced from *steam* methane reforming *(SMR*) without the use of CO_2 capture.
- brown or black – produced from the gasification of lignite or hard coal, respectively.

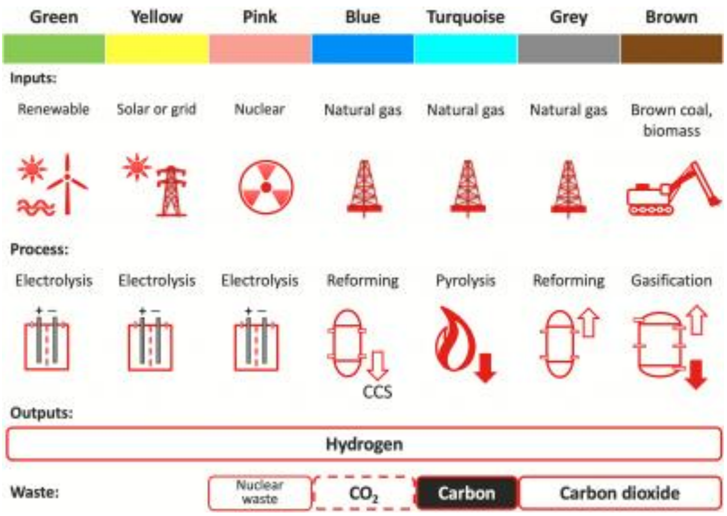


Figure2. Hydrogen colours and production methods

Source: https://broadleaf.com.au/resource-material/the-colour-of-hydrogen/

White or gold hydrogen, which occurs naturally (in underground deposits) or is a 'waste product' of production processes, is also mentioned, as is red hydrogen, which is produced by electrolysis using energy obtained from biomass. However, the division into individual categories is not normative, which is why slightly different classifications can be found in the literature.

From the point of view of environmental challenges, where the key challenge is to reduce greenhouse gas emissions into the atmosphere, the most desirable types of hydrogen are green or yellow, as they ensure the elimination of emissions and waste throughout their life cycle. Pink and blue hydrogen, as well as turquoise hydrogen, also meet the environmental requirements for reducing greenhouse gases (decarbonisation), but their use involves the need to manage post-production waste.

As indicated, the colour of hydrogen is also a result of the production methods used, among which five basic methods can be distinguished, including: steam reforming of methane, electrolysis and photolysis of water, pyrolysis of methane, coal gasification and biological production (gasification of biomass and waste).

Table1. Basic characteristics of hydrogen production methods

Technology	CO_2 emissions	Development stage	Raw material
Methane steam reforming	High	Mature	Natural gas
Coal gasification	High	Mature	Coal
Methane steam reforming + CCS	Medium	Commercial	Natural gas
Electrolysis	Low	Scalable	Electricity
Biomass gasification	Low	Pilot	Biomass
Methane pyrolysis	None	Demonstration	Methane
Photocatalysis	None	Pilot	Solar

Source: Own study based on: Hydrogen Council, 2021; IEA, 2022

The most widely used method of hydrogen production in the world today (in 2024, hydrogen production reached almost 100 million tonnes) is steam methane reforming, which accounts for about 60% of production. Other technologies include coal gasification (approx. 20%) and hydrogen production as a waste product from technological processes (approx. 18%). Low-carbon hydrogen currently accounts for only 1% of global production, which corresponded to 0.8 million tonnes in 2024[1].

Returning to environmental issues, in economic practice the term "green hydrogen" often refers to a much broader scope than EMSA does. It is assumed that green hydrogen is hydrogen obtained through electrolysis based on renewable energy sources, direct production of hydrogen from solar energy (photoelectrolysis, thermolysis and biophotolysis), biomass fermentation (dark fermentation, photo-fermentation and multiphase fermentation), as well as thermochemical conversion of biomass (pyrolysis, gasification)[2]. For most the indicated production methods, the level of technological maturity is relatively low and amounts to, respectively:

- electrolysis: 3-9 TRL;
- direct production from the sun: 1-4 TRL;
- biomass fermentation: 1-4 TRL;
- thermochemical conversion of biomass: 4-6 TRL.

[1] Global Hydrogen Review 2025, EIA 2025.
[2] *Potential of hydrogen as fuel for shipping, EMSA/Hydrogen-2022/2023, 31 August 2023.*

It can therefore be said that, at present, only electrolysis based on sustainable energy sources has market potential, which is why this source of green hydrogen should be the focus in the context of environmental challenges.

2.2. Requirements and limitations for hydrogen storage and supply

The use of hydrogen in economic applications requires a dedicated storage and transport system. Hydrogen storage itself is a key link in the hydrogen economy, enabling the stabilisation of supplies, the powering of industrial processes, use in transport and the balancing of the RES-based power system. Hydrogen can be stored in various forms, including:

- physical storage:
  - [3] e (CH_2);
  - [4] e (LH_2);
- storage in solid materials:
  - metal hydrides;
  - porous materials (MOFs, zeolites, nanocarbons);
- chemical storage:
  - LOHC ([5]);
  - ammonia (NH_3).

The choice of the appropriate method depends on factors such as scale, storage time, end use, safety and costs. The development of storage facilities allows for the elimination of discrepancies in both the timing and location of hydrogen production. This is because hydrogen is produced irregularly (e.g. by electrolysers powered by photovoltaics or wind), which is why it needs to be stored for times when energy demand increases. In addition, the use of an appropriate storage method facilitates the spatial integration of the supply chain and increases its transportability. Depending on the method used, the following options for transporting/transmitting hydrogen can be considered:

- transport via hydrogen pipelines (compressed hydrogen in gaseous form);
- transport of CH_2 in high-pressure tanks (350-700 atm);
- transport of LH_2 in cryogenic tanks (-253 °C);
- transport in cryogenic tanks in the form of ammonia (-33 °C);
- transport in liquid organic hydrogen carrier (LOHC) tanks.

An important issue concerning hydrogen storage and transport technology is the energy potential of individual carriers, where the most effective solutions are liquefied hydrogen (LH_2) and hydrogen transported in pressure tanks (CH_2). Of course, in the case of liquefied hydrogen, the technological challenge is to maintain the required storage temperature. On the other hand, a lower temperature regime applies to the use of ammonia, but in this case, an important technological and

[3] Compressed Hydrogen
[4] Liquid Hydrogen
[5] Liquid Organic Hydrogen Carrier

safety-related challenge is its toxicity and corrosive properties, which necessitate appropriate certification and handling procedures.

2.3. The spectrum of hydrogen use in the socio-economic system

Hydrogen has relatively wide applications in many sectors of the economy, and its use in production processes in heavy industry, energy and heating, as well as in transport, can be considered key.

The main applications in heavy industry are the production of ammonia and methanol, which is also an important area in the context of transport and the use of low-emission or zero-emission green varieties of these fuels (green hydrogen must be used in production processes). It can also be used in oil refining technologies (so-called hydrorefining) and in the conversion of iron ore into steel (e.g. RDI-H_2technologies) as a source of high-temperature heat. In this case, green hydrogen can replace coke in the steel smelting process in electric arc furnaces, which allows for the production of so-called green steel
(H2 GreenSteel). Hydrogen as a raw material can also be used as a fuel for high-temperature process heat used in cement plants.

Another area where hydrogen solutions are being implemented is energy and heating. In this case, the key factor determining the use of hydrogen is mainly the desire to utilise the 'waste heat' generated in the electrolysis process. The efficiency of electrolysers is currently around 60-70%, which means that one third of the energy is released as heat. Losses are also recorded when hydrogen is reused for electricity production using gas turbines or fuel cells, where efficiency is estimated at 40-55%. Thus, the total efficiency of the entire process is approximately 24-38%. Waste heat recovery can therefore increase this efficiency to 60-80%. Hydrogen itself can also be used as a fuel for energy production, both in the form of hydrogen-natural gas mixtures and in hydrogen boilers (hydrogen power plants). Cogeneration processes (electricity + heat) carried out in this way increase the energy efficiency of systems and support local energy sources. However, it is crucial to integrate the various stages of the process, from production and storage to utilisation. This maximises energy and, therefore, economic gains. Another popular solution is to use hydrogen that is produced as a by-product of industrial processes. An example of this is chlorine production, where hydrogen is a valuable 'waste product' that can then be used to produce energy. Hydrogen is also of great importance for the energy sector as a carrier for the storage of electricity from renewable energy sources (including photovoltaics and wind energy). Hydrogen electrolysis is a technology that allows the variable supply and demand for electricity to be balanced.

A sector where hydrogen has potential applications is land transport, including private transport (cars), public transport (buses) and freight transport (lorries, locomotives). Hydrogen is also used as a fuel or energy carrier (hydrogen fuel cells) in maritime transport. Attempts are also being made to develop hydrogen technology for civil aviation (e.g. Airbus ZEROe).

An analysis of global data indicates the leading importance of industrial applications of hydrogen, which account for 55% of consumption (including ammonia and methanol production and the steel industry), with a further 43% being demand from the refining industry. The marginal importance of other hydrogen applications is therefore evident. The main global consumers of hydrogen are China (29%), North America (16%), the Middle East (15%), India (10%) and Europe (7%)[6] . In Europe, demand for hydrogen is mainly generated by the refining industry (57%), ammonia production (25%) and the manufacture of other chemicals (9%)[7] . The use of hydrogen for transport, heating and energy accounts for only about 4% of European demand.

2.4. Strategic documents in the area of hydrogen sector development

The preparation of this Plan must take into account the programme frameworks defined at European, national and regional level, which is why it is essential to identify the key priorities and development measures set out therein.

At the European Union level, the guiding programme document in this area is **the Hydrogen Strategy for a Climate-Neutral Europe** (the so-called EU Hydrogen Strategy). The communication sets out the basic priorities and tasks for the period to 2050. It points out that it is crucial to develop renewable hydrogen production using mainly wind and solar energy. This solution is most consistent with the EU's long-term goal of climate neutrality and zero emissions, and is also consistent with the plan to build an integrated EU energy system. The strategy also emphasises that the hydrogen ecosystem will develop gradually, at different rates in different sectors and regions. Four development phases have been identified. In the first phase (2020-2024), the strategic objective was to install renewable energy-powered electrolysers with a capacity of at least 6 GW, capable of producing up to 1 million tonnes of renewable hydrogen in the EU. In the second phase (2025-2030), hydrogen is to become an integral part of the integrated energy system, with the goal of installing at least 40 GW of electrolysers that can produce up to 10 million tonnes of renewable hydrogen by 2030. It is expected that renewable hydrogen will gradually become cost-competitive with other forms of hydrogen production. The document also emphasises the importance of local or regional hydrogen clusters and valleys , which are to be developed on the basis of local, centralised production based on energy from renewable sources and local demand. The infrastructure is to enable the use of hydrogen not only for industrial and transport applications and for balancing electricity, but also for supplying heat to residential and commercial buildings (cogeneration). In the third phase (until 2050), green hydrogen technologies should reach maturity and be implemented on a large scale. According to the document, the key element in promoting hydrogen in the EU economy is the need to stimulate demand. Potential applications for green hydrogen include industry (production of ammonia, methanol, steel, oil refining) and transport (city buses, taxis, heavy road vehicles, hydrogen trains, inland waterway and short sea shipping, air transport). The document also addresses the issue of research

[6] Global Hydrogen Report 2025, EIA 2025
[7] European hydrogen market landscape, November 2024, European Hydrogen Observatory 2025

and innovation in hydrogen technologies, which are intended to support all initiatives in the implementation process.

The Polish Hydrogen Strategy until 2030 with a perspective until 2040 is a strategic document that defines the main objectives for the development of the hydrogen economy in Poland, as well as the directions of action necessary to achieve them. It anticipates the production of 10 million tonnes of renewable hydrogen per year by 2030. The installed capacity of low-carbon hydrogen production facilities is expected to reach 50 MW by 2025 and 2 GW by 2030. At the same time, the Strategy refers to the key role of transport as a consumer of green hydrogen, which is why it assumes the creation of at least 32 hydrogen refuelling stations by 2025 and the appearance of a thousand hydrogen buses by the end of the current decade. An important element of the activities promoting hydrogen is the establishment of at least five hydrogen valleys, the conclusion of an agreement for the development of a hydrogen economy (concluded on 14 October 2021), the creation of an innovation ecosystem for hydrogen valleys, and the establishment of a Hydrogen Technology Centre.

The basic programme document at the regional level relating to the implementation of hydrogen solutions is **the Pomeranian Province Development Strategy 2030**. In the Strategy, hydrogen issues appear under operational objective 1.2. Energy security, which emphasises the region's potential for producing green hydrogen from renewable sources, which is to be the future of regional energy. Hydrogen use is also mentioned in relation to the transport system, where alternative fuels, including hydrogen, are to be used more widely (Operational Objective 2.4 Mobility). The Strategy also emphasises the need to create (hydrogen) refuelling infrastructure. The document refers to the issue of cooperation between stakeholders, as according to its provisions, it is necessary to create appropriate conditions for the implementation of green solutions, including the exchange of experiences on best practices in the implementation of investments in a way that benefits the regional economy and labour market. As a result, the region should become a national leader in green energy production and eco-efficient technologies. The strategy emphasises that Pomerania has significant potential for the development of hydrogen-based energy based on hydrogen. The refinery located in Gdańsk produces hydrogen in its technological processes and is also working on its use in energy, primarily in transport. When discussing the role of the province in the development of the hydrogen energy sector, reference can also be made to Operational Objective 3.1. Competitive position. The implementation of hydrogen solutions requires R&D activities, export activity by Pomeranian enterprises (technologies and, ultimately, green hydrogen), and the strengthening of the adaptive capacity of enterprises.

The second document that addresses issues related to the development of the hydrogen economy in the Pomeranian Province is **the Regional Strategic Programme for Environmental and Energy Security**. Here, too, reference is made to the production capacity of the refinery in Gdańsk, which currently produces grey hydrogen, but in the future will form the basis for the development of a hydrogen system based on renewable sources – green hydrogen. It is expected that the technology will be used as a form of storage for surplus electricity and as the transport fuel of the future. Hydrogen is expected to build not only energy and environmental security, but also the economic potential of the region. Hydrogen issues are included in Priority 2.1 Clean Energy, which refers to the development of energy-efficient and intelligent systems for the transmission, distribution and storage of energy fuels, which is also to include the use or production of hydrogen. The document provides for the implementation of a strategic project – the Pomeranian Hydrogen Valley. The implementation of the task is to include a number of initiatives, such as raising awareness of the use of hydrogen technologies and developing the *power-to-gas* concept in the Pomeranian Province, in particular the use of green hydrogen to store surplus renewable energy and as a fuel in public transport. The tasks are to be completed by 2030.

An important contribution to defining the directions and activities for the development of the hydrogen sector is the report **Pomerania on light gas – directions and scenarios for the hydrogen economy until 2030 with a perspective until 2040**. This strategic document, based on both desktop research and surveys conducted among Pomeranian stakeholders in the sector, defines scenarios for the development of the hydrogen sector in Pomerania. At the same time, the authors of the study define a number of recommendations concerning the required implementation measures for hydrogen technologies in the region. The general guidelines include:

- looking after the interests of the Pomeranian Province at the central level, which in particular concerns regulatory and financial issues taking into account its key role in national hydrogen plans;
- building awareness among local communities about decarbonisation, energy transition and the safety of hydrogen technologies;
- the importance of education in the process of implementing hydrogen technologies;
- the fundamental role of the province in supporting local entrepreneurship, ensuring good conditions for the development of the industry, including enabling innovative activities and increasing their competitiveness on an international scale.

The document also sets out the vision, mission and objectives that the province should pursue on the way to implementing hydrogen solutions. The strategic objectives include the following:

1) Building a green economy in the Pomeranian Province by 2040 by supporting energy transition, stimulating the decarbonisation of local businesses, and creating favourable conditions for large-scale investments.

2) Integrating the region into the emerging central hydrogen economy while developing local distributed energy based on local hydrogen production.

3) Ensuring the availability of cheap hydrogen and renewable energy sources for the needs of the regional economy.

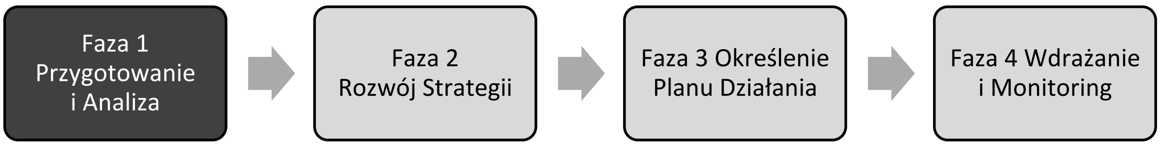
4) Promoting the Pomeranian Province and local entities to the largest domestic and foreign stakeholders in the hydrogen economy in such a way that by 2040 the Pomeranian Province will be perceived as a key element of the national and international hydrogen value chain and an important element of the national and European hydrogen infrastructure.

5) Building awareness among the region's population of the benefits of developing the hydrogen economy in Pomerania, and thus building local hydrogen competences.

The guidelines and elements contained in the strategic documents are an important reference point for defining the Hydrogen Action Plan, which is why the issues raised therein will be used in the discussions planned as part of the consultation meetings. It should also be emphasised that the Plan itself will use (and partly replicate) the guidelines and recommendations contained therein.

3. ***Best practices and case studies of hydrogen implementation in economic activity***

According to the H2CE methodology, the first step in the process of preparing a Hydrogen Action Plan is to define the information framework and analyse the potential, opportunities, challenges and needs related to the implementation of the technology in the region. By reviewing the key factors related to the supply and demand sides, it is possible to identify the specific stakeholder groups involved in the development of the sector.



First, however, examples of best practices and solutions will be presented to demonstrate the possibilities of implementing hydrogen technology. The following sections of this chapter will therefore discuss key areas that have the potential to generate demand for green hydrogen. Chapter 5 will refer to supply factors that will determine access to hydrogen in the region in the future.

3.1.

3.1.1. Private motorisation

Hydrogen technology has been an area of research and innovation in the automotive industry for years, but this type of drive system only made its market debut in passenger cars in 2014, when Toyota launched the Mirai car on the domestic market (the second generation of the car is now on sale). The vehicle used fuel cells that convert hydrogen into electricity. The car is therefore an electric vehicle, and the only by-product of hydrogen consumption is water vapour. In 2016 , the Honda Clarity Fuel Cell went on sale (initially in the form of leasing for government institutions and companies), followed by the Hyundai Nexo in 2018. In 2025, Honda launched the CR-V e:FCEV model, which replaced the Clarity model. Currently, there are three hydrogen car models on sale, which indicates the relatively early stage of development of the technology, as well as its limited potential for widespread adoption.

As a result of supply constraints and other challenges related to the implementation of the technology (including vehicle prices, hydrogen prices, and the availability of hydrogen stations), the total number of hydrogen vehicles in Europe (EU27) is estimated at approximately 5,200, most of which (4,300) are passenger cars (Figure 3).

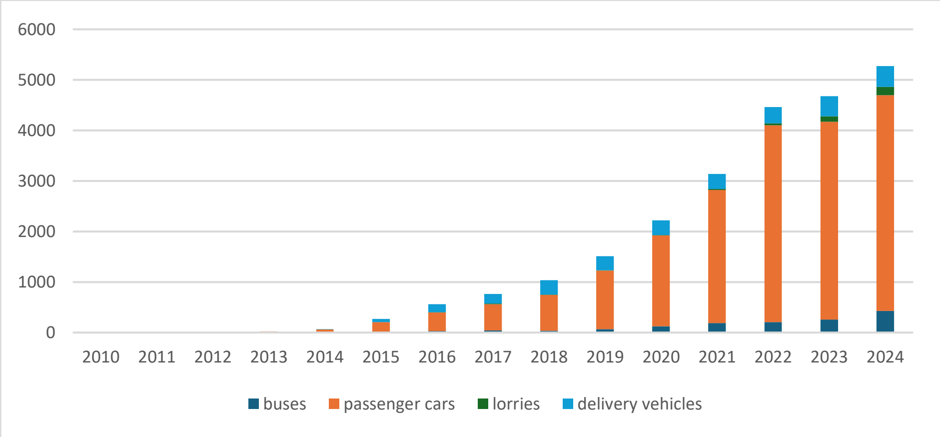


Figure3. Fleet of hydrogen vehicles in Europe 2010-2024 [units]

Source: Hydrogen Fuel Cell Electric Vehicles | European Hydrogen Observatory

The largest market for hydrogen vehicles is Germany, where a total of 2,200 hydrogen vehicles are registered, of which 1,900 are passenger cars. The next countries in this ranking are France (1,300 vehicles) and the Netherlands (800 vehicles). The fourth market is Poland, where there are currently 400 hydrogen vehicles, of which 313 are passenger cars and 87 are buses.

The global fleet of hydrogen cars is estimated at around 70,000, most of which are in Korea, China and the United States. However, analyses indicate a decline in sales of new hydrogen cars, which is particularly noticeable in the largest markets (Korea, the United States, China). In Korea, sales in 2024 were 40% lower than in the previous year, and in China they fell to 100 cars (500 were sold in 2023). There is therefore a visible shift away from hydrogen-powered passenger cars, with the dynamic development of battery-based electric mobility and the slow development of hydrogen technology, including both the range of vehicles and the infrastructure for hydrogen refuelling, being cited as significant factors.

3.1.2. Road freight transport

The use of hydrogen propulsion also applies to road freight transport, where both delivery vans and lorries are used. There are around 50 models of commercial vehicles available on the market. The total fleet of hydrogen commercial vehicles worldwide is approximately 28,000, most of which (95%) are used in China. There has been a dynamic increase in the registration of hydrogen commercial vehicles in the last year (+40%), but this is not due to a significant improvement in the competitiveness of the technology, but rather to the policies pursued by public authorities. An example of this is the support that the Chinese government has been providing since 2020 for the implementation of hydrogen technology in three urban clusters (Beijing, Shanghai, Guangdong)[8] . On the other hand, several bankruptcies of companies working on hydrogen commercial vehicles have been reported, particularly in Europe (e.g. Stellantis).

An example of a truck using hydrogen technology (fuel cells) is the Hyundai XCIENT Fuel Cell. The vehicle was designed for long-distance transport, where traditional electric (battery) drives often

[8] Global Hydrogen Review 2025, EIA 2025

prove insufficient (range, charging time). It uses two sets of fuel cells with a total power of approximately 190 kW, working in conjunction with a 350 kW electric motor and a 72 kWh buffer battery. The truck is equipped with tanks that can hold up to 68 kg of hydrogen at a pressure of 700 bar, which allows it to achieve a range of up to 700 km on a single refuelling, which takes approximately 15 minutes. Thanks to their hydrogen propulsion, these trucks do not emit any exhaust gases, so they are in line with the strategy of decarbonising transport and achieving climate neutrality goals[9] .

3.1.3. Public transport

Urban bus passenger transport is a very important area for the implementation of hydrogen technology, especially in Asian countries, with China at the forefront, as mentioned above. The global fleet of fuel cell-powered buses is estimated at 11,300 vehicles. In 2024 alone, their number increased by 25%. Almost three-quarters of them are located in China and over 15% in Korea. The Korean fleet of hydrogen buses numbers 1,700 (2024). It is worth noting that the Korean government aims to increase its fleet of hydrogen-powered buses tenfold by 2030. In order to increase interest in purchasing these vehicles, fuel subsidies are available to operators of hydrogen fuel cell buses. The European fleet of hydrogen buses in 2023 amounted to 464 vehicles. It is worth noting that a decade earlier, there were only 5 vehicles. Therefore, we can talk about dynamic growth in the size of the fleet, although this is being achieved at very low absolute levels. The largest number of such vehicles are in Germany (149), the United Kingdom (98) and the Netherlands (64). There is no doubt that their number has grown in the meantime, as indicated by analyses concerning Poland.

n Poland, hydrogen technology is used in urban transport services. The places where such buses are currently in regular operation are: Konin, Lublin, Poznań, Rybnik, Chełm, Wejherowo and Gdańsk. At the same time, in cities such as Wałbrzych, Rzeszów, Płock and Kraków, hydrogen buses have already been ordered and will be put into service in the near future (Table 2). In addition, there are cities where hydrogen vehicles are being tested, including Wrocław (NesoBUS, Solaris and Mercedes tests), Gdynia (NesoBUS and Caetano tests), Warsaw (Autosan Sancity 12 LFH and Solaris Urbino 12 hydrogen tests) and Szczecin.

[9] https://ecv.hyundai.com/global/en/products/xcient-fuel-cell-truck-fcev?utm

Table2. Cities using and implementing hydrogen buses

City	Brand	In operation	Ordered
Konin	Solaris Urbino 12 hydrogen	1	0
	NesoBUS	3	7
Lublin	Solaris Urbino hydrogen	1	0
	ArthurBus	3	20
Poznań	Solaris Urbino hydrogen	25	9
Wałbrzych	Solaris Urbino hydrogen	0	20
Rybnik	NesoBUS	20	14
Chełm	NesoBUS	5	21
Rzeszów	NesoBUS	0	20
Płock	Solaris Urbino hydrogen	0	18
Wejherowo	Solaris Urbino hydrogen	2	6
Krakow	NesoBUS	0	10
Gdańsk	NesoBUS	10	-
		70	**145**

Source: O. Niemczyk, Analysis of the use of hydrogen buses in Polish cities, RIGP 2025.

It is worth noting that the leader in the European hydrogen bus market, with a share of 70%, is the Polish manufacturer Solaris Bus & Coach. The company has supplied its vehicles to Germany, France, Italy and Spain, among others. Solaris Urbino 12 Hydrogen buses are equipped with 70 kW fuel cells and auxiliary batteries, which give them a range of over 350 km on a single tank. Refuelling takes about 10 minutes, which makes them competitive with electric buses. In 2023, Solaris signed contracts to supply several dozen buses to cities such as Belfort in France and Kerpen in Germany. These implementations
show that hydrogen works well in public transport, especially where high flexibility and long vehicle operating times are required. Hydrogen buses are quiet, emission-free and can be operated in all weather conditions. Importantly, Solaris is also developing service infrastructure and cooperating with refuelling station operators, creating comprehensive value chains in the field of hydrogen technologies[10] .

3.2. Ports and maritime transport – fuel for handling equipment and commercial fleets

3.2.1. Hydrogen as a shipping fuel

Hydrogen and its derivatives (ammonia, methanol) are mentioned as alternative fuels that offer a potential solution to the decarbonisation requirements in maritime shipping. Of course, this refers to green fuels that can radically reduce greenhouse gas emissions, in line with the *well-to-wake* approach (from extraction to consumption). Currently, however, hydrogen technologies are marginal in the global fleet, as in 2024 there were a total of 39 ships in operation, of which only three were hydrogen-powered. At the same time, the order book included another 10 hydrogen-powered ships, 25 ammonia-powered ships and 234 methanol-powered ships (Figure 4). It is worth noting that although methanol is the least energy-

[10] https://swiatoze.pl/polski-gigant-podbija-europejski-rynek-autobusow-wodorowych/

efficient hydrogen-derived fuel, it is the most user-friendly, as it does not require extreme temperature regimes. This is why some shipowners (e.g. Maersk) are investing mainly in this type of propulsion.

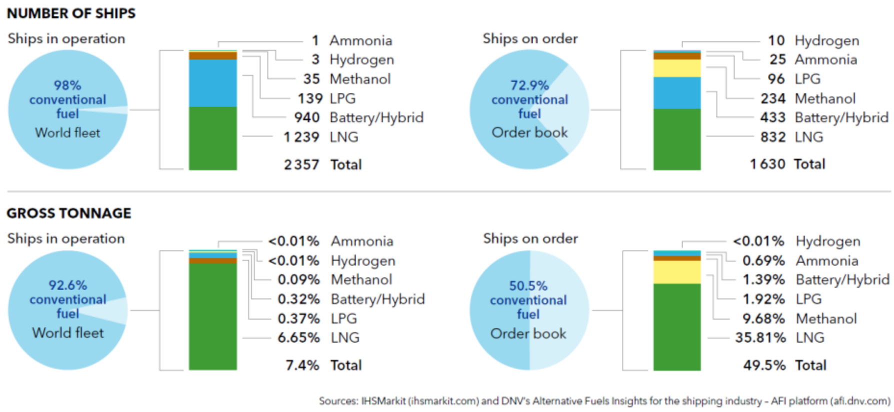


Figure4. Use of alternative fuels in the global maritime fleet in 2024.

Source: Energy Transition Outlook 2024. Maritime Forecast to 2050, DNV Norway 2024.

The first vessel powered by liquefied hydrogen was the Norwegian ferry MF Hydra, which has been in operation since 2023. In 2025, another 120-metre ferry ordered by Torghatten is to enter service, which, for a change, will be powered by compressed hydrogen. An important step in the implementation of hydrogen technology in the maritime fleet was the order by Dutch logistics operator Samskip for two 700 TEU container ships to be equipped with hydrogen-powered fuel cells. There are also plans to use hydrogen in other vessels, including dredgers[11] .

3.2.2. The use of hydrogen in seaports

Hydrogen is also an interesting alternative for powering cargo handling equipment in seaports. An example of this is the Port of Valencia, which is a European pioneer in the use of hydrogen in handling operations. As part of the H2Ports project, the world's first hydrogen-powered reach stacker (manufactured by Hyster) and H2 terminal tractor[12] were implemented there. These machines are used in daily container handling operations, and their operation proves that hydrogen can replace diesel fuel. The equipment was in use at the MSC Terminal Valencia and Valencia Terminal Europa[13] . The project also includes a mobile refuelling station, which solves the infrastructure problem in the initial phase of implementation. In the long term, the port plans to integrate hydrogen into its entire fleet of handling equipment, as well as into coastal shipping and ferries. This is a step towards creating fully green transport corridors, where hydrogen will be the fuel for both ships and port infrastructure.

An example of hydrogen implementation in ports was the delivery of heavy fuel cells E-45 *fuel* cells to a Hyster *container handler* operating at the Fenix Marine Services terminal in the Port of Los Angeles (CMA CGM Group). The equipment was powered by two fuel cell modules working in conjunction with a Nuvera lithium-ion battery. The cells can power the device directly or charge the

11 Liquid hydrogen dredgers – a real revolution or an expensive future? | PortalMorski.pl
12 https://www.worldcargonews.com/cargo-handling-equipment/2025/09/hydrogen-on-trial-in-valencia/?utm
13 https://www.valenciaport.com/en/hydrogen-is-already-moving-containers-in-the-port-of-valencia/

internal battery, and the energy recovered during operation (e.g. braking) increases the efficiency of the system. Hydrogen refuelling takes about 15 minutes, and continuous operation time is 8-10 hours. The initiative is part of the *California Climate Investments* programme, which promotes the reduction of greenhouse gas emissions and improvement of environmental quality[14] . Another interesting example from the United States is a test programme launched in May 2024 at Yusen Terminals in the Port of Los Angeles. A hydrogen-powered RTG crane is being tested there. As part of the project, PACECO's H2-ZE RTG "Transtainer" device, in collaboration with Mitsui E&S, has been adapted to be powered by hydrogen fuel cells. In addition to a significant reduction in greenhouse gas emissions, noise levels have also been reduced. The measures are part of *the Clear Air Action Plan* for the ports of Long Beach and Los Angeles, which stipulates that by 2030 all terminal equipment will be zero-emission. Importantly, the project is partly funded by the Japanese organisation NEDO, which is an example of a mechanism for supporting hydrogen innovation[15] .

3.3. Hydrogen production in seaports

Another area of cooperation between seaports and the hydrogen sector that could potentially be developed in Pomerania is hydrogen production. An example of this is the port of Antwerp-Bruges, which is a pioneer in the development of the hydrogen economy. In 2022, the construction of a 100 MW green hydrogen production plant, implemented by Plug, was announced there. The installation is expected to produce up to 12,500 tonnes of hydrogen per year, both in gaseous and liquid form. Production will be powered by renewable energy, and the hydrogen will be supplied to the chemical industry, heavy transport and the energy sector. The project is part of Belgium's national strategy to make the country a major import and transit point for green hydrogen in Europe. The implementation of the plan is of strategic importance, as it will not only enable the decarbonisation of local industry, but also the export of hydrogen to other EU countries. In the long term, the port plans to expand its transmission and storage infrastructure to become a key link in the European hydrogen network[16] .

Production and import infrastructure for hydrogen is also being developed at the port in Rotterdam. The Holland Hydrogen 1 project, Europe's largest green hydrogen plant with a capacity of 200 MW, is being built there and is expected to produce 60 tonnes of hydrogen per day. It will used in refineries, heavy transport and the chemical industry. Rotterdam is also investing in import terminals to enable the import of hydrogen and its derivatives (e.g. ammonia) from Africa and the Middle East. A network of pipelines is also being developed to connect it to Antwerp and the German Ruhr area, creating a European hydrogen corridor . This will make Rotterdam not only a logistics centre but also an energy hub supporting the decarbonisation of the entire region[17] . The implementation of

[14] https://www.nuvera.com/press-release/nuvera-powers-fuel-cell-shipping-container-handler-at-the-port-of-los-angeles/?utm

[15] https://yti.com/2024/05/yusen-terminals-launches-worlds-first-hydrogen-fuel-cell-rtg-program/?utm

[16] https://www.gramwzielone.pl/magazynowanie-energii/102565/z-europejskiego-portu-poplynie-30-ton-zielonego-wodoru-dzienni

[17] https://www.wnp.pl/przemysl/hutnictwo/duza-instalacja-wodoru-dla-regionu-przemyslowego-rotterdam-antwerpia,56185.html

these projects shows that hydrogen can be the fuel of the future not only for transport, but also for industry and energy, and Antwerp, together with Rotterdam, forms the largest chemical and petrochemical hub in Europe, making the ports a natural centre for the development of this technology.

3.4. Green hydrogen from offshore wind farms

The Holland Hydrogen 1 project described above, implemented in the port of Rotterdam, can also be considered a best practice in the integration of the offshore wind energy sector and hydrogen production. The hydrogen production facility will be powered by energy from the Hollandse Kust Noord offshore wind farm (759 MW)[18] . Importantly, the green hydrogen produced will be used primarily at the Shell Energy and Chemicals Park Rotterdam refinery, replacing some of the grey hydrogen produced from natural gas. This can therefore be described as the creation of a hydrogen hub, centred on the seaport. A similar structure can be found in the Pomeranian region, where there will be a high supply of green energy from offshore wind farms, potential future production and distribution, as well as consumption needs, both from the industrial sector (refinery) and the transport sector (including public transport, local and regional freight transport).

Another example of combining the potential of offshore wind energy and hydrogen production was the HyBalance demonstration project in Hobro, Denmark, in 2018-2020. As part of the project, a 1.2 MW electrolyser was installed, which produced hydrogen from wind farm energy, thus storing surplus production. The green hydrogen itself was used both in transport (refuelling stations for hydrogen buses and cars) and in the local energy system. HyBalance showed that hydrogen can play a dual role, both as a transport fuel and as a stabiliser for the power grid. At the same time, it confirmed that hydrogen can be an effective tool for integrating renewable energy sources into the economy[19] .

Another example of green hydrogen production development is the Refhyne project, one of the first large-scale installations in Europe, located at the Shell refinery in Wesseling (North Rhine-Westphalia) in Germany. The 10 MW electrolyser, commissioned in 2021, produces hydrogen for use in refinery processes, replacing some of the grey hydrogen. Refhyne demonstrates how hydrogen production can be integrated into existing industrial infrastructure. The project is co-financed by the European Union under the *Fuel Cells and Hydrogen Joint Undertaking* (FCH JU) programme. There are currently plans to expand the installation to 100 MW (Refhyne II), which will allow the production of hydrogen not only for industry, but also for heavy transport and local energy networks. Refhyne is a good example of scaling up electrolysis technology[20] .

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18 https://www.wnp.pl/energia/energetyka/shell-rozpoczyna-budowe-fabryki-zielonego-wodoru-w-holandii-ma-byc-najwieksza-w-europie,599548.html

19 https://hybalance.eu/

20 https://www.refhyne.eu/

3.5. The use of hydrogen in thermal energy

Heating is another area where hydrogen can be used. Gas turbines operating with up to 90% hydrogen admixture are already available on the market. Manufacturers supplying this type of technology include GE, Ansaldo and Siemens. GE's Aeroderative turbines, with a single ring burner, can burn gas with a hydrogen content of 30 to 80%, and Heavy Duty turbines can burn gas with a hydrogen content of up to 90%. Ansaldo manufactures a Class H gas turbine that can operate with a hydrogen content of up to 50%, but this value can be increased to 70%. The company is also working on a hydrogen-only installation. Siemens is gradually increasing the hydrogen efficiency of its gas turbines, which are ultimately expected to run on 100% hydrogen by 2030. A Kawasaki installation running exclusively on hydrogen fuel is currently in the demonstration phase hydrogen fuel in Kobe, Japan. Mitsubishi, on the other hand, is to adapt a 440 MW CCGT unit in the Netherlands to run on 100% hydrogen[21] .

Japan is a pioneer in the use of hydrogen in local thermal energy. The Ene-Farm programme has been operating there since 2009, selling over 400,000 domestic cogeneration systems based on fuel cells. These devices simultaneously produce heat and electricity using hydrogen obtained from natural gas or, increasingly, from renewable energy sources. This allows households to significantly reduce CO_2 emissions emissions and increase their energy independence. In cities such as Kobe, hydrogen microgrids are being developed, in which hydrogen serves as an energy storage and heat source for entire neighbourhoods. These projects are particularly important in a country prone to earthquakes and other natural disasters. Hydrogen provides an emergency source of energy and heat in crisis situations. Clean hydrogen boilers are also being tested there, which could replace traditional gas boilers in single-family homes. The technology is being developed by companies such as Panasonic and Tokyo Gas. Importantly, these initiatives are supported by the Japanese government through subsidies, research and development programmes, and a national strategy that envisages hydrogen as one of the pillars of the country's energy transition[22] .

Germany is one of the European leaders in testing hydrogen in local heating systems. In several regions, including North Rhine-Westphalia, projects are underway to inject hydrogen into gas networks in proportions ranging from 10 to 20%. Studies have shown that most modern gas boilers are capable of operating on such mixtures without major modifications. This approach allows for a gradual transformation of heating systems without the need for immediate replacement of the entire infrastructure. An example is the H2HoWi project in the city of Herten, where hydrogen is fed into the local district heating network. In the future, there are plans to switch to 100% hydrogen in selected housing estates. At the same time, German manufacturers such as Viessmann and Bosch are developing hydrogen-ready boilers that can run on natural gas and, after modernisation, switch completely to hydrogen. Germany is also testing the use of hydrogen in large combined heat and power plants. In Hamburg, there are plans to build a plant that will produce heat and electricity

[21] https://h2poland.eu/pl/kategorie/zastosowanie/cieplownictwo/wodor-w-cieplownictwie/

[22] https://h2poland.eu/pl/kategorie/zastosowanie/rozwiazania-indywidualne/wodor-jako-zrodlo-ogrzewania-pod-japonska-strzecha/

in cogeneration, powered by green hydrogen from electrolysis. This project aims to show that hydrogen can be a fuel not only for individual buildings, but also for entire heating systems[23] .

In Poland, hydrogen in heating is at a very early stage of development, but the first initiatives and pilot projects are already emerging. Cities such as Sanok and Tarnowskie Góry are analysing the possibility of using hydrogen in local heating systems. In Sanok, conceptual work is underway on the integration of renewable energy sources (RES) with the production of green hydrogen, which could then be used in the municipal heating network. In Tarnowskie Góry, on the other hand, the combination of hydrogen with public transport and heating is being considered, which would create a local hydrogen ecosystem. Two main technological models are being considered. The first is hydrogen-natural gas mixtures (10-20% H_2), which allow CO_2 emissions to be reduced without the need to immediately replace the entire infrastructure. The second is fuel cells in cogeneration, which simultaneously produce heat and electricity. This solution increases the efficiency of the system and allows for local, emission-free energy production.

In Śrem, Greater Poland, thanks to an initiative by the Śrem Social Housing Association and the Śrem Municipality, design work has begun on a hydrogen boiler room, which will be part of a diversified heating system supplying heat to 195 planned flats. The system provides for the installation of a hydrogen boiler room based on the combustion of hydrogen and oxygen, and a heating system comprising ground source heat pumps using brine/water.

23 https://wodorowe.info/wodor-w-systemach-cieplowniczych-niemcy-testuja-innowacyjne-rozwiazania/

4. *Identification of potential demand and development opportunities for the (green) hydrogen sector*

4.1. Hydrogen for the processing industry in Pomerania

Hydrogen is an important element in industrial production, particularly in the chemical, refining and cement industries. In this context, the main consumer of hydrogen is the Gdańsk Refinery. Currently, the plant is also one of the producers of (grey) hydrogen, which it uses in its technological processes. In addition to the refinery, there are also chemical industry producers operating in the province, such as Siarkopol Gdańsk SA (production of sulphuric acid, sulphur fertilisers and feed additives), Zakłady Chemiczne Organika in Gdynia (production of synthetic resins, adhesives and chemicals for industry) and smaller producers of paints, varnishes, cleaning agents and chemical components for the shipbuilding and construction industries. Unfortunately, there is no comprehensive data on hydrogen consumption by these entities.

4.2. Land transport

The use of hydrogen as a fuel for transport is the most widely used solution in public transport. Assuming, therefore, that urban transport companies constitute an area of demand for this type of transport, it can be assumed that the potential market for hydrogen solutions is identical to the rolling stock operating in the province. According to data for 2024, this amounted to a total of 757 vehicles (Table 3), of which 84.4% were buses with traditional engines (diesel engines). Low-emission solutions used in buses in the region include vehicles powered by liquefied petroleum gas (LPG), compressed natural gas (CNG) and hydrogen buses. The region therefore already has experience with this type of vehicle, which is an undoubted advantage and a stepping stone for expanding the use of this technology.

It is worth noting that public transport services, which are a type of public activity, are subject to decarbonisation regulations, where the key directive is *the Clean Vehicle Directive (CVD*)[24] . The directive promotes clean mobility solutions in public procurement tenders, providing an impetus for demand and further implementation of low- and zero-emission vehicles. It applies to the purchase, lease, rental and relevant service contracts and applies to passenger cars, vans, lorries and buses (excluding coaches). The regulation defines 'clean vehicles' and sets national targets for their public procurement.

[24] Directive 2019/1161

Table3. Public transport bus fleet operating in the Pomeranian Province

Drive	2023	2024	Share 2024
Diesel engine	651	639	84.4
Hybrid drive	0	0	0.0
Electric batteries	63	63	8.3
Liquefied petroleum gas (LPG)	0	0	0.0
Compressed natural gas (CNG)	45	45	5.9
Liquefied natural gas (LNG)	0	0	0.0
Hydrogen	0	10	1.3
Total	**759**	**757**	**100.0**

Source: Own study based on Local Data Bank (10.2025)

Referring to the provisions of the regulation concerning public transport requirements, it can be pointed out that an environmentally friendly vehicle (*clean vehicle*) is a bus that uses one of the following alternative fuels: hydrogen, electric battery (including plug-in hybrids), natural gas (both CNG and LNG, including biomethane), liquid biofuels, synthetic and paraffin fuels, and LPG. Furthermore, in the case of buses, half of the targets must be achieved through zero-emission vehicles (battery electric or hydrogen-powered buses). The Directive also specifies the minimum percentage of clean vehicles in total public procurement in a given Member State. The requirements for Poland are presented in Table 4.

Table4. Requirements for Poland specified in the CVD Directive

Vehicle type	2021-2025	2026-2030
Light vehicles (LDV)	22%	22%
HDV lorries	7	9
Buses	32	46

Source: Directive 2019/1161

The data indicate that the level of implementation of the required parameters for the Pomeranian Province is 15.6%, which is why a significant increase in the share of environmentally friendly vehicles in the transport fleet can be expected. Applying the provisions of the directive directly, the Pomeranian bus fleet should ultimately consist of approximately 350 environmentally friendly buses, half of which should be electric or hydrogen buses.

The directive also indirectly supports the use of hydrogen in other areas of services provided by public entities, such as waste and refuse collection, infrastructure maintenance (including water supply, sewage and energy) and education. Clean, environmentally friendly vehicles should be used wherever green hydrogen propulsion is one of the desired solutions. Hydrogen-powered passenger cars, vans and lorries will therefore help to achieve the target levels.

Referring to the regulations, it is also worth mentioning the revision of the ETS Directive of 2023[25] , which provides for the inclusion of road transport in the emissions trading system and, more specifically, will impose a cost on companies placing emission-producing fuel for road vehicles on the market. It can be assumed that the cost of emissions will increase the price of fuel and thus result in

[25] Directive 2023/959

higher costs for carriers. In this context, the use of green hydrogen becomes a solution that avoids additional costs, which is why its attractiveness on the market can be expected to increase.

4.3. Maritime transport – hydrogen as an alternative fuel and energy carrier

A particular area of demand for hydrogen in the region is maritime transport, which is directly related to the servicing of vessels in Gdańsk and Gdynia, as well as in other ports in the province. As indicated above, the use of hydrogen to power sea vessels is currently marginal, but treating it together with its derivatives may be a significant factor in stimulating the need for hydrogen production and distribution.

The operational characteristics of hydrogen make it ideal for powering vessels with a short range, operating in a limited area. This allows for the creation of an effective supply chain, where the bunkering point is fixed and frequently used. Therefore, the best target area of application may be small ferries or service vessels (tugs, pilot boats). It is also worth mentioning vessels for servicing offshore wind farms, known as CTVs (*crew transfer vessels*), which will operate from the ports of Ustka, Łeba and Władysławowo. Potentially, fishing boats could also use this fuel.

4.4. Seaports – decarbonisation through the use of sustainable fuels and energy

Seaports are also potential consumers of hydrogen, but this time not as a place of distribution, but as consumers. In this case, hydrogen could be used as fuel for handling equipment or to power port installations and infrastructure. The implementation of hydrogen solutions in ports will depend on the availability and cost of the technology, as well as the availability of green hydrogen.

4.5. District heating and local energy – hydrogen as an energy carrier

The current energy mix in the Pomeranian Province in terms of to heat energy consumption is favourable, as a large part of it comes from sustainable energy sources. Pomerania is currently one of the leaders in terms of installed capacity in onshore wind farms, and preparations are underway to build offshore wind farms in the Baltic Sea, which are expected to significantly increase RES energy production. In addition, there are many local biomass and biogas installations in the region, especially in rural municipalities. They are part of energy clusters and energy cooperatives that support local self-sufficiency. The region is also seeing dynamic growth in the number of PV installations, both prosumer and commercial. On the other hand, Pomerania does not have any large coal-fired power plants, which is conducive to a faster energy transition. Conventional energy is imported from other regions of the country. It is also worth mentioning the planned construction of Poland's first nuclear power plant in Lubiatowo-Kopalino. The project is scheduled to start in 2026, with commissioning planned for 2033–2035. In this context, the potential demand for hydrogen will be generated by power stabilisation processes and, thus, the implementation of energy storage functions.

5. (Green) hydrogen value chain – potential hydrogen supply in Pomerania

5.1. hydrogen production

In 2023, approximately 1.2 million tonnes of hydrogen were produced in Poland, which means that it is the third largest hydrogen market in Europe after Germany (2.0 million tonnes) and the Netherlands (1.5 million tonnes) – Figure 5. This is mainly grey hydrogen produced for technological processes in industrial plants or as a by-product of such processes.

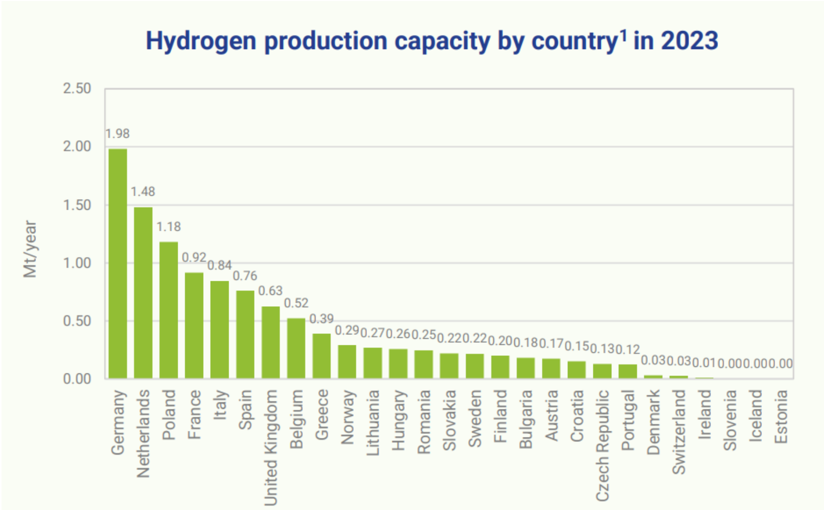


Figure5. Hydrogen production in European countries in 2023 [million tonnes/year]

Source: The European hydrogen market landscape_November 2024.pdf

The entities that currently dominate the hydrogen production market are companies from the refining and chemical industries. The largest hydrogen producer in the country is the Orlen Group. Hydrogen is produced here in refining processes (fuel desulphurisation, steam reforming of gas). At the same time, the company is also developing green hydrogen projects to reduce emissions from its production (including Trzebina, Włocławek and Płock). A similar project is also being implemented in the Pomeranian Province, where the Gdańsk Refinery plans to launch a green hydrogen production plant using a 5 MW electrolyser. The project is being implemented as part of the PureH2 programme and is co-financed by the EU's *Connecting Europe Facility – Transport Blending Facility* programme. The plant is scheduled to be commissioned in mid-2027. Electrum has been appointed as the general contractor for the investment and will carry out the project on a turnkey basis. The second producer is Grupa Azoty, which uses hydrogen to produce ammonia and nitrogen fertilisers. It should be added that the plants in Tarnów, Puławy and Police are among the largest consumers and producers of hydrogen in Central Europe. Hydrogen as a by-product of coking processes is produced by JSW (Jastrzębska Spółka Węglowa). Other large producers include nd Synthos, a manufacturer of chemicals and synthetic rubbers. It is used in chemical processes, and the company is exploring possibilities for its wider application.

Hydrogen projects are also being developed by ArcelorMittal, where pilot projects are underway to use hydrogen to reduce iron ore instead of coke. Another domestic example is the activities of ZEPAK, which operates a biomass power plant (Konin). The plan is to use the energy from biomass combustion to produce hydrogen through electrolysis. The agreement with the supplier, Hydrogenics Europe, initially provides for the construction of a 2.5 MW plant, followed by its expansion to 5 MW. ZEPAK plans further investments in green energy – within a few years, 10 electrolysers, each with a capacity of 5 MW, are to be installed in Konin [26].

5.2. Sustainable energy sources as a prerequisite for green hydrogen production

5.2.1. Solar energy

The production of green hydrogen requires electrolysis processes to be powered by renewable energy sources, which is why the production capacity of this element will be proportional to the development of renewable energy sources in the region itself. The first of the analysed energy sources is the sun. It is worth noting that Poland is one of the EU leaders in terms of the growth of photovoltaic (PV) farm capacity, and at the same time a large market for distributed (individual) solar energy production. The total installed capacity is estimated at 21.8 GW, which translates into a 65% share in the national renewable energy mix. Over 41% of the installed capacity (9 GW) is accounted for by large-scale installations with a capacity of over 1 MW. In total, there are over 3,600 such farms operating in the country. Most large photovoltaic farms are being built in the northern part of the country, where Wielkopolska is the leader, with key installations in Przykona (200 MW), Brudzew (70 MW) and Kleczew (30 MW). Photovoltaic farms are also being built in other regions of Poland, including Kujawsko-Pomorskie, Mazowieckie, Warmińsko-Mazurskie, Zachodniopomorskie, Śląskie and Pomorskie. It is worth noting that the largest photovoltaic farm in the country, Zwartowo (204 MW), is located in the Pomeranian Province. Other significant facilities on a national scale include installations in Sztum, Choczewo, Lębork and Bytów (Table 5).

Table5. The largest photovoltaic farms in the Pomeranian Province

Location (province)	Installed capacity [MW]	Developer/owner
Zwartowo	204	Goldbeck Solar / Respect Energy
Sztum	86	PAD RES
Choczewo	40	Polenergia
Lębork	25	Columbus Energy
Bytów	20	R.Power

Source: Own study based on online sources[27]

[26] https://h2poland.eu/pl/kategorie/zastosowanie/cieplownictwo/wodor-w-cieplownictwie/

[27] Fotowoltaika magazine – The photovoltaic market in Poland in 2025, https://magazynfotowoltaika.pl/rynek-fotowoltaiki-w-polsce-2025/; Institute for Renewable Energy (IEO) – PV 2025 Report, https://ieo.pl/raport-

The largest developers of industrial photovoltaic installations include: Goldbeck Solar / Respect Energy, R.Power, EDP Renewables, PAD RES, Polenergia, Columbus Energy and ZE PAK / ESOLEO (Polsat Plus).

It is estimated that by 2030, Poland could achieve 40 GW of PV capacity, a significant part of which will be large-scale farms. For this reason, the development of hydrogen projects may be a complementary element for them. Hydrogen production will consume surplus energy from the sun, thus stabilising its supply to consumers.

5.2.2. Onshore wind farms

The second important area of renewable energy development in Poland is onshore wind power. The total installed capacity of Polish wind farms is estimated at 10.9 GW (first half of 2025). The electricity is generated by 7,000 wind turbines installed in approximately 500 farms (there is no uniform, official register). Considering the spatial distribution of the installations, the largest centre of onshore wind energy is the West Pomeranian Province. The Pomeranian, Greater Poland and Kuyavian-Pomeranian regions also have a significant market share (Table 6). The largest developers here are: Polenergia, PGE Energia Odnawialna, EDP Renewables, RWE Renewables, Energa/Orlen, and Iberdrola.

Table6. The largest onshore wind farms in Poland (TOP 10)

Location	Province	Installed capacity	Developer/owner
Drzeżewo	Pomeranian	139 MW	Polsat Plus Group (Eviva Drzeżewo)
Margonin	Wielkopolska	120 MW	EDP Renewables
Banie	West Pomeranian	106 MW	Energix / Wiatromill
Kozienice–Radom	Masovian	102 MW	Polenergia
Ławica Airport	Wielkopolska	94 MW	RWE Renewables
Wróblew	Łódź	90 MW	PGE Renewable Energy
Tychowo	West Pomeranian	89 MW	Energa/Orlen
Pągów	Opole	80 MW	Iberdrola
Kawęczyn	Mazovia	79 MW	Polenergia
Widzino	Pomeranian	77 MW	R.Power / Columbus Energy

Source: Own study based on online sources[28]

In the Pomeranian Province alone, the installed capacity of onshore wind power is estimated at 1,326 MW. The largest facilities are the Drzeżewo and Widzino farms, listed in the table. It is also worth mentioning Polenergia's Choczewo farm with an installed capacity of 40 MW. Onshore wind farms are therefore another source of power for installations that enable the production of green hydrogen in the region, and their combination with large-scale photovoltaics can contribute to stabilising the electricity supply.

pv-2025/raport-pv-2025; Polish Press Agency – The photovoltaic market in Poland in 2025. Summary and conclusions from the report, https://www.pap.pl/mediaroom/rynek-fotowoltaiki-w-polsce-2025-podsumowanie-i-wnioski-z-raportu; Civil Engineer – Photovoltaic market in Poland 2025. REPORT, https://inzynierbudownictwa.pl/rynek-fotowoltaiki-w-polsce-2025-raport/; Smart-Grids.pl – Report "The photovoltaic market in Poland 2025". Summary, https://smart-grids.pl/aktualnosci/raporty/4949-raport-%E2%80%9Erynek-fotowoltaiki-w-polsce-2025%E2%80%9D-podsumowanie.html.

28 Report "Wind Energy in Poland 2025" – OffshoreWindPoland.pl; Largest wind farms in Poland – Wikana Bioenergia; Wind Energy in Poland 2025 Report – TPA Poland; TPA Poland Report – Wind Energy in Poland 2025.

5.2.3. Offshore wind energy

Offshore wind energy is a promising area for the potential production of hydrogen based on sustainable energy sources. Its development is directly linked to the Pomeranian Province. The province is home to wind farm service facilities (installation and service ports) and is also the area where power from offshore installations will be transmitted from offshore installations (onshore transformer stations). Thus, the use of technological solutions based on hydrogen as an energy carrier stored during periods of oversupply is a natural part of the region's development.

A programme is currently underway to build nineteen offshore wind farms with a total estimated capacity of 17.5 GW (Table 7). The first of these farms, Baltic Power, is being built by the Orlen Group. According to the schedules, full implementation of the programme should be completed in 2031/2032.

Table7. Offshore wind farms in Poland

No.	Offshore Wind Farm	Planned capacity [MW]
1	Baltica 1	896
2	Baltica 2	1,489
3	Baltica 3	1,036
4	Baltic Power ORLEN	1,200
5	BC-Wind	399
6	Baltic II	350
7	Baltic I	1,560
8	Baltic Sea II	720
9	Baltic Sea III	720
10	ORLEN Neptune	900
11	ORLEN Neptun	900
12	ORLEN Neptun	1,200
13	ORLEN Neptun	1,200
14	Baltica 7	990
15	Baltica 9	975
16	Baltica 2+	210
17	ORLEN Neptune	1000
18	Baltic 1+	1185
19	Baltica 1++	555

Source: Own study

An important aspect of offshore wind energy production is its seasonality, which translates into higher power yields in winter. In this context, the development of cogeneration technologies based on renewable energy sources, where hydrogen is used as an energy carrier and heat from the electrolysis process is used for the needs of nearby towns, is an attractive model for the implementation of hydrogen technologies. At the same time, the green hydrogen obtained in this way will be able to power vehicles (e.g. public transport).

5.3. Natural hydrogen storage potential in the Pomeranian Province

Salt mines and specially designed salt caverns in rock salt deposits are extremely favourable locations for storing fuels such as gas, oil, petrol and oils. Due to the fact that salt does not react chemically with the fuel stored in the caverns, its physical and chemical properties remain unchanged. Salt caverns are also considered one of the most promising locations for hydrogen storage.

There are seven underground natural gas storage facilities in salt caverns in Poland, with a total capacity of over 3.3 billion m³. Salt caverns are underground chambers created by leaching rock salt deposits with unique geological and chemical properties. In the case of hydrogen, it can also be noted that salt does not react chemically with the element, and salt rock potentially ensures the tightness and stability of its storage. Hydrogen can therefore be stored in large quantities and for a long time without losing its quality. Salt caverns can serve as seasonal hydrogen (energy) storage facilities, balancing fluctuations in production and demand.

The Pomeranian Province is home to some of the most important salt deposits in the country, which are potential locations for caverns. These include well-documented rock salt deposits, e.g. the Łeba, Zatoka Pucka and Mechelinki, as well as other areas marked out by boreholes and individual boreholes. The locations highlighted refer to the oldest rock salt deposit, already partially developed for the Kosakowo gas storage cavern, with possibilities for further expansion. Such deposits are also found in the Gdańsk Bay area[29] . The advantage of these facilities is their location on the Baltic Sea, which allows the use of seawater as a leaching liquid during the creation of caverns and the direct discharge of the brine produced into the open sea without significant environmental damage and the need to build a special brine plant. This is, of course, also important from the point of view of hydrogen production, both in terms of access to sustainable energy (offshore wind farms, nuclear power plant) and water, transport (seaports, planned hydrogen transit pipelines) and hydrogen consumption (agglomerations, seaports).

The location of hydrogen storage facilities in the region is currently being verified by the State Geological Service as part of the scientific project[30] , which aims to investigate how the lithological heterogeneity of salt deposits in the Łeba Uplift area affects the stability of the planned underground hydrogen storage facilities. The results of the research will allow for the assessment of potential risks and challenges related to the construction and operation of underground hydrogen storage facilities in the geological conditions of the region. It is worth noting that an important element of the project is also the popularisation of the results and raising public awareness about underground hydrogen storage. A popular science website, , will be created, where PIG-PIB specialists and experts will present key issues related to this technology. The project is scheduled for completion in 2026.

Pomerania can therefore use its salt resources and experience in gas storage to become a leader in hydrogen storage in the Baltic Sea region and Central Europe. Hydrogen storage in salt caverns can therefore be considered an important direction for the development of regional energy. The construction of hydrogen tanks that will serve both the domestic market and foreign contractors (hydrogen bank) will significantly increase the supply of hydrogen, and thus translate into its prices.

[29] G. Czapowski, *Location of storage caverns in salt formations in Poland – old and new options*, Przegląd Solny 2021/2022, 16 (https://psgs.agh.edu.pl/wp-content/uploads/2023/04/Czapowski.pdf)

[30] https://www.pgi.gov.pl/centrum-modelowania-procesow-geologicznych/aktualnosci-cmpg/15721-podziemne-magazynowanie-wodoru.html

What is more, it will allow for the effective use of regional renewable energy resources, increase energy security and support the development of the region's hydrogen economy. The geological resources and technical expertise available in Pomerania should allow for the large-scale implementation of this technology.

5.4. Hydrogen distribution infrastructure – hydrogen refuelling stations in the region

The *use* of green hydrogen for both public and private transport requires a developed network of hydrogen refuelling *stations* (*HRS*). These stations are a fundamental element of the infrastructure supporting the development of zero-emission transport based on fuel cells. Their task is to fill vehicle tanks with hydrogen, most often in compressed form, under high pressure. At the same time, such stations perform several additional functions, such as storage, hydrogen compression, hydrogen cooling before refuelling (to approx. -40°C), and process and safety monitoring. The stations themselves can be public, industrial or mobile.

The global network of hydrogen stations currently comprises around 1,300 points, the vast majority of which are located in Asia. The number of HRSs there is estimated at 500 points in China, 200 in Korea and 160 in Japan. It is also estimated that in 2024 alone, more than 120 new hydrogen refuelling stations were launched worldwide. The network of hydrogen refuelling points in Europe is estimated at 300 locations by the end of 2024, of which less than 200 were public stations (Figure 6).

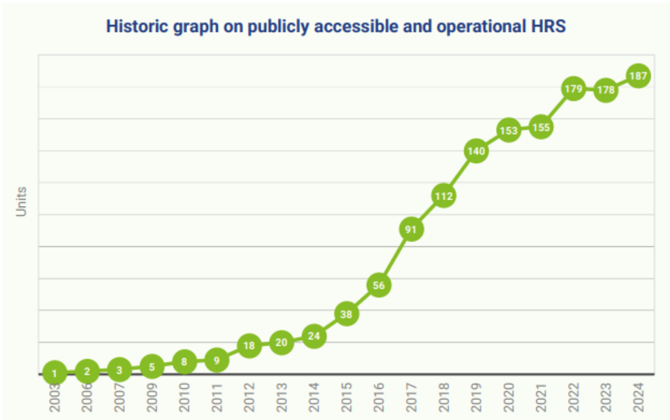


Figure6. Development of the public hydrogen refuelling station network in Europe 2003-2024

Source: The European hydrogen market landscape_November 2024.pdf

In 2024, the largest number of HRS were available in Germany (86 stations), France (27) and the Netherlands (24). The data also indicates two public stations operating in Poland. Currently (Q3 2025), there are already ten hydrogen distribution points for individual users, including the following locations:

- Warsaw: NESO station at Port Praski, station near Łopuszańska Street;
- Rybnik: NESO station;
- Gdańsk: Station at the Lotos refinery, NESO station;

- Gdynia: NESO station;
- Lublin: NESO station;
- Poznań: NESO station;
- Szczecin: Planned opening of PKN Orlen station;
- Wrocław: NESO station.

There are therefore three public hydrogen refuelling stations in the Pomeranian Province, which
in the context of its dissemination is a significant limitation and as such should be considered an important development direction in the context of regional hydrogen challenges.

In the case of using hydrogen to power public transport buses, fuel is most often supplied at dedicated (industrial) stations, which is why this supply element should be treated separately. On the other hand, the implementation of hydrogen buses will contribute to the dissemination of the technology, as refuelling points dedicated to public transport will also be available to private customers.

When considering hydrogen refuelling points, reference should be made to the European regulations contained in the AFIR (*Alternative Fuel Infrastructure Regulation*[31]), which imposes an obligation on European Union countries to develop the HRS network. According to its provisions, publicly accessible hydrogen refuelling points with a minimum capacity of 1t/day should be located no more than 200 km apart on the core sections of the TEN-T road network[32] , and at the same time, at least one publicly accessible hydrogen refuelling station should be available in each urban node
at least one publicly accessible hydrogen refuelling station should be available in each urban node. EU countries should meet these requirements by the end of 2030. It can therefore be assumed that Poland should ultimately have at least 20 hydrogen stations on the TEN-T network, as well as additional points in the urban nodes themselves (there are 9 in total).

5.5. The commercial potential of hydrogen – import, export and transit of (green) hydrogen

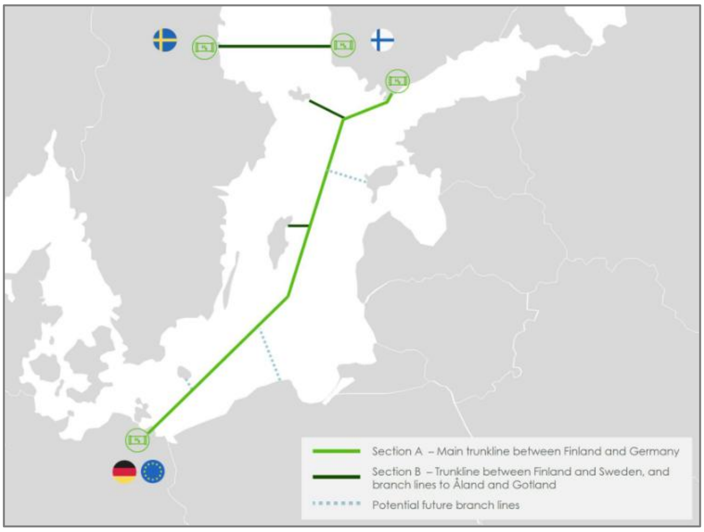
The hydrogen trade potential of the Pomeranian region will be directly linked to import needs and export opportunities. At the same time, given the natural geological conditions of northern Poland, it is possible for the region to play a transit role through the development of the concept of a Baltic hydrogen storage hub. The creation of a a so-called bankable hydrogen storage facility in the region may be an important element of the system in the Baltic Sea area and Central Europe. The availability of large-scale hydrogen storage on the market, especially in the context of green hydrogen production, will significantly increase the efficiency of hydrogen installations, thereby reducing the costs of hydrogen production and sale.

[31] Regulation (EU) 2023/1804

[32] In Poland, the TEN-T core network mainly comprises motorways (A1, A2, A4), expressways (S3, S7, S8, S17) and other key sections connecting major cities and border crossings. The total length of the TEN-T core network is estimated at 4,000 km.

In the case of imports, the key factor determining volumes will be the pace of adoption of hydrogen solutions in the country and the region, especially those requiring green hydrogen supplies. Currently, there is no realistic basis for estimating future hydrogen consumption and production in the region, and therefore it is not possible to determine the level of deficit (imports) or surplus (exports) of this raw material.

The situation is similar with regard to the transit role and the creation of a hydrogen bank storage facility. This option requires the inclusion of Pomerania in the planned hydrogen pipeline network, including *the Baltic Sea Hydrogen Collector* (BHC) and *the Nordic Baltic Hydrogen Corridor* (NBHC). The BHC is a cross-border project designed to ensure the supply of green hydrogen in the Nordic countries and Central Europe. The main section will connect Finland with Germany and Sweden (Figure 7). In the future, additional branches may connect Bornholm, Poland and the Baltic States, depending on market development and infrastructure readiness.



7 . Route of the Baltic Sea Hydrogen Collector

Source: https://balticseahydrogencollector.com/about-the-project/

The merger of BHC with Poland would naturally integrate the Pomeranian Province into the hydrogen trading system in every possible dimension (import, export, transit, bank).

The Nordic Baltic Hydrogen Corridor, on the other hand, is a cooperation agreement between gas transmission system operators to develop cross-border hydrogen infrastructure from Finland through Estonia, Latvia, Lithuania and Poland to Germany. The hydrogen connection, approximately 2,500 km would run through the indicated countries, creating an axis for the exchange and trade of raw materials. For the widespread implementation of hydrogen technologies in the region, as well as for the utilisation of Pomerania's storage potential, it will also be necessary to expand the transmission infrastructure northwards (Figure 8).

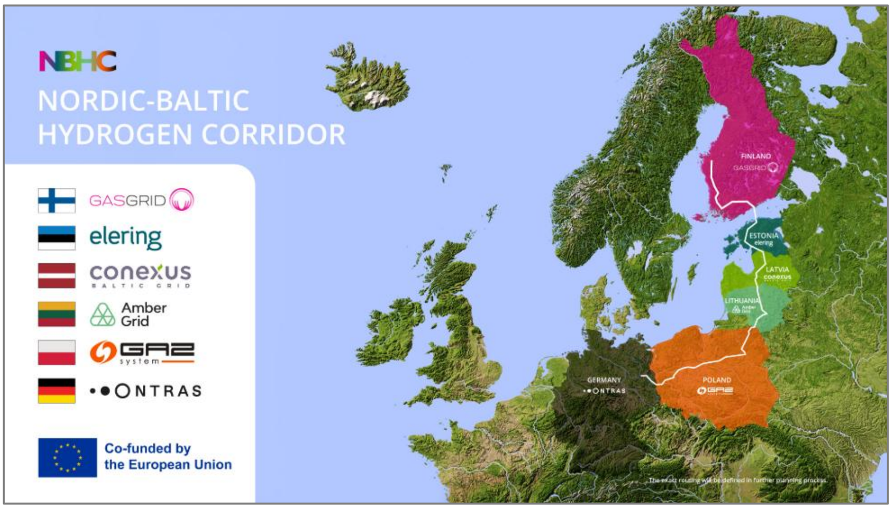


Figure8. Model route of the Nordic Baltic Hydrogen Corridor

Source: https://www.gaz-system.pl/en/hydrogen-market/projects/nordic-baltic-hydrogen-corridor.html

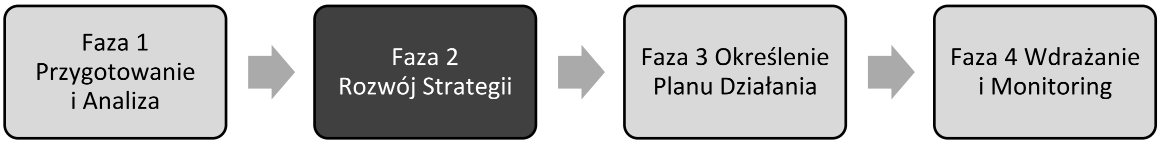
The development of the hydrogen market in Pomerania therefore requires lobbying and promotional activities emphasising the potential for the development of a Baltic hydrogen storage hub integrated with the transmission system in this part of Europe.

Referring to general trends, it can be added that the global hydrogen market is growing rapidly as a result of increasing demand for clean energy sources and the need to decarbonise industrial sectors. In 2024, its value was estimated at USD 204.5 billion, and according to forecasts, it is expected to reach over USD 556 billion by 2034. This represents an average annual growth rate (CAGR) of 7.82%. Unfortunately, the vast majority of turnover comes from grey or blue hydrogen produced from natural gas without CO_2 capture.

6. *The process of dialogue with stakeholders in the (green) hydrogen sector*

6.1. Methodology for conducting consultation meetings and the dialogue standard implemented

The second phase of preparing the Hydrogen Action Plan, in accordance with the methodology developed
within the European H2CE project, is the so-called strategy development. The key activity here was to engage hydrogen market stakeholders in seminars and workshops aimed at discussing the potential, opportunities and development challenges associated with the implementation of green hydrogen into the region's socio-economic system.



The selection of participants for each seminar was specified in the H2CE guidelines, which take into account four basic stakeholder groups, depending on their level of interest in the topic and their real influence on future implementation (Figure 9).

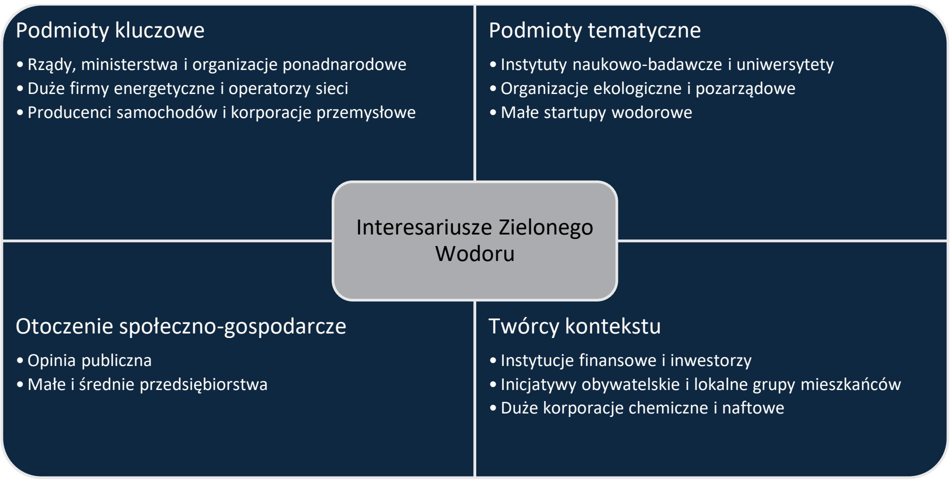


Figure9. Structure of green hydrogen stakeholders according to the H2CE methodology

Source: Guidelines for the development of a hydrogen strategy or action plan H2CE – WP1 Deliverable 1.2.1.

From the perspective of the project, the most important group will be *the* so-called key *players*, who are both strongly interested in green hydrogen and have considerable influence. Entities and institutions representing a high level of interest or having a significant impact on future activities will also make a significant contribution to the development of the Plan. The first category of stakeholders will be the so-called *Subjects*, which will include research institutions and universities, environmental and non-governmental organisations, and start-ups involved in hydrogen technologies. The so-called Context *Setters*, i.e. financing institutions and investors or large corporations from the refining or chemical industry, will also have a significant influence with a limited level of interest. The last group of stakeholders will be entities creating the socio-economic environment (*Crowd*).

The consultation meetings were held to implement the second step in the WPD development procedure, which involves identifying:

- motives and factors supporting the implementation of the technology,
- objectives and derivative factors conducive to the process,
- potential conflicts and challenges facing stakeholders.

In order to systematise the issues discussed, the series of consultation meetings was divided into three basic thematic blocks:

1) Green hydrogen production in the Pomeranian Province,
2) The use of green hydrogen as an energy carrier or fuel and a substrate for storing technological surpluses.
3) Transport and storage of green hydrogen in the Pomeranian Province,

Within these blocks, selected issues were discussed, which revolved around the following topics: the potential for the development of (green) hydrogen production, technological challenges for the development of the hydrogen industry, land transport powered by (green) hydrogen, the implementation of (green) hydrogen in ports and maritime transport, technologies for the transport and storage of (green) hydrogen, and development challenges for the Pomeranian (green) hydrogen hub.

Due to the open nature of the meetings and the direct links between the individual blocks and topics, the discussion often covered several areas. In order to streamline the consultation process and increase the number of potential participants, synergies with the activities of the hydrogen sector carried out during the project implementation period were used. Therefore, in addition to dedicated meetings organised by the Pomeranian Regional Chamber of Commerce, the opportunities offered by meetings of members and supporters of the Hydrogen Technology Cluster, as well as the PCHET 2025 conference (*Polish Conference on Hydrogen Energy and Technologies*). The series of consultation meetings was held between 16 September and 13 November this year (Table 8).

Table8. Schedule of consultation meetings and workshops as part of the preparation of the Hydrogen Action Plan for the Pomeranian Province

Thematic blocks	Thematic segments	Date	Meeting
Green hydrogen production in the Pomeranian Province	Potential for the development of (green) hydrogen production	15 October 2025	PCHET 2025 - Panel VIII: Power System 2030+: nuclear, wind and hydrogen – a new energy architecture for the region
	Technological challenges for the development of the hydrogen industry	30 October 2025	Dedicated RIGP meeting
The use of green hydrogen as an energy carrier or fuel and a substrate for storing technological surpluses	Land transport powered by (green hydrogen)	16 September 2025	Second meeting of members and supporters of the Hydrogen Technology Cluster (public transport)
	Implementation of (green) hydrogen in ports and maritime transport	16 October 2025	PCHET 2025 - Panel XIII: Decarbonisation of ports and shipping
Transport and storage of green hydrogen in the Pomeranian Province	Technologies for the transport and storage (green) hydrogen	15 October 2025	PCHET 2025 - Panel VII: Land and rail transport – Is hydrogen on the way?
	Development challenges for the Pomeranian (green) hydrogen hub	06.11.2025	Dedicated RIGP meeting
WORKSHOP: The life cycle of (green) hydrogen – challenges and opportunities for implementation in the Pomeranian Province		13	Dedicated RIGP meeting

Source: Own work

The discussions held during each event were recorded and then analysed in terms of the WPD requirements. A report was prepared for each meeting, which addressed several key areas, including:

1) Challenges related to the dissemination of hydrogen;
2) Opportunities for Pomerania;
3) Recommendations, including:
    a. for central government;
    b. for local government;
    c. for industry;
    d. for education and science.

When analysing the discussions on key challenges related to the implementation of hydrogen technologies, the most frequently mentioned issues were financial, both in terms of high capital expenditure (capex) related with the use of hydrogen, but also to the price of hydrogen itself, which increases operating expenses (opex). Following on from this, the lack or limited possibilities of support for enterprises in implementing this low-carbon technology was also raised. Participants in the meetings also frequently raised the issue of formal procedures, certification and regulations, which constitute an administrative barrier to the widespread use of hydrogen. Another important issue was the uncertainty about the future role of the technology in the energy system and economic applications, including transport. At present, it is still uncertain whether hydrogen will be widely implemented in the indicated sectors or whether it will remain a marginal solution.

Discussions on the opportunities for the Pomeranian Province mainly focused on the role of a hub that would integrate hydrogen production, storage, distribution and trade. This would naturally provide a basis for increasing the consumption of this element, including as a fuel for public transport vehicles. Issues related to the development of renewable energy production (offshore wind farms, nuclear power plant) and the functioning of seaports were raised.

However, most attention was devoted to recommendations which, despite being to three levels of impact, revolved around similar topics. A general observation from the consultations is that the participants generally treated the recommendations in a general manner, often abstracting from the competences and support tools available to specific administrative structures (cities, regions, country). For the sake of simplicity, a keyword approach was used to define the recommendations made by the consultation participants, as presented in Figure 10.

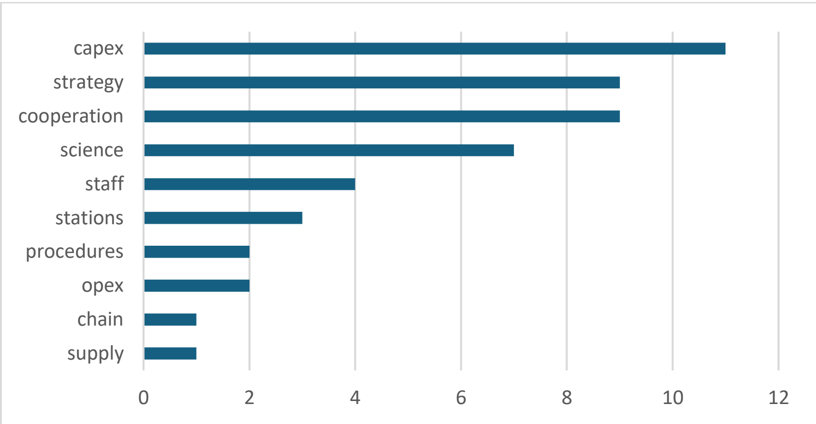


Figure10. Keyword structure of recommendations defined during consultation meetings

Source: Own work

The three most frequently mentioned recommendations were the need for support for capital expenditure (capex), the need to develop strategies, and the intensification of cooperation between stakeholders. The dominant recommendation that recurred during all consultation meetings was support for investment processes in the hydrogen sector. This referred to the need to create a financing framework based on European, national or regional funds. The need for support was discussed, both for infrastructure investments (including the distribution network and storage facilities), pilot implementations (e.g. public transport, vessels) and the expansion of laboratory and research facilities.

The second point called for the development of a strategy for the implementation of hydrogen solutions, which would cover both the progress in the development and implementation of propulsion technologies, development scenarios for the region's production and distribution potential, and the creation of comprehensive, cross-sectoral hydrogen-based value chains. Among the interesting topics were the need to reserve land for new hydrogen installations and the preparation of plans to adapt infrastructure to the needs of hydrogen.

The third, very frequently recurring theme was the need for closer cooperation between stakeholders in the hydrogen sector (cooperation). This referred both to the creation of platforms for the exchange of knowledge and information between stakeholders representing different links in the supply chains, cooperation between the business sector and public administration, as well as to building broader cooperation, both in geographical terms (international cooperation) and in terms of subject matter (development of research centres and teams, or a comprehensive educational offer).

The topic of science and research (science) also came up relatively often. Discussions focused about the region's potential to provide modern solutions for the hydrogen sector in the areas of storage technology, hydrogen propulsion and the safe operation of installations and vehicles. A complementary element was the issue of developing competent personnel, who are essential for the efficient and safe use of hydrogen in economic applications.

The heading 'stations' covers topics related to the need to ensure the availability fuel if it is to become widespread. The development of hydrogen refuelling stations is therefore a catalyst, and according to the participants of the meetings, the burden of action should be shared between the private and public sectors.

The formal requirements related to hydrogen (procedures) were also discussed, with the multitude and complexity of regulations being raised, both in the context of hydrogen infrastructure construction and the development of equipment and components necessary for hydrogen handling.

Another important topic was the operating costs (opex) of using hydrogen, with the price of hydrogen itself being a key issue. It was recommended that tools be created to directly support the purchase of fuel or lead to price reductions.

The last slogan, which is strongly correlated with the issues raised earlier (including 'stations' and 'opex') is increasing the supply of fuel on the market (supply). As already indicated, the widespread adoption of hydrogen technology requires ensuring the availability of fuel, and it should be emphasised that this applies to both the adequate amount of hydrogen on the market (supply), the operation of many points of sale (stations), and ensuring adequate fuel prices (opex).

Another recurring theme during the discussions was the high level of uncertainty regarding the prospects for the development of the green hydrogen market, particularly in relation to transport applications. This is due to the fact that there are currently several alternative propulsion solutions competing for primacy in the transport sector. Moreover, environmental pressure on the transport sector appears to be easing, which may delay the implementation of more expensive alternative solutions. This calls into question the effectiveness of potential investments, which in turn encourages companies to hold off on decisions.

6.2. Survey

The series of seminars discussing key challenges and directions for the development of hydrogen technology and applications in the Pomeranian Province was complemented by an online survey in which stakeholders had the opportunity to express their views on several issues. The use of this method of gathering information was intended both to expand the stakeholder base beyond the groups of people participating in the meetings and to systematise the information obtained. Ultimately, 33 people took part in the survey during the project implementation period. A publicly available tool (Microsoft Forms) was used to prepare the survey sheet. The survey asked seven questions that allowed both to determine the structure of the respondents and to identify key aspects of the development of the hydrogen sector. The number of questions was a compromise between the desire to obtain as broad and detailed information as possible and the respondents' willingness to answer.

The first question asked was whether the respondent belonged to a specific stakeholder group, with thirteen categories indicated. The results obtained indicate a relatively large diversity of respondents, as responses were recorded in ten of them (Figure 11). The largest number of responses (7) came from people representing non-governmental organisations, as well as representatives of the energy and maritime transport sectors. Three responses came from representatives of public authorities, the energy sector, the refining or chemical industry, and research institutions.

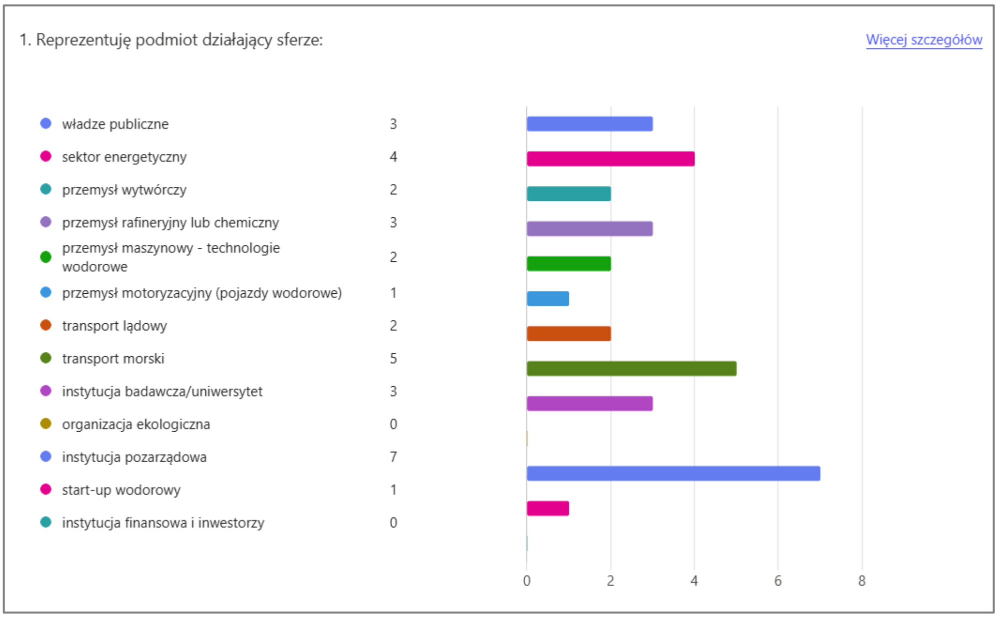


Figure11. Affiliation of survey respondents

In the second preliminary question, respondents were asked about the scope of their activities. The most common responses were European (27%), national (21%) and global (21%). Only 12% of respondents indicated that their activities were regional in nature.

The next five questions referred directly to issues related to the opportunities, prospects and limitations associated with the development of the hydrogen sector. The focus was on green hydrogen, and the region was indicated as the area of implementation. The third question asked respondents to assess the prospects for the use of green hydrogen in specific economic activities, allowing for a graded response (Figure 12).

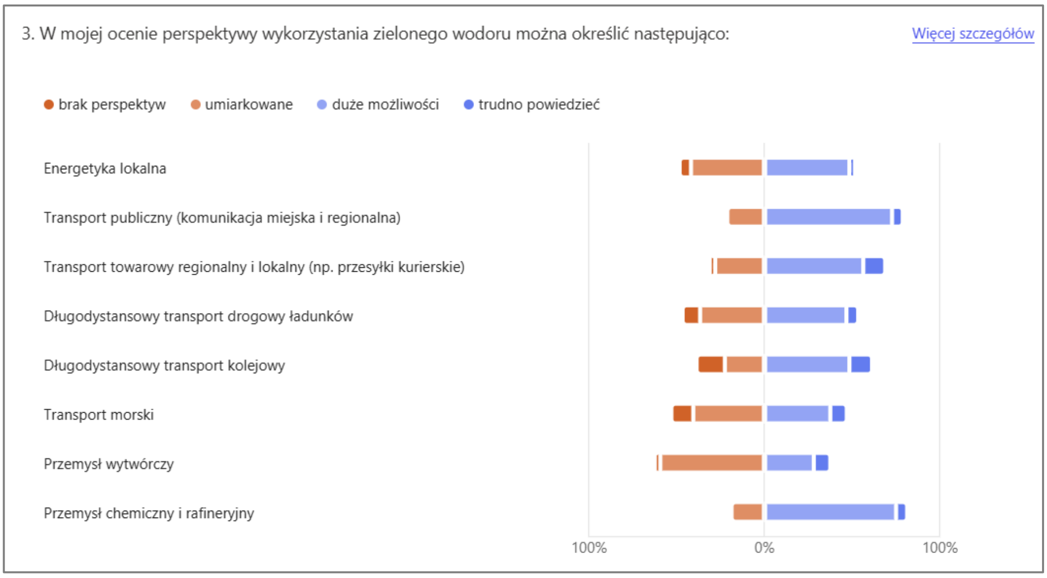


Figure12. Prospects for the use of green hydrogen in key economic applications

The greatest opportunities for the use of green hydrogen were in the chemical and refining industries and public transport. Regional and local freight transport, as well as long-distance rail transport, also received high ratings. Interestingly, long-distance rail transport was also the option that received the highest number of "no prospects" responses. Limited opportunities were also identified in relation to local energy, maritime transport and long-distance road freight transport. Respondents also considered the prospects for the manufacturing industry to be moderate.

The next question concerned the form of hydrogen use in the represented industry. In this case, hydrogen as an alternative fuel gained the highest share (55%). Hydrogen was also indicated as an energy carrier (21%) and as a raw material for production (18%). Other uses were indicated relatively rarely (6%).

The fifth survey question focused on the main factors determining the dissemination of hydrogen technology (Figure 13). The most frequent response was the price of hydrogen, which increases the implementation of the technology. The responses also highlighted the issues of investment costs (CAPEX) and the unclear prospects for the development of the technology.

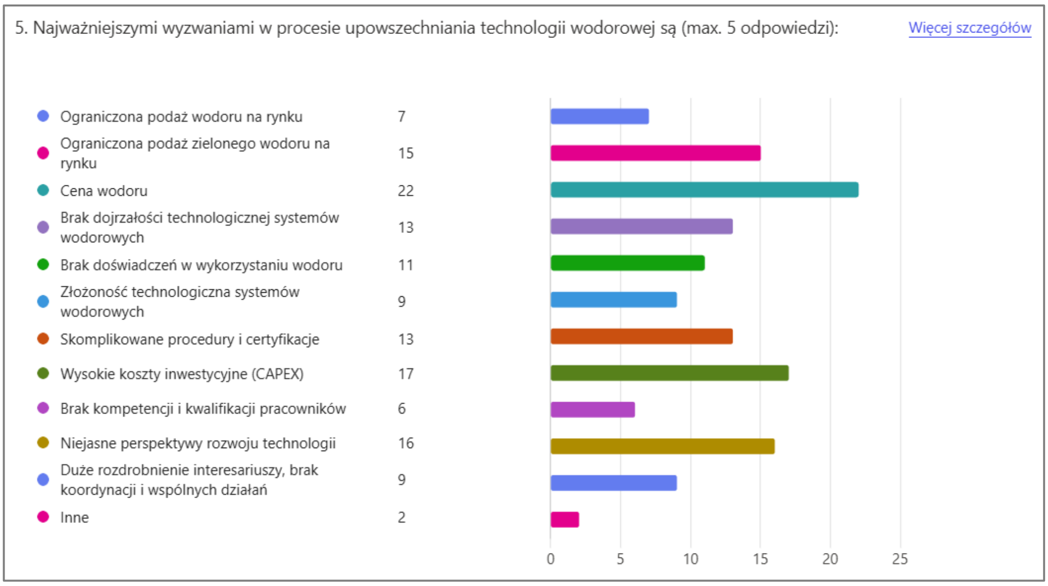


Figure13. Key challenges in the process of hydrogen technology adoption

A relatively large number of responses mentioned issues such as the limited supply of green hydrogen, the lack of technological maturity of hydrogen systems, and complicated procedures and certifications. Among the responses in the "other" category, attention was drawn to the low calorific value of hydrogen
compared to traditional marine fuels (e.g. MGO, HFO), as well as the lack of competence and real willingness to implement the technology on the part of public authorities.

The next question was directly focused on the Pomeranian region and asked about the role the region could play in future green hydrogen supply chains. In this case, three answers dominate: 1) green hydrogen production; 2) storage, distribution and trade of green hydrogen; 3) consumption (use) of green hydrogen – TRANSPORT (Figure 14).

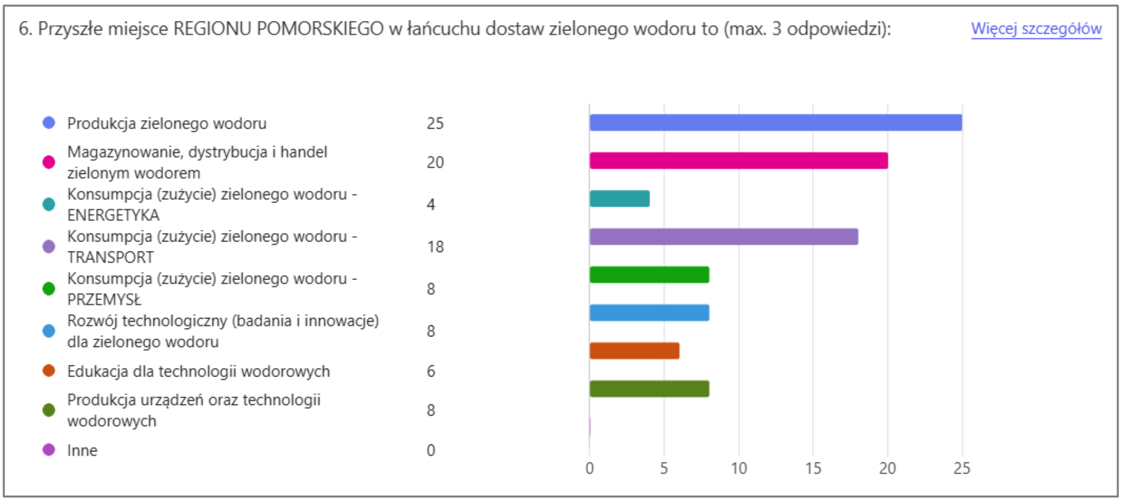


Figure14. The future place of the Pomeranian region in green hydrogen supply chains

In other cases, the number of responses was limited, although respondents used the full range of suggested answers.

The last question in the survey concerned activities which, according to stakeholders, have a significant impact on the dissemination of hydrogen technologies in Pomerania. The most popular responses were here, support for development work on hydrogen technologies, as well as financial support for companies implementing energy transition (Figure 15).

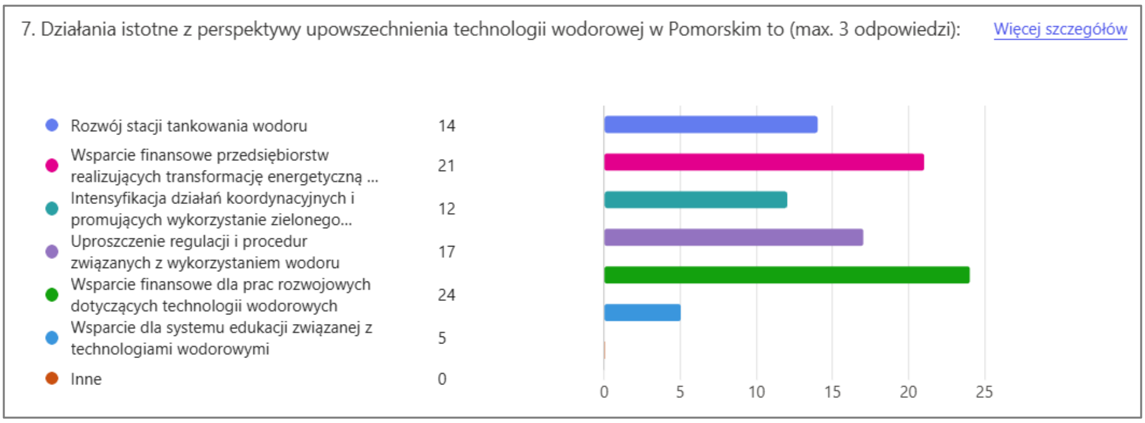
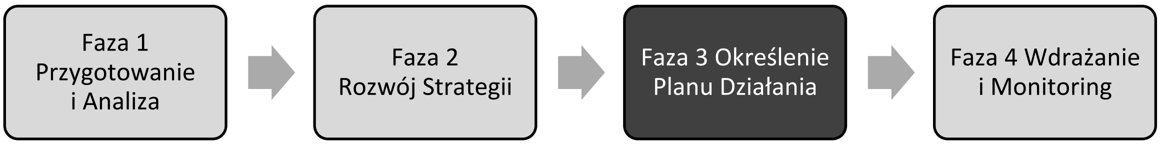


Figure15. Activities important from the perspective of the dissemination of hydrogen technology in Pomerania

Respondents also considered the simplification of regulations and procedures, as well as the development of refuelling stations and the intensification of coordination and promotion activities for the use of green hydrogen, to be important issues. The lowest number of responses was given to issues related to supporting education in the field of hydrogen technologies.

7. *Identification of priority initiatives and activities supporting the implementation of the hydrogen economy in the region*

A key stage in the development of the Hydrogen Action Plan, and at the same time the third phase in accordance with the methodology developed by H2CE, is to define the essential part of the Plan, i.e. a list of tasks that are to support the process of implementing the technology in the economic and social areas of the region.



The activities have been divided into two main parts, the first of which refers to those projects that can be implemented in the short term (in this case, the perspective until the end of 2026 has been adopted). The second part includes activities with a longer time frame, with 2030 as the target date for implementation. This is an important perspective, as a number of European regulations in the area of decarbonisation and energy transition set out specific requirements or changes within this time frame. At the same time, by 2030, the implementation measures for the new financing strategies in the EU budget perspective for 2027-2034 will be fully implemented.

The following sections take into account both the elements analysed in the areas of demand and supply, the indications of participants in the discussion held during consultation meetings with representatives of stakeholders involved in the hydrogen sector in Pomerania, as well as the conclusions of a survey on potential areas of hydrogen technology development and the challenges facing the region.

7.1. List of actions that can be implemented in the short term

Due to the current low level of use of green hydrogen technologies in the economy, which are often of a pilot nature, short-term actions will mainly refer to supporting those elements of the hydrogen ecosystem that already have a market dimension today or constitute preparatory activities for significant changes supporting its development. At the same time, it is important to work on promoting hydrogen, especially its sustainable types, which contribute to reducing the environmental impact of human activity. As indicated, the actions concern activities whose implementation should be completed by 2026. Key elements include:

1) Active participation of regional authorities in the preparation and implementation of hydrogen sector events to promote the concept of the Pomeranian Hydrogen Valley and hydrogen technologies in the region, including:
    a) *Power Connect Energy Summit* Gdańsk (18-20 March 2026)

   b) *NetZero H2Poland* Poznań (25-26 March 2026),
   c) *Ptak Warsaw Expo* Warsaw (14-16 April 2026),
   d) *PCHET 2026* Gdynia (29-30 September 2026),
   e) *European Hydrogen Week* Brussels (26–30 October 2026).

2) Preparation of a preliminary technological and operational concept and strategic verification from the operator's perspective for the creation of a Baltic hydrogen storage hub based on salt caverns in Pomerania and planned transmission investments in the Baltic Sea region, together with a set of materials promoting the concept in the international community.

3) Inclusion of regional hydrogen sector companies in the Pomeranian Export Broker 2030 initiative in order to support them in promoting and disseminating the hydrogen solutions they offer (including the production of equipment and components, installation design, construction of production facilities and hydrogen refuelling stations).

4) Continuation of development and research projects in the field of hydrogen economy in order to increase the potential of hydrogen knowledge and experience, including:

   - projects implemented jointly by the Marshal's Office of the Pomeranian Province and the Pomeranian Regional Chamber of Commerce – coordinator of the Hydrogen Technology Cluster:
     a) *H2CE Empowering H2-ready regions in Central Europe* (March 2023 – March 2026),
     b) *Hyperion* (April 2024 – June 2028),
   - projects implemented by the Pomeranian Regional Chamber of Commerce – coordinator of the Hydrogen Technology Cluster:
     c) *H2 Excellence* (June 2023 – June 2027),
     d) *Green Skills 4H2* (July 2022 – June 2026).

5) Preparation of a project application under the *Project Development Assistance (PDA)* programme[33], implemented as part of *the Clean Hydrogen Partnership* dedicated to hydrogen valleys (two competitions remain for 2026–2027).

6) Preparation of a concept for the operationalisation of the Pomeranian Hydrogen Valley using the *Smart Green Progress* initiative, affiliated with the Regional Research Agenda (RAB) animation initiatives, covering the main principles, functions and expected effects of the activities.

7) Development of a preliminary list of pilot projects relevant from the region's perspective, in order to address them in terms of contractors and financial support opportunities under the new EU financial perspective.

7.2. Medium-term tasks (until 2030)

The tasks defined in the WPD in the medium term were related to the strategic objectives developed in the report *Pomorskie na lekkim gazie – kierunki and Scenarios for the Hydrogen Economy until 2030 with a Perspective until 2040.* At the same time,

[33] https://pda.h2v.eu/en

the specific objectives indicated therein were used, verifying, redefining and supplemented them in accordance with current knowledge and needs. Of course, the presented list also takes into account the results of discussions held during consultation meetings and information provided in the survey.

The promoter of the indicated tasks is the Marshal's Office of the Pomeranian Province, which is why the issues raised remain within its competence and under its influence. Of course, the full implementation of the indicated tasks and the implementation of individual solutions require the involvement of a wide range of stakeholders, as well as many decisions at the central level and in the international arena.

Cel I. Building a green economy in the Pomeranian Province by 2040 by supporting energy transition, stimulating the decarbonisation of local businesses, and creating favourable conditions for large-scale investments.

1. Introduction at the regional level of a system to support hydrogen production technologies from renewable energy sources by co-financing investment projects in installations for the production and distribution of green hydrogen in the region. The implementation of such support tools should be included in the next EU financial perspective for 2028-2034.
2. Implementation of the prepared concept of the Pomeranian Hydrogen Valley and the resulting reactivation of the community gathered around its objectives by expanding the circle of its signatories in order to build potential consortia investing in hydrogen technologies. In particular, this refers to the activation of the participation of large regional enterprises from the maritime, port, logistics and manufacturing industries, which will provide the initiative with its driving force.
3. Implementation of activities supporting the increase of green hydrogen in transport and logistics through reviewing documents, conducting public consultations, supporting project proposals in the field of hydrogen technologies, initiating industry meetings and creating partnerships.
4. Promoting changes in tendering and procurement procedures for hydrogen technologies, where the key criterion for project evaluation should be the total cost of hydrogen (*LCOH – Levelised Cost of Hydrogen*), including construction costs (CAPEX), operating costs (OPEX) and decommissioning costs (DCC). Currently, the most common approach is to base the evaluation on investment costs (CAPEX), which prevents a full assessment of the efficiency of hydrogen solutions and their effectiveness in an environmental context.
5. Exchange of experiences and promotion of hydrogen solutions in the procurement procedures for environmentally clean vehicles by public entities, in accordance the Directive on clean and energy-efficient road transport vehicles[34] . This applies in particular

[34] Directive 2019/1161

to public transport vehicles, refuse collection vehicles and vehicles used for the technical maintenance of urban infrastructure.

6. Combining the strategic objectives of the Pomeranian Province with the Kaszubia Green Industrial District project. The "Kaszubia" project envisages the comprehensive development of industry, renewable energy, critical infrastructure and modern technologies in Pomerania. It may provide a strategic framework for the implementation of investments related to the production, storage and distribution of green hydrogen. The initiative will allow for the prioritisation of hydrogen projects in the region, including the development of the Pomeranian Hydrogen Valley, the integration of local industry leaders and the creation of consortia investing in low-carbon technologies.

Cel II. The inclusion of the region in the emerging central hydrogen economy while developing local distributed energy based on local hydrogen production.

1. Preparation of investment projects in the field of hydrogen technologies dedicated to financial support from EU funds 2028-2034 and their inclusion into strategic regional documents.
2. Establishment of a working group in the area of hydrogen corridors and hydrogen storage facilities in cooperation with Gaz System and the Orlen Group in order to create a new specialisation for the region in the area of hydrogen storage and distribution.
3. Active participation of representatives of the region (administration, enterprises, organisations, universities) in hydrogen initiatives at the central level, such as the Sectoral Agreement for the Development of the Hydrogen Economy.
4. Utilisation of the potential *of Hydrogen Europe* and active observation of European best practices (study visits, HYPERION and H2CE projects) to implement hydrogen production solutions (especially in seaports).

Cel III. Ensuring the availability of cheap hydrogen and renewable energy sources for the needs of the regional economy.

1. Implementation of the concept of creating a hydrogen storage hub based on the storage potential located in the Pomeranian Province (salt caverns – Kosakowo; Underground Gas Storage Caverns, Operator Gas Storage Poland), which will ensure access to large quantities of hydrogen in the long term, thereby reducing purchase costs and increasing its availability. Promoting the concept in the Baltic and European dimension.
2. Integration of hydrogen infrastructure with transmission infrastructure by ensuring connections between the planned hydrogen pipelines (*Baltic Sea Hydrogen Collector* and *Nordic-Baltic Hydrogen Corridor*) and Pomeranian cavern storage facilities, offshore gas terminals (including FSRU) and key distribution points in the region. This solution will enable the efficient transport, storage and distribution of hydrogen, supporting the development of the local economy, increasing fuel availability and reducing its final cost.

3. Use in the form of a project consuming effects in the area of hydrogen storage during the implementation of the Nordic-Baltic Hydrogen *Corridor* project, currently at the feasibility study stage in a consortium with Gaz-System S.A. The project has been included in the PCI list as part of the *Baltic Energy Market Interconnection Plan in hydrogen - BEMIP Hydrogen*) and has been granted the status of a priority investment project in the European Union[35] .
4. Reservation of land for future hydrogen installations, which will enable the creation of integrated hydrogen hubs with a full value chain: production – storage – distribution – consumption through cooperation between the public and private sectors.
5. Promoting changes in the certification system and changes aimed at harmonising standards and procedures for the use of hydrogen. The currently high and scattered certification requirements determine the high cost of the technology, and the lack of such common standards limits trade and investment in technology development.

Cel IV. Promoting the Pomeranian Province and local entities to the largest domestic and foreign stakeholders in the hydrogen economy in such a way that by 2040, the Pomeranian Province is perceived as a key element of the national and international hydrogen value chain and an important element of the national and European hydrogen infrastructure.

1. Building the image of Pomerania as a centre of hydrogen innovation attracting strategic investments through active promotion of the region and international cooperation (organisation of economic missions, participation in trade fairs and conferences, cooperation with European and global partners in the field of investments in hydrogen technologies).
2. Continuation of the activities of the *Offshore to Hydrogen* working group, whose aim is to create a coherent regulatory and technological framework for offshore hydrogen production, prepare recommendations for central and regional administrations, and set investment priorities.
3. Establishment and development of cooperation with the *HZwo e. V.* cluster and the Hydrogen Innovation Cluster in Chemnitz (Germany) in order to exchange experiences and implement good hydrogen practices.
4. Developing cooperation with the Department *for International Trade of Scotland* (DIT), *GlobalScot network, and local industry partners* through operational cooperation with *Scottish Development International* in Poland in the field of promoting hydrogen technologies and joint investment, export and educational initiatives.

Cel V. Building awareness among the region's population of the benefits of developing the hydrogen economy in Pomerania, and thus building local hydrogen expertise.

[35] https://www.gaz-system.pl/pl/rynek-wodoru/projekty/nordycko-baltycki-korytarz-wodorowy.html; accessed on 02.11.2025

1. Strengthening coordination activities and developing knowledge about hydrogen technologies within the framework of a forum for cooperation between stakeholders, including through the activities of the Hydrogen Technology Cluster and the further implementation of the Pomeranian Hydrogen Valley concept. Organising conferences and events aimed at providing the public with comprehensive knowledge about hydrogen technologies.
2. Prioritising comprehensive education in the field of modern, sustainable energy at all levels of education. Participation in trade fairs (career days), initiating meetings in the field of hydrogen economy with the active participation of the Hydrogen Centre of Gdańsk University of Technology.
3. Inclusion of activities within the Pomeranian Cooperation Network as a structure coordinating human resources development for the energy sector — especially industries related to renewable energy sources, offshore/onshore energy, energy storage and hydrogen technologies. This network should initiate cooperation between local government, educational institutions, universities, local businesses and investors to provide training programmes that meet the real needs of the market.
4. Preparation of education and retraining paths enabling young people and adults to acquire the skills needed in modern energy (renewable energy installations, wind farms, offshore, hydrogen technologies, energy storage, operation and maintenance of energy equipment, raw material/energy logistics, etc.).
5. Supporting local educational and vocational institutions in adapting their curricula to the needs of the sector by creating classes or technical courses focused on green energy, renewable energy sources, hydrogen technology, offshore/marine energy.
6. Creating a system for monitoring demand and forecasting staffing needs in the region, enabling vocational and technical education to respond to labour market needs, such as preventing shortages, skills gaps and the migration of skilled workers.

7.3. Hydrogen projects and activities in Pomerania

The above list of tasks can be preliminarily supplemented with indications relating to individual projects, both those currently in the implementation phase and and those that have a high chance of being implemented in the coming years. In part, these projects provided practical guidance in the process of preparing the Hydrogen Action Plan, and, in a way, complement the scope of activities envisaged therein. Importantly, in most cases, unlike in the Plan itself, the implementation of projects depends on the activities of external entities, which is why the host of the plan – the Marshal's Office of the Pomeranian Province – has only indirect possibilities to support and implement them. This applies to both projects currently in the implementation phase and development plans communicated by individual stakeholders.

The first category of activities undoubtedly includes projects related to the implementation of hydrogen propulsion in public transport vehicles, as well as ensuring wider access to fuel (refuelling stations). Another important activity that will potentially contribute to the implementation of green hydrogen in the region's economy is the construction of production facilities for (green) hydrogen, as exemplified by the investment in an electrolyser carried out by the Gdańsk Refinery of the Orlen Group. Table 9 lists the projects currently being implemented in Pomerania.

Table9. Current hydrogen projects in Pomerania

No.	Project/description	Deadline	Entity	Financing
1	Launch of the NesoBus H2 refuelling station at Jabłoniowa Street in Gdańsk	2024	Neso PAK PCE H2 stations	NesoBus
2	Delivery of 10 NesoBus H2 buses for Gdańsk (10-year lease)	2024/2025	Gdańsk Buses and Trams	GAiT
3	Launch of the NesoBus H2 refuelling station at the bus depot in Gdynia, Kacze Buki	2025	NesoBus PAK PCE H2 stations	NesoBus
4	Purchase of 6 new (Solaris) and 2 used hydrogen buses by the public transport company in Wejherowo	2025/2026	MZK Wejherowo	Co-financing from the National Fund for Environmental Protection and Water Management (NFOŚiGW) "Green Public Transport" programme
5	Launch of an H2 refuelling station at the bus depot in Wejherowo	2026	MZK Wejherowo	Co-financing from the National Fund for Environmental Protection and Water Management (NFOŚiGW) "Green Public Transport" programme
6	Expansion of the Orlen station to include H2 refuelling in Gdynia Karwiny, Wielkopolska Street (CEF project: *Clean Cities – Hydrogen mobility in Poland*)	2025	ORLEN Group	EU/CEF co-financing
7	Construction of a 2 x 2.5 MW electrolyser for the Gdańsk refinery (CEF project: GREEN H2)	2027	Lotos Green H2	EU/CEF funding

It should be emphasised that the above-mentioned projects are an important element in building the region's potential and experience in the region in the use of hydrogen, both in terms of access to the fuel itself (production, refuelling stations) and its use in public transport.

However, further action is needed to give the dissemination of hydrogen technologies the necessary impetus for development. Table 10 identifies potential implementation projects that should be subject to detailed analysis and assessment, both in terms of economic and financial requirements and legal and regulatory requirements, in particular those relating to decarbonisation measures.

Table10. Future hydrogen development projects in the perspective of 2030 recommended for detailed assessment in Pomerania

No.	Project/description	Comments
1	Construction of a low-power electrolyser at a wind farm (onshore or offshore) or photovoltaic farm based on surplus power (utilisation of non-market distribution)	Energy company operating in WP
2	Purchase of hydrogen buses by public transport companies in WP cities (implementation of requirements for the introduction of low-emission vehicles in public services)	WP cities
3	Purchase of hydrogen buses for regional transport services in WP (implementation of requirements for the introduction of low-emission vehicles in public services)	UMWP

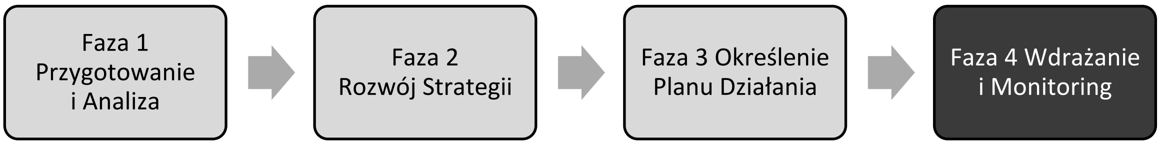
No.	Project/description	Comments
4	Purchase of hydrogen passenger cars for local government entities subordinate to the Marshal's Office of the Podlaskie Province (implementation of requirements concerning the use of low-emission vehicles in public services)	UMWP
5	Construction of hydrogen-powered ferries for the water tram system in Gdańsk	City of Gdańsk/Operator
6	Development of medium-power electrolyser construction technology by an entity from the Pomeranian Province. Use of the preparatory path for R&D projects based on support funds from the 'Grants for Eurogrants' programme.	Dedicated entities
7	Development of equipment technology accompanying the use of hydrogen technology in industry and public transport (e.g. high-pressure tanks, electrolyser instrumentation). Use of the preparatory path for R&D projects based on support funds from the 'Grants for Eurogrants' programme.	Dedicated entities
8	Construction of a small H2-powered vessel for maritime ports (Gdańsk or Gdynia) with service functions (e.g. waste and sewage collection, pilot vessel, control vessel, tugboat).	Dedicated entities
9	Pilot implementation of hydrogen propulsion for transhipment equipment and manoeuvring rolling stock in seaports (Gdańsk, Gdynia).	Dedicated entities
10	Construction of a pilot low-power electrolyser in the Słupsk Bioenergy Cluster – as an energy storage facility and/or for use in urban transport infrastructure.	Słupskie Wodociągi Sp. z o.o. + dedicated partner entities

Projects characterised by a high level of feasibility and, at the same time, effectively supporting the process of dissemination and development of technology should be included in the longer term into support programmes, both at national and and regional levels.

Another direction of change that should be noted is the targeted expansion of the scope of activities of the Hydrogen Technology Cluster, where by 2030 its area of activity should include low- and zero-emission technologies that go beyond strictly hydrogen solutions and support the decarbonisation of industry, transport, ports and logistics. At the same time, a major challenge is the targeted coordination of activities between the many entities and organisations involved in the development of individual components of the zero-emission economy. This includes, among other things, the integration of hydrogen technologies with the potential of renewable energy sources, in particular offshore and onshore wind energy, energy storage, the development of e-fuel production and distribution facilities, including bio and synthetic fuels, as well as intelligent management systems that enable the effective use of complex, sustainable energy solutions. A natural area for expanding activities is greater involvement in R&D projects and pilot investment projects carried out in cooperation with domestic and foreign partners. This expansion responds to current market and regulatory conditions, including changes in European taxonomy, the need to develop low-carbon hydrogen and the need to build viable business models.

8. Strategy implementation monitoring plan

The implementation of the identified tasks will require systematic monitoring and assessment of the degree of implementation, as provided for in the final phase of the H2CE project methodology.



Depending on the above-defined categories of activities (short-term and medium-term), different verification models should be applied, because while a simple assessment system can be used for current tasks, in the case of medium-term objectives, the implementation of individual proposals is more complex and requires the involvement of many stakeholders. The tables below present a set of parameters that can be used to monitor the effects of the implementation of the Hydrogen Action Plan.

Referring to all the points included in the HAP task list, for short-term actions, a YES/NO verification system is proposed. This is due to the fact that all tasks have specific completion dates (mostly by the end of 2026), and secondly, it is possible to easily assess their effects/status (Table 9).

Table11. Criteria for assessing the implementation of the Hydrogen Action Plan tasks in the short term

Task	Action	Assessment indicator	Assessment
1a	Participation of the Marshal's Office of the Pomeranian Province in the *Power Connect Energy Summit Gdańsk* event	Number of events: 1	YES/NO
1b	Participation of the Marshal's Office of the West Pomeranian Province in the *NetZero H2Poland Poznań* event	Number of events: 1	YES/NO
1c	Participation of the Marshal's Office of the West Pomeranian Province in the *Ptak Warsaw Expo* event *in Warsaw*	Number of events: 1	YES/NO
1d	Participation of the Marshal's Office of the West Pomeranian Province in the *PCHET 2026* event in *Gdynia*	Number of events: 1	YES/NO
1e	Participation of the Marshal's Office of the West Pomeranian Province in the *European Hydrogen Week* event in *Brussels*	Number of events: 1	YES/NO
2	Concept and materials promoting the creation of a Baltic hydrogen storage hub prepared	Number of promotional kits: 1	YES/NO
3	At least one company from the hydrogen sector has benefited from the support of *the Pomeranian Export Broker 2030*	Number of companies receiving support: 1	YES/NO
4a	*H2CE* project completed on time	Number of projects: 1	YES/NO
4b	*Hyperion* project completed on schedule	Number of projects: 1	YES/NO
4c	*H2 Excellence* project implemented according to schedule	Number of projects: 1	YES/NO
4d	*Green Skills 4H2* project completed on schedule	Number of projects: 1	YES/NO
5	Application for the *Project Development Assistance/Clean Hydrogen Partnership* programme submitted	Number of applications submitted: 1	YES/NO
6	List of pilot projects for the EU financial perspective 2028-2034 prepared	Number of project lists prepared: 1	YES/NO

In the case of medium-term WPD tasks, it is currently not possible to develop a comprehensive model for verifying implementation, as both the complexity and multidimensionality of individual activities and the dependence of their implementation on the activities of many stakeholders make it difficult to develop such a system. Nevertheless, Table 10 presents a proposal for criteria and potential indicators that could be used for such an assessment. It should be emphasised, however, that the achievement of the expected results depends to a large extent on many external factors, which is why those directly related to regional government have been identified. Another issue is the expected level of implementation of individual tasks, as in many cases there are no reference points or benchmarks that could be used to define such an assessment. Moreover, many hydrogen technologies and solutions based on this energy carrier are currently at the implementation or testing stage, which makes it difficult to assess whether they will become widespread and commercially implemented in economic or social activities. Therefore, it will be necessary to periodically review the tasks set and adapt them to economic realities, as well as to the current technical and regulatory situation. In addition, the geopolitical aspect should also be taken into account, as it may significantly influence the possibilities and directions of implementation of individual solutions.

Table12. Proposed criteria and indicators for assessing the implementation of the Hydrogen Action Plan tasks in the medium term

Tasks	**Evaluation criterion**	**Indicators**	**Tasks of the Marshal's Office of the Pomeranian Province**
Objective I. Building a green economy in the Pomeranian Province by 2040 by supporting energy transition, stimulating the decarbonisation of local enterprises, and creating favourable conditions for large-scale investments			
1	Hydrogen projects with financial support EU 2028-2034	Number of projects / priority budget	UMWP
2	The Pomeranian Hydrogen Valley has become operational	Number of PDW members / number of promoted projects	
3	Activities supporting the increase of green hydrogen use in transport and logistics	Number of events / number of documents reviewed	UMWP
4	Comprehensive assessment of the effectiveness of hydrogen investments (LCOH) implemented in procurement procedures	Number of projects incorporating the new approach	
5	Environmental efficiency criterion taken into account in public tendering procedures	Number of procedures taking into account the criterion	
6	Strategic cooperation between the Pomeranian Hydrogen Valley and the Green Industrial District "Kaszubia" implemented	Cooperation agreement concluded and implemented	UMWP
Objective II. Integration of the region into the emerging central hydrogen economy while developing local distributed energy based on local hydrogen production			
1	List of projects prepared and included into strategic regional documents for 2028-2034	List prepared and included in strategic documents	UMWP
2	New regional specialisation in hydrogen storage and distribution approved	Number of new specialisations	UMWP
3	The region has a strong position in the Sectoral Agreement for the Development of the Hydrogen Economy	Number of regional representatives in the Agreement	
4	Study visits carried out as part of Hydrogen Europe	Number of visits completed	
Objective III. Ensuring the availability of cheap hydrogen and renewable energy sources for the regional economy			
1	Concept of a Baltic hydrogen storage hub identified at international level	Number of enquiries/contracts concluded regarding cooperation with foreign entities	
2	Plans for the integration of hydrogen infrastructure with port and transmission infrastructure prepared for implementation	Plan prepared	
3	Concept for the creation of a Baltic hydrogen storage hub included in *BEMIP Hydrogen*	Dedicated provisions in BEMIP Hydrogen	

Tasks	Evaluation criterion	Indicators	Tasks of the Marshal's Office of the Pomeranian Province
4	Land reserved for the development of the hydrogen sector	Area of dedicated land	UMWP
5	Changes to the certification system simplifying the use of hydrogen technologies implemented	Scope of changes / stakeholder assessment	
Objective IV. Promotion of the Pomeranian Province and local entities to the largest domestic and foreign stakeholders in the hydrogen economy in such a way that by 2040 the Pomeranian Province is perceived as a key element of the national and international hydrogen value chain and an important element of the national and European hydrogen infrastructure			
1	Established image of Pomerania as a centre of hydrogen innovation	Number of hydrogen development projects implemented	UMWP
2	Recommendations and investment priorities prepared as part of *Offshore to Hydrogen*	List of recommendations and priorities defined	
3	Cooperation with European partners implemented on an ongoing basis	Number of events	UMWP
4	Cooperation with European partners carried out on an ongoing basis	Number of events	UMWP
Objective V. Building awareness among the region's population of the benefits of developing the hydrogen economy in Pomerania, and thus building local hydrogen competences			
1	Hydrogen Technology Cluster as a centre of hydrogen knowledge in the region	Number of cluster members / number of events organised	
2	Education in the field of modern energy as an important priority for education in the region	Relevant indications in regional documents	UMWP
3	Active operation of the Pomeranian Cooperation Network in the area of training for the hydrogen sector	Training available on the market	UMWP
4	Education and retraining pathways for modern energy defined	Education and retraining pathways and retraining schemes prepared	UMWP
5	Technical classes for green energy are operating in the region	Number of classes created	
6	Staff monitoring system for modern energy implemented	System prepared and implemented	UMWP

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Appendices

1. Report 1: Consultation meeting (16 September 2025) – ‘Hydrogen in public transport – challenges and prospects’ – Pomeranian Science and Technology Park in Gdynia.
2. Report 2: Consultation meeting (15 October 2025) – green hydrogen transport and storage – “Technologies for the transport and storage of (green) hydrogen” PCHET Conference – Panel VII: Land and rail transport – Is hydrogen on the way?
3. Report 3: Consultation meeting (15 October 2025) – green hydrogen production – “Potential for the development of (green) hydrogen production” PCHET Conference – Panel VIII: Power System 2030+: nuclear, wind and hydrogen – a new energy architecture for the region.
4. Report 4: Consultation meeting (16 October 2025) – ‘The use of green hydrogen as an energy carrier or fuel and a substrate for storing technological surpluses’ – PCHET Conference Panel XIII: Decarbonisation of shipping and ports – the role of hydrogen (hydrogen derivatives).
5. Report 5: Consultation meeting (30 October 2025) – "Technological challenges for the development of the hydrogen industry in the Pomeranian Province" – online meeting.
6. Report 6: Consultation meeting (6 November 2025) – “Development challenges for the Pomeranian green hydrogen hub” – Pomeranian Science and Technology Park in Gdynia.
7. Memo: "Workshop summarising project activities, surveys, conclusions and comments" (13 November 2025)

SAMORZĄD WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

Notatka ze spotkania

W dniu 16 września 2025 r. odbyło się **II Spotkanie Klastra Technologii Wodorowych** pod hasłem *„Wodór w transporcie publicznym – wyzwania i perspektywy”*. Było to **pierwsze spotkanie konsultacyjne realizowane w ramach „Wodorowego Planu Działań”**, zgodnie z harmonogramem przedsięwzięcia strategicznego *Pomorska Dolina Wodorowa*.

W wydarzeniu wzięło udział **14 przedstawicieli firm oraz instytucji**:

- ROCKFIN S.A.
- EKO-KONSULT ASE GROUP
- Miejski Zakład Komunikacji Wejherowo Sp. z o.o.
- BPR ASE Group Sp. z o.o.
- Gdańskie Autobusy i Tramwaje Sp. z o.o.
- Urząd Marszałkowski Województwa Pomorskiego
- Polska Agencja Inwestycji i Handlu

Spotkanie składało się z części prelekcyjnej oraz wizyty studyjnej. W części pierwszej zaprezentowano projekt **„Wodorowy Plan Działań dla Województwa Pomorskiego”** oraz omówiono działalność **PAK-PCE Stacje H2**. Następnie uczestnicy mieli okazję wziąć udział w dyskusji, w której poruszono kluczowe kwestie dotyczące rozwoju technologii wodorowych w regionie.

Kluczowe wątki dyskusji:

- **Cena wodoru** – uznana za jedną z najważniejszych barier ekonomicznych. Pojawiły się pytania, dlaczego samorządy decydują się na zakup autobusów wodorowych pomimo wysokich kosztów. Wskazano, że decydujące są **wymogi regulacyjne** – od stycznia 2026 r. samorządy będą musiały ponosić opłaty za emisję CO_2, a od 2029 r. wejdzie w życie system **ECS2**. Regulacje te sprawiają, że presja na wdrażanie zeroemisyjnych rozwiązań staje się ważniejsza niż sama ekonomika.

- **Doświadczenia Rybnika** – przytoczono przykład miasta, gdzie od dwóch lat eksploatowane są autobusy wodorowe. Podkreślono, że okres ten pozwolił na stabilizację procesu i zdobycie cennych doświadczeń eksploatacyjnych.

- **Prognozowanie zapotrzebowania** – padło pytanie od uczestnika, w jaki sposób **Neso Bus prognozuje rozwój rynku i zapotrzebowanie na wodór**. Dyskusja pokazała, że niezbędne są analizy zarówno na poziomie krajowym, jak i lokalnym, uwzględniające tempo rozwoju infrastruktury.

- **Koszty transportu wodoru** – zwrócono uwagę, że opłacalność transportu maleje wraz z odległością. Uczestnicy wskazali, że **powyżej 200 km przewóz wodoru staje się nieekonomiczny**, co podkreśla wagę lokalnej produkcji i krótkich łańcuchów dostaw.

- **Rozwój infrastruktury** – niska liczba stacji w Polsce wciąż stanowi barierę dla popularyzacji samochodów i autobusów wodorowych. Podkreślono, że bez sieci stacji trudno będzie zachęcić użytkowników do zakupu pojazdów zasilanych wodorem.’

SAMORZĄD WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

- **Technologia magazynowania w zbiornikach oraz sprężanie wodoru**– rozwój technologii zbiorników umożliwiał będzie- przy zachowanych lub zmniejszonych gabarytach zbiorników zwiększenie zasięgu pojazdów poprzez wyższy poziom kompresji wodoru

W części studyjnej uczestnicy odwiedzili stację tankowania wodoru przy ul. Starochwaszczyńskiej w Gdyni, gdzie zaprezentowano technologię tankowania i funkcjonowanie autobusu wodorowego **NesoBus**. Możliwość obserwacji całego procesu pozwoliła uczestnikom lepiej zrozumieć praktyczne aspekty wdrażania tego typu rozwiązań w transporcie publicznym.

Wnioski i rekomendacje:

- **Potrzebny jest równoległy rozwój produkcji zielonego wodoru i infrastruktury tankowania** – tylko takie podejście pozwoli zrównoważyć podaż i popyt oraz uniknąć barier inwestycyjnych.
- **Konieczne jest działanie na rzecz obniżenia kosztów wodoru**, tak aby jego cena nie stanowiła głównej bariery wejścia na rynek.
- **Samorządy i instytucje publiczne powinny wspierać rozwój stacji tankowania**, aby zwiększyć zaufanie użytkowników i zachęcić do zakupu pojazdów wodorowych.
- **Model ekosystemowy stworzony przez ZE PAK**, obejmujący produkcję zielonej energii, wodoru, transport, infrastrukturę oraz zastosowania końcowe (jak NesoBus), pokazuje, że samowystarczalny łańcuch wartości jest możliwy i skuteczny. Rekomenduje się przeniesienie tego modelu na inne regiony i podmioty, aby przyspieszyć transformację wodorową w Polsce.

Spotkanie potwierdziło potrzebę ścisłej współpracy między przedsiębiorstwami, samorządami i instytucjami badawczymi. Tylko skoordynowane działania pozwolą na pełne wykorzystanie potencjału technologii wodorowych w województwie pomorskim i w całej Polsce.

SAMORZĄD WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

Notatka ze spotkania

W dniu 15 października 2025 r. w trakcie Konferencji PCHET odbyło się **2 spotkanie konsultacyjne realizowane w ramach „Wodorowego Planu Działań"**, zgodnie z harmonogramem przedsięwzięcia strategicznego *Pomorska Dolina Wodorowa*.
Podczas Panelu **VII: Transport lądowy i kolejowy - Czy jest z wodorem po drodze?** pod hasłem "Technologie transportu i magazynowania (zielonego) wodoru"

Paneliści:
Olaf Godlewski – Worthington
Sebastian Suppan – Central Fluidsystem Swagelok Polska
Jakub Lubiński – Orlen S.A.
Krzysztof Ruciński - PAiH

W części pierwszej zaprezentowano projekt **„Wodorowy Plan Działań dla Województwa Pomorskiego"** oraz przedstawiono zagadnienia dla prelegentów.

- Który z obszarów aktywności transportowej naszego regionu – przewozy lokalne (transport publiczny, kurierzy), przewozy długodystansowe (drogowe, kolejowe) czy motoryzacja indywidualna można uznać za najbardziej podatny na wdrażanie technologii wodorowych?
- Jakie podstawowe bariery identyfikujecie Państwo w procesie upowszechniania się technologii wodorowych w sektorze transportu w regionie?
- Czy identyfikujecie Państwo potrzeby edukacyjne oraz badawcze wspierające wdrażanie wodorowych technologii w sektorze transportu?

Następnie prelegenci mieli okazję wziąć udział w dyskusji, w której poruszono kluczowe kwestie dotyczące technologii transportu i magazynowania zielonego wodoru w regionie. Uczestnicy konferencji mieli możliwość wypełnienia ankiety, celem której jest identyfikacja potencjalnych obszarów implementacji zielonego wodoru oraz działań i przedsięwzięć wspierających w regionie pomorskim

1. Kluczowe wątki dyskusji

• Wodór jako narzędzie dekarbonizacji transportu – wskazano jego potencjał szczególnie w transporcie publicznym, kolejowym i ciężkim, gdzie baterie są niewystarczające.
• Budowa łańcucha wartości – konieczność rozwoju całego ekosystemu: produkcji niskoemisyjnego wodoru, infrastruktury magazynowania i sieci stacji tankowania (HRS).
• Transport publiczny jako motor rozwoju – obecnie to główny obszar wdrożeń (autobusy wodorowe, miejskie floty zeroemisyjne).
• Transport kolejowy i ciężki – uznany za naturalny kierunek kolejnych wdrożeń (np. lokomotywa manewrowa PESA).
• Bezpieczeństwo i edukacja społeczna – podkreślono, że instalacje wodorowe są równie bezpieczne jak LPG i CNG, lecz wymagają certyfikowanych komponentów i społecznego zaufania.
• Rola państwa i PAIH – Polska Agencja Inwestycji i Handlu wspiera polskie firmy technologiczne w ekspansji zagranicznej oraz włączeniu ich w globalne łańcuchy dostaw.
• Edukacja i kadry – programy takie jak Akademia Wodorowa Orlenu rozwijają przyszłe pokolenie specjalistów w dziedzinie gospodarki wodorowej.
• Serwis i utrzymanie infrastruktury – firmy takie jak Rockfin rozwijają kadry i technologie monitoringu predykcyjnego, gwarantujące niezawodne działanie stacji 24/7.
• Potrzeba współpracy sektorowej – wodór wymaga integracji przemysłu, nauki, samorządów i inwestorów – zarówno na poziomie krajowym, jak i lokalnym.

SAMORZĄD
WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

2. Wyzwania

• Skomplikowane i długotrwałe procesy administracyjne przy budowie stacji wodorowych.
• Wysokie koszty inwestycji i niepewność co do popytu na wodór.
• Brak jednolitych przepisów technicznych oraz barier legislacyjnych (częściowo już przezwyciężonych).
• Ograniczona świadomość społeczna dotycząca bezpieczeństwa i korzyści z wodoru.
• Wysokie koszty eksploatacji pojazdów wodorowych – brak dopłat do operacyjnych kosztów transportu publicznego.
• Nierównomierny rozwój infrastruktury (pytanie: co pierwsze – stacje czy pojazdy?).

3. Szanse dla Polski i Pomorza

• Rozwój lokalnych hubów wodorowych w oparciu o porty, przemysł i energetykę morską.
• Możliwość budowy pełnego krajowego łańcucha wartości – od produkcji po dystrybucję i serwis.
• Wzrost eksportu technologii (kompresory, instalacje, komponenty) dzięki wsparciu PAIH.
• Potencjał akademicki i szkoleniowy (Akademia Wodorowa Orlenu, współpraca z uczelniami).
• Integracja z energetyką odnawialną i atomową w ramach przyszłego miksu „Systemu Mocy 2030+".

REKOMENDACJE

Dla administracji centralnej

• Uprościć procedury administracyjne i pozwoleniowe dla budowy infrastruktury wodorowej.
• Zapewnić stabilne i długoterminowe mechanizmy wsparcia finansowego, również dla kosztów eksploatacji.
• Stworzyć krajowy plan rozwoju transportu wodorowego, obejmujący transport publiczny, ciężki i kolejowy.
• Rozbudować sieć stacji HRS oraz systemy dystrybucji wodoru w ramach krajowej strategii transportowej.

Dla samorządów

• Aktywnie uczestniczyć w programach pilotażowych (floty miejskie, komunikacja publiczna).
• Współpracować z Orlen S.A. i partnerami przemysłowymi przy planowaniu lokalnych stacji wodorowych.
• Promować edukację ekologiczną i zaufanie społeczne do technologii wodorowych.

Dla przemysłu

• Inwestować w rozwój i standaryzację komponentów oraz systemów bezpieczeństwa.
• Rozwijać usługi serwisowe, predykcyjne utrzymanie i monitoring infrastruktury.
• Nawiązywać partnerstwa z instytucjami publicznymi i uczelniami dla wspólnego rozwoju kadr.

Dla sektora nauki i edukacji

• Wspierać programy edukacyjne i szkoleniowe (np. Akademia Wodorowa, studia interdyscyplinarne).
• Tworzyć wspólne laboratoria i projekty badawcze z przemysłem.
• Rozwijać badania nad bezpieczeństwem, magazynowaniem i efektywnością energetyczną wodoru.

Podsumowanie

Wodór jest kluczowym elementem przyszłości transportu niskoemisyjnego w Polsce. Panel pokazał, że mamy solidne fundamenty technologiczne, kompetentne kadry i rosnące wsparcie instytucjonalne Aby w pełni wykorzystać ten potencjał, potrzebna jest koordynacja działań administracji, przemysłu i nauki, uproszczenie procedur oraz długofalowa polityka wsparcia. Wodór nie jest już tylko paliwem przyszłości – staje się realnym komponentem transformacji energetycznej Polski i regionu Pomorza.

SAMORZĄD WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

Notatka ze spotkania

W dniu 15 października 2025 r. w trakcie Konferencji PCHET odbyło się **3 spotkanie konsultacyjne realizowane w ramach „Wodorowego Planu Działań"**, zgodnie z harmonogramem przedsięwzięcia strategicznego *Pomorska Dolina Wodorowa.*
Podczas Panelu VIII **System Mocy 2030+: atom, wiatr i wodór – nowa architektura energetyczna Regionu poruszono zagadnienia z obszaru produkcji zielonego wodoru** pod hasłem "Potencjał rozwoju produkcji (zielonego) wodoru"

Paneliści:
dr hab. Sylwia Mrozowska, prof. UG Uniwersytet Gdański
Dr Katarzyna Iwińska– Łukasiewicz ITECH
Stanisław Szultka– Urząd Marszałkowski Województwa Pomorskiego
prof. dr hab. inż. Jakub Kupecki– Narodowe Centrum Badań Jądrowych
Andrzej Wójtowicz- Prezes Zarządu Wodociągi Słupskie sp. z o.o.

W części pierwszej zaprezentowano projekt **„Wodorowy Plan Działań dla Województwa Pomorskiego"** oraz przedstawiono zagadnienia dla prelegentów.

Pierwsza część pytań: OZE + wodór
Morska energetyka wiatrowa na Pomorzu będzie generować duże nadwyżki energii elektrycznej w okresach wysokiej wietrzności. Te nadwyżki można wykorzystać do produkcji zielonego wodoru — paliwa bezemisyjnego, które może być magazynowane, transportowane i wykorzystywane w przemyśle, transporcie i energetyce. Wodór z offshore może więc stać się sposobem stabilizacji systemu elektroenergetycznego, który kompensuje zmienność produkcji z OZE.
Jakie są realne perspektywy wdrożenia produkcji i wykorzystania zielonego wodoru na Pomorzu? Czy region ma szansę stać się eksporterem, czy raczej odbiorcą zielonego wodoru? Jakiego rodzaju wsparcie byłoby niezbędne, aby upowszechnić technologie wodorowe w regionalnej energetyce i przemyśle?
Druga część pytań Atom +wodór i Program Polskiej Energetyki Jądrowej (PPEJ)
W jaki sposób budowa elektrowni jądrowej jest spójna z rozwojem Pomorskiej Doliny Wodorowej? Czy możliwy jest równoległy rozwój tych sektorów i ich współistnienie? Jak PPEJ wpływa na rozwój innych technologii?

Następnie prelegenci mieli okazję wziąć udział w dyskusji, w której poruszono kluczowe kwestie dotyczące produkcji zielonego wodoru w regionie. Uczestnicy konferencji mieli możliwość wypełnienia ankiety, celem której jest identyfikacja potencjalnych obszarów implementacji zielonego wodoru oraz działań i przedsięwzięć wspierających w regionie pomorskim

1. Kluczowe wątki dyskusji
• Konieczne jest zrównoważenie miksu energetycznego poprzez połączenie źródeł odnawialnych i stabilnych źródeł bazowych (atom, gaz, wodór).
• Wodór został wskazany jako kluczowy nośnik energii umożliwiający magazynowanie nadwyżek z OZE oraz zasilanie przemysłu i transportu.
• Energetyka jądrowa ma pełnić funkcję stabilizatora systemu elektroenergetycznego, zwłaszcza w północnej Polsce.
• Morska energetyka wiatrowa, rozwijana dynamicznie na Bałtyku, stanie się podstawowym źródłem zielonej energii dla przemysłu, portów i produkcji wodoru.
• Podkreślono znaczenie współpracy między sektorem publicznym, prywatnym i nauką – transformacja energetyczna wymaga koordynacji na poziomie krajowym i regionalnym.

SAMORZĄD WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

2. Wyzwania

• Brak spójnego planu infrastrukturalnego integrującego OZE, atom i wodór w ramach jednego systemu.
• Ograniczenia sieci przesyłowych i brak zdolności do przesyłu energii z północy kraju do południa.
• Wysokie koszty inwestycji i długi czas realizacji projektów jądrowych oraz wodorowych.
• Potrzeba szkolenia kadr technicznych oraz tworzenia zaplecza badawczego w dziedzinie energetyki przyszłości.
• Brak skutecznych mechanizmów finansowania lokalnych inicjatyw energetycznych.

3. Szanse dla Pomorza

• Region pomorski ma wyjątkowy potencjał: dostęp do morza, rozwinięte porty, planowane lokalizacje elektrowni jądrowej i farm wiatrowych.
• Możliwość budowy regionalnego systemu energetycznego opartego na synergii atomu, wiatru i wodoru.
• Współpraca z przemysłem ciężkim, portami i rafineriami może stworzyć z Pomorza centrum czystej energii w Polsce.
• Dodatkowym impulsem może być rozwój lokalnych dolin wodorowych i projektów CCS (sekwestracja CO_2).

REKOMENDACJE

1. Dla administracji centralnej
• Przygotować zintegrowaną strategię System Mocy 2030+, obejmującą atom, OZE i wodór jako powiązane elementy.
• Stworzyć krajową mapę inwestycji energetycznych z priorytetem dla północnej Polski.
• Zapewnić długoterminowe finansowanie projektów infrastrukturalnych poprzez fundusze UE i KPO.
• Wprowadzić mechanizmy zachęt dla inwestycji w zielony wodór i technologie magazynowania energii.

2. Dla samorządów i regionu pomorskiego
• Tworzyć regionalne strategie integrujące energetykę wiatrową, jądrową i wodorową.
• Zaplanować tereny pod inwestycje infrastrukturalne (magazyny energii, elektrolizery, sieci przesyłowe).
• Wspierać rozwój dolin wodorowych i lokalnych klastrów energii.
• Koordynować współpracę pomiędzy portami, przemysłem i operatorami systemu energetycznego.

3. Dla przemysłu i sektora energetycznego
• Inwestować w technologie umożliwiające integrację źródeł odnawialnych z produkcją wodoru.
• Tworzyć partnerstwa z portami i samorządami w celu rozwoju sieci dystrybucji zielonego wodoru.
• Przygotować plany adaptacji infrastruktury przemysłowej do odbioru energii z OZE i wodoru.
• Angażować się w projekty CCS/CCUS w celu redukcji emisji CO_2.

4. Dla sektora nauki i edukacji
• Rozwijać badania nad magazynowaniem energii, technologiami elektrolizy i bezpieczeństwem wodoru.
• Powołać interdyscyplinarne centra badawcze dla energetyki atomowej i wodorowej.
• Wprowadzić programy kształcenia w zawodach związanych z energetyką przyszłości.
• Wspierać międzynarodową współpracę badawczą i transfer technologii.

Podsumowanie

System Mocy 2030+ oparty na synergii atomu, wiatru i wodoru może zapewnić Polsce bezpieczeństwo energetyczne i stabilność cen energii. Region Pomorski ma szansę stać się liderem transformacji energetycznej kraju, pod warunkiem skoordynowanego działania administracji, nauki i przemysłu. Wspólne planowanie infrastruktury i inwestycje w nowe technologie to klucz do realizacji tej wizji.

SAMORZĄD WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

Notatka ze spotkania

W dniu 16 października 2025 r. w trakcie Konferencji PCHET odbyło się **4 spotkanie konsultacyjne realizowane w ramach „Wodorowego Planu Działań"**, zgodnie z harmonogramem przedsięwzięcia strategicznego *Pomorska Dolina Wodorowa*.
Podczas Panelu XII Dekarbonizacja portów i żeglugi pod hasłem "Wykorzystanie zielonego wodoru jako nośnika energii lub paliwa oraz substratu magazynowania nadwyżek"

Paneliści:
Bogdan Ołdakowski – Actia Forum
Adam Niklewski – DNV
Marek Narewski – PRS
Jarosław Polak - Zarząd Morskiego Portu Gdańsk S.A.
Dariusz Rudziński - ENMARO

W części pierwszej zaprezentowano projekt **„Wodorowy Plan Działań dla Województwa Pomorskiego"** oraz przedstawiono zagadnienia dla prelegentów.

- Złożoność technologiczna czy potencjał dekarbonizacyjny zielonego wodoru – co wygra w przyszłości żeglugi morskiej?
- Porty jako huby wodorowe zaangażowane w produkcję, magazynowanie i dystrybucję – który element łańcucha dostaw będzie dominował w przyszłości?
- Paliwo alternatywne, nośnik energii czy surowiec do produkcji zrównoważonych paliw (metanol, amoniak) dla żeglugi morskiej – jaka może być przyszła rola zielonego wodoru w sektorze transportu?
- Regionalne inicjatywy ukierunkowane na rozwój sektora wodorowego – jak wspierać skuteczną implementacje?

Następnie prelegenci mieli okazję wziąć udział w dyskusji, w której poruszono kluczowe kwestie dotyczące wykorzystania zielonego wodoru jako nośnika energii lub paliwa oraz substratu magazynowania nadwyżek. Uczestnicy konferencji mieli możliwość wypełnienia ankiet

1. Kluczowe wyzwania dla portów i armatorów

• Brak jednolitej technologii paliwowej – obecnie trwają równoległe prace nad LNG, metanolem, amoniakiem i wodorem.
• Wysokie koszty inwestycyjne – porty muszą dostosować infrastrukturę do bunkrowania nowych paliw.
• Niepewność regulacyjna i rynkowa – brak jasności, które paliwo stanie się dominujące po 2035 r.
• Dostępność paliw – infrastruktura produkcyjna dopiero się rozwija; w Polsce jest jeszcze w fazie pilotażowej.
• Bezpieczeństwo i logistyka – bunkrowanie amoniaku i wodoru wymaga nowych procedur bezpieczeństwa.

SAMORZĄD WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

2. Perspektywa Portu Gdańsk

Port Gdańsk, jako kluczowy węzeł TEN-T, ma strategiczne znaczenie w rozwoju infrastruktury paliw alternatywnych na Bałtyku. Planowane są działania w kierunku budowy terminali do bunkrowania LNG
i w przyszłości metanolu/amoniaku, tworzenia hubu wodorowego oraz modernizacji infrastruktury energetycznej w obrębie portu (shore power). Wskazano na konieczność współpracy z przemysłem i regionem.

3. Znaczenie dla Pomorza i Polski

Transformacja żeglugi to szansa gospodarcza dla regionu: rozwój nowych technologii, stoczni, przemysłu wodorowego i logistyki. Pomorze posiada silne zaplecze naukowe (Politechnika Gdańska, Uniwersytet Morski, IMP PAN) do budowy łańcucha wartości paliw alternatywnych. Wskazano potrzebę koordynacji międzysektorowej – energetyka, przemysł, transport morski, uczelnie i samorząd powinny działać wspólnie.

REKOMENDACJE

1. Dla portów (w tym dla Zarządu Morskiego Portu Gdańsk S.A.)

• Opracować strategię dekarbonizacji portu z harmonogramem wdrażania paliw alternatywnych.
• Inwestować w infrastrukturę multi-fuel – elastyczną wobec LNG, metanolu, wodoru i amoniaku.
• Rozwijać system shore power (OPS), zwłaszcza w terminalach kontenerowych i pasażerskich.
• Współpracować z operatorami paliwowymi i samorządami przy tworzeniu stref produkcji i dystrybucji zielonych paliw.

2. Dla administracji centralnej i regionalnej

• Wprowadzić krajowy plan dekarbonizacji żeglugi, spójny z polityką morską i energetyczną Polski.
• Zachęcać finansowo do inwestycji w infrastrukturę (fundusze UE, CEFFEnIKS, ETS).
• Wspierać projekty badawczo-rozwojowe dotyczące bunkrowania, magazynowania i bezpieczeństwa paliw.
• Rozwijać kompetencje poprzez szkolenia i centra wiedzy o technologiach paliwowych.

3. Dla uczelni i instytucji badawczych

• Skoncentrować się na badaniach nad zastosowaniem wodoru i amoniaku w napędach morskich.
• Tworzyć pilotażowe jednostki z napędem zeroemisyjnym.
• Włączać studentów w projekty europejskie (Horizon Europe, CINEA, Clean Hydrogen Partnership).

4. Dla przedsiębiorstw i armatorów

• Analizować scenariusze paliwowe i planować inwestycje zgodnie z trendami (LNG→ metanol → wodór/amoniak).
• Modernizować statki (retrofit) z myślą o przyszłej konwersji na paliwa zeroemisyjne.
• Tworzyć konsorcja publiczno-prywatne w ramach projektów demonstracyjnych w regionie.

Podsumowanie

Proces dekarbonizacji żeglugi morskiej to nieunikniona zmiana, w której Port Gdańsk i region pomorski mogą odegrać kluczową rolę – pod warunkiem, że już teraz rozpoczną skoordynowane działania inwestycyjne, regulacyjne i edukacyjne. Przyszłość żeglugi to nie wybór czy się dekarbonizować, ale jak szybko i w jakim kierunku.

SAMORZĄD WOJEWÓDZTWA POMORSKIEGO

HYDROGEN ACTION PLAN

Notatka ze spotkania

W dniu 30 października 2025 r. odbyło się **spotkanie online za pośrednictwem aplikacji MicrosoftTeams**, realizowane w ramach prac nad **„Wodorowym Planem Działań dla Województwa Pomorskiego”**, zgodnie z harmonogramem przedsięwzięcia strategicznego **Pomorska Dolina Wodorowa**

Spotkanie poświęcone było **Technologiczny wyzwaniom rozwoju przemysłu wodorowego** w Województwie Pomorskim oraz dyskusji nad potencjałem technologii wodowrowych w regionie.

Zakres spotkania i główne tematy:

W pierwszej części spotkania przedstawiciele **firmy Electrum** zaprezentowali projekt budowy instalacji do produkcji zielonego wodoru w **Rafinerii Gdańskiej** – pierwszego tego typu projektu w Polsce, realizowanego w technologii elektrolizy alkalicznej o mocy 5 MW.

Omówione zagadnienia techniczne

Elektrolizer alkaliczny składa się z dwóch stosów po 2,5 MW każdy, gwarantujących produkcję ok. 85 kg wodoru/h o czystości 99,995%.
Instalacja obejmuje system separacji i oczyszczania wodoru (adsorpcjazmiennotemperaturowa), system chłodzenia i integrację z infrastrukturą rafineryjną.
Czas realizacji projektu: **22 miesiące (uruchomienie – 2027 r.)**
Elektrolizer będzie zasilany energią elektryczną (pochodzenie energii – do ustalenia; potencjalnie kontrakt PPA).
Technologia alkaliczna wybrana ze względu na stabilność pracy i mniejsze uzależnienie od materiałów rzadkich w porównaniu z technologią PEM.
Wskazano istotne kwestie środowiskowe: zużycie wody demineralizowanej (ok. 1 m^3/h), ograniczona ilość ługu KOH, bezpieczeństwo procesowe i integracja z istniejącymi mediami rafinerii.

Dyskusja i wnioski:

1. Zielony charakter wodoru
Uczestnicy pytali o źródło zasilania i rzeczywisty „zielony” charakter produkowanego wodoru.
Przedstawiciele Electrum wyjaśnili, że będzie to zależało od kontraktu na dostawy energii (PPA) i certyfikatów pochodzenia. Instalacja ma **potencjał do produkcji zielonego wodoru**, choć obecnie jego kolor pozostaje „otwarty”.
2. Wyzwania technologiczne
Kluczowe znaczenie ma odpowiedni dobór technologii elektrolizy (PEM vs. alkaliczna) w zależności od charakterystyki źródła energii.
Przy źródłach niestabilnych (OZE) korzystniejsza może być technologia PEM, natomiast przy stałym zasilaniu (np. energetyka jądrowa) – alkaliczna.
Omówiono kwestie kosztów energii i wpływu przewymiarowania źródeł OZE na opłacalność projektu.
3. Lokalne kompetencje i potencjał
Wskazano na silny potencjał Pomorza w zakresie technologii wodorowych: firmyRokfin, ASE, Valmet, Eksjon, Orkwin, Electrum.
Podkreślono znaczenie **local contentu** i możliwości tworzenia łańcucha wartości w regionie – od produkcji komponentów po projektowanie i integrację instalacji.
Wspomniano o potrzebie ekspansji eksportowej polskich rozwiązań technologicznych.

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4. Kryteria oceny inwestycji
Dyskutowano nad koniecznością odejścia od prostego kryterium **najniższej ceny (CAPEX)** w przetargach na rzecz **całkowitego kosztu wytworzenia wodoru (LCOH)**, który uwzględnia OPEX, efektywność energetyczną i koszty serwisowe.
Zwrócono uwagę, że polskie przetargi powinny premiować efektywność i długoterminową trwałość technologii.
5. Aspekty środowiskowe
Poruszono kwestię ograniczonych zasobów wody słodkiej w regionie – jako potencjalnej bariery dla rozwoju dużych projektów wodorowych.
W przypadku Rafinerii Gdańskiej media (woda, azot, powietrze) są zapewniane przez istniejącą infrastrukturę, więc bariera ta nie występuje.

Znaczenie dla regionu Pomorskiego:

Projekt stanowi **pierwszy krok w praktycznej dekarbonizacji przemysłu rafineryjnego** w regionie i przykład zastosowania technologii wodorowych w przemyśle ciężkim.
Dla Pomorza to również **szansa rozwoju przemysłu wodorowego**, kompetencji inżynierskich i lokalnych firm technologicznych.

REKOMENDACJE:

Dla administracji i samorządów:

- Wspierać rozwój lokalnego łańcucha dostaw i producentów komponentów technologii wodorowych.
- Uwzględniać w zamówieniach publicznych kryteria LCOH i efektywności energetycznej.
- Koordynować działania w ramach strategii Pomorskiej Doliny Wodorowej.

Dla przemysłu i inwestorów:

- Wykorzystywać doświadczenia z projektu Rafinerii Gdańskiej przy kolejnych inwestycjach.
- Budować kompetencje w zakresie projektowania, integracji i utrzymania instalacji wodorowych.
- Uwzględniać czynniki środowiskowe i optymalizację zużycia wody.

Dla uczelni i instytucji badawczych:

- Rozwijać badania nad efektywnością technologii elektrolizy i gospodarką obiegu wody.
- Włączać studentów i młodych inżynierów w projekty demonstracyjne.

Podsumowanie:

Spotkanie potwierdziło duże znaczenie projektu Rafinerii Gdańskiej dla rozwoju sektora wodorowego w Polsce i regionie Pomorskim.
Podkreślono potrzebę **integracji lokalnych kompetencji**, **racjonalizacji kosztów**, **zrównoważonego wykorzystania zasobów** oraz **koordynacji działań badawczo-przemysłowych** w ramach Pomorskiej Doliny Wodorowej.
Realizacja projektu do 2027 roku będzie ważnym krokiem w kierunku **transformacji energetycznej i dekarbonizacji przemysłu na Pomorzu.**

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NOTATKA ZE SPOTKANIA

W dniu 6 listopada 2025 r. w Pomorskim Parku Naukowo-Technologicznym w Gdyni (Budynek IV, sala F 0.17) odbyło się **szóste spotkanie konsultacyjne**, realizowane w ramach przedsięwzięcia **„Pomorska Dolina Wodorowa”**, prowadzonego w projekcie **H2CE – Hydrogen Clean Energy**.
Spotkanie poświęcone było kontynuacji prac nad opracowaniem **„Wodorowego Planu Działania dla Województwa Pomorskiego”**, w szczególności zagadnieniom związanym z rozwojem **pomorskiego hubu zielonego wodoru** oraz zastosowaniem wodoru w **transporcie publicznym**.

Temat przewodni spotkania:

„Wyzwania rozwojowe dla pomorskiego hubu zielonego wodoru”

Przebieg spotkania

W pierwszej części spotkania **Paweł Misiak** omówił doświadczenia PKM Gdynia z **testów autobusów wodorowych i autobusów hybrydowych elektryczno-wodorowych**, przeprowadzonych na liniach miejskich na przełomie września i października 2025 r.

1. Doświadczenia z testów autobusów wodorowych

Testowane modele:
Autobus wodorowy (12 m) – ogniwo Ballard 70 kW, zbiorniki 30 kg, zasięg ~500 km.
Autobus elektryczno-wodorowy (hybrydowy) – baterie NMC 294 kWh + ogniwo 60 kW.
Wyniki eksploatacyjne:
Średnie zużycie wodoru:
- autobus wodorowy: **~7 kg/100 km**,
- autobus elektryczno-wodorowy: **~4,4 kg/100 km + 27 kWh/100 km energii elektrycznej**

Czas tankowania: **10–12 minut**
Zasięgi dzienne na liniach 300+ km uzyskano bez problemów.

2. Wnioski ekonomiczne

Koszt przejazdu 100 km autobusem wodorowym jest **~2x wyższy** niż autobusem diesla.
Hybryda elektryczno-wodorowa wypada korzystniej kosztowo niż klasyczny autobus wodorowy.
Cena wodoru pozostaje kluczowym czynnikiem decydującym o opłacalności.
Zakup autobusu wodorowego to koszt **2,8–3,5 mln zł**, czyli ok. **2× diesel**.

3. Infrastruktura tankowania

Omówiono stacje w:
Gdyni: ul. Chwaszczyńska oraz nowa stacja przy ul. Wielkopolskiej, testowana podczas prób autobusów.

Dyskusja (wybrane wątki)

Stymulacja popytu na wodór
- Wskazano potrzebę **mechanizmów wsparcia paliwa (dopłat)** aby przełamać barierę kosztów.
- Rozwój infrastruktury musi następować równolegle z zakupami taboru.

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Potencjał regionalny produkcji wodoru

Możliwości produkcji wodoru przy farmach wiatrowych onshore i offshore.
Perspektywa **zielonego wodoru po 2030 r.** w powiązaniu z morską energetyką wiatrową.

Rola Portu Gdańsk

Port analizuje wykorzystanie wodoru jako paliwa i surowca oraz potencjał udziału w importach i magazynowaniu.

Wnioski dla regionu

Zastosowanie wodoru w transporcie jest **technicznie możliwe i sprawdzone**, ale wymaga:

- **stabilnego systemu wsparcia cen paliwa**,
- **zwiększania skali** zakupów taboru,
- **rozwoju lokalnych źródeł produkcji wodoru**, aby obniżyć koszty.

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REKOMENDACJE

Dla samorządu regionalnego / UMWP

Uruchomić regionalny program **pilotażowego wsparcia zakupu autobusów zeroemisyjnych** (elektrycznych i elektryczno-wodorowych).
Wspierać rozwój infrastruktury **tankowania i serwisowania** autobusów wodorowych.
Promować współpracę między operatorami komunikacji w zakresie **wspólnych zamówień i serwisu**.
Promować pośród przewozów regionalnych, na dłuższych trasach autobusy wodorowe. Przewozy regionalne UMWP koordynuje bezpośrednio

Dla miast i operatorów transportu

Utrzymywać stopniową ścieżkę transformacji (diesel → elektryczny → wodorowy/hybrydowy).
Korzystać z projektów **pilotażowych** jako przestrzeni do zdobywania doświadczeń.

Dla przemysłu i sektora energii

Rozwijać **lokalne łańcuchy dostaw** dla produkcji i dystrybucji zielonego wodoru.
Przygotować **pilotażowe instalacje produkcyjne** zasilane energią OZE.

Podsumowanie

Rozwój pomorskiego hubu wodorowego wymaga **koordynacji działań transportu, energetyki i samorządów**, a także wsparcia kosztów paliwa i inwestycji infrastrukturalnych. Wodór w transporcie publicznym jest **technicznie dojrzały**, lecz jego ekonomiczne wdrożenie zależy od **skalowania rynku i spadku kosztów paliwa** w nadchodzących latach.

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NOTATKA Z WARSZTATU

W dniu 13 listopada 2025 r. w trybie hybrydowym - w Pomorskim Parku Naukowo -Technologicznym w Gdyni (Budynek IV, sala F 0.28) oraz na platformie MS Teams odbył się **warsztat podsumowujący w obszarze zielonego wodoru**, realizowany w ramach przedsięwzięcia **„Pomorska Dolina Wodorowa",** prowadzonego w projekcie **H2CE – Hydrogen Clean Energy**.
Spotkanie poświęcone było podsumowania dotychczasowych prac nad opracowaniem **„Wodorowego Planu Działania dla Województwa Pomorskiego,"** w szczególności zagadnieniami związanymi z rozwojem **pomorskiego hubu zielonego wodoru** w ujęciu średnio i długoterminowej strategii województwa pomorskiego.

Temat przewodni warsztatu:

„Warsztat podsumowujący – działania projektowe, ankietowanie, wnioski i uwagi"

Przebieg spotkania

W pierwszej części warsztatu ekspert Wykonawcy – RIGP / Klastra Technologii Wodorowych Profesor Uniwersytetu Morskiego Maciej Matczak przedstawił w formie prezentacji całość wymogów wynikających z zadania postawionego przed Wykonawcą przez Zamawiającego, szczególnie:

1) Organizację oraz przygotowanie merytoryczne spotkań konsultacyjnych (6 spotkań);
2) Organizację oraz przeprowadzenie warsztatu w obszarze zielonego wodoru;
3) Przygotowanie dokumentu: „Wodorowy Plan Działania dla Województwa Pomorskiego".

Kolejno, omówiona została zastosowana metodologia organizacji i tworzenia Wodorowego Planu Działania, oparta wprost o rekomendacje zawarte w Projekcie H2CE – **„Guidelines for the development of a Hydrogen strategy or action plan H2CE"- WP1 – Deliverable 1.2.1.**
W następnej kolejności Ekspert Wykonawcy omówił model interesariuszy sektora wodorowego H2CE, ze szczególnym uwzględnieniem roli sektora administracji samorządowej oraz centralnej, jak i strategicznych podmiotów w obszarze energetyki, SSP oraz sektora prywatnego, także MMŚP.
W dalszym ciągu prezentacji prof. Maciej Matczak przypomniał obszar tematyczny oraz jego kluczowe zagadnienia objęte opracowaniem:

Cykl seminariów zostanie podzielony na trzy bloki tematyczne

1) Produkcja zielonego wodoru w województwie pomorskim,
2) Transport i magazynowanie zielonego wodoru w województwie pomorskim,
3) Wykorzystanie zielonego wodoru jako nośnika energii lub paliwa oraz substratu magazynowania nadwyżek technologicznych.

W ramach bloków organizowane były seminaria ukierunkowane na omówienie zagadnień:

- ✓ Potencjał rozwoju produkcji (zielonego) wodoru,
- ✓ Technologiczne wyzwania rozwoju przemysłu wodorowego,
- ✓ Transport lądowy napędzany (zielonym) wodorem,
- ✓ Wdrażanie (zielonego) wodoru w portach i żegludze morskiej,
- ✓ Technologie transportu i magazynowania (zielonego) wodoru,
- ✓ Wyzwania rozwojowe dla pomorskiego hubu (zielonego) wodoru.

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Prezentacja dotychczasowych działań objęła także podsumowanie głównych wątków poruszanych na spotkaniach z interesariuszami – obejmujące w przeważającej większości takie tematy jak: capex, strategia i kooperacja. Wyniki badań ankietowych wskazują na największe wyzwania w zakresie upowszechniania technologii wodorowych w Polsce, którymi jest cena zielonego wodoru oraz wskazywane przez ankietowanych niejasne perspektywy technologii wodorowych.

Ankietowane podmioty wskazywały rolę naszego województwa pomorskiego – jako obszaru produkcji zielonego wodoru w perspektywie średnioterminowej, wykorzystującej efekty inwestycji w offshore oraz pierwszą elektrownię atomową, z uwzględnieniem rosnącej roli transportu publicznego (konsumpcja wodoru) oraz jego magazynowania. Wyniki ankiet wskazują także kierunkowo potrzeby artykułowane przez interesariuszy w zakresie wsparcia finansowego obszaru R&D a także wsparcia finansowego całego procesu dekarbonizacji gospodarki na Pomorzu

Finalnym elementem prezentacji Wykonawcy było wskazanie zgodnie z treścią zlecenia rekomendowanych działań w perspektywie krótko (1 rok) – oraz długoterminowej (do 2030 r.) które powinny zostać zainicjowane w ramach Wodorowego Planu Działania:

Działania krótkookresowe:

1. Wzmacnianie działań koordynacyjnych oraz rozwój wiedzy (Klaster Technologii Wodorowych)
2. Reaktywacja Pomorskiej Doliny Wodorowej, aktywizacja udziału dużych przedsiębiorstw regionalnych, które zapewnią inicjatywie potencjał sprawczy.
3. Promocja Pomorskiej Doliny Wodorowej poprzez aktywny udział firm w wydarzeniach krajowych w 2026 roku, m.in. Ptak Warsaw Expo Warszawa, NetZero H2Poland Poznań, PCHET 2026 Gdynia, Hydrogen Week Bruksela.
4. Wsparcie przedsiębiorstw oferujących rozwiązania wodorowe poprzez wspólne przedsięwzięcia promocyjne (m.in. inicjatywa Broker Gospodarczy).
5. Opracowanie listy projektów pilotażowych istotnych z perspektywy regionu, w celu ich zaadresowania pod względem wykonawców oraz możliwości wsparcia finansowego.
6. Kontynuacja realizacji projektów rozwojowych i badawczych realizowanych w regionie w obszarze gospodarki wodorowej (HYPOP, H2CE, H2 Excellence, Hyperion, Green Skills 4H2)
7. Przygotowanie aplikacji projektowej w ramach programu Project Development Assistance - PDA, realizowanego w ramach Clean Hydrogen Partnership dedykowanego dla dolin wodorowych (pozostały 2 konkursy na lata 2026 – 2027)
8. Przygotowanie propozycji zmian w systemie certyfikacji oraz zmian mających na celu zharmonizowanie standardów i procedur korzystania z wodoru
9. Promowanie zmian w procedurach przetargowych i zakupowych dotyczących technologii wodorowych (LCOH)
10. Wymiana doświadczeń oraz promowanie rozwiązań wodorowych w procedurach zakupowych ekologicznie czystych pojazdów przez podmioty publiczne

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REGIONALNA IZBA GOSPODARCZA POMORZA

KLASTER TECHNOLOGII WODOROWYCH

POMORSKA DOLINA WODOROWA

Interreg CENTRAL EUROPE Co-funded by the European Union H2CE

HYDROGEN ACTION PLAN

Działania średniookresowe:

1. Wprowadzenie na szczeblu regionalnym systemu wspierania technologii produkcji i dystrybucji wodoru z OZE. Perspektywa finansowa UE 2028 -2034
2. Przygotowanie projektów inwestycyjnych w obszarze technologii wodorowych dedykowanych wsparciu finansowemu ze środków UE 2028 -2034 oraz włączenie ich do strategicznych dokumentów regionalnych
3. Uruchomienie regionalnego programu pilotażowego wsparcia zakupu autobusów zeroemisyjnych (elektryczno-wodorowych), zarówno dla komunikacji miejskiej, jak i przewozów regionalnych (UMWP)
4. Promowanie współpracy między operatorami komunikacji w zakresie wspólnych zamówień i serwisu pojazdów i zaplecza wodorowego
5. Przygotowanie pilotażowych instalacji produkcyjnych zasilanych energią OZE
6. Aktywny udział przedstawicieli regionu w inicjatywach wodorowych na poziomie centralnym, jak m.in. Porozumienie sektorowe na rzecz rozwoju gospodarki wodorowej
7. Umożliwienie tworzenia zintegrowanych wodorowych hubów z pełnym łańcuchem wartości poprzez współpracę sektora publicznego i prywatnego, w tym poprzez rezerwację terenów pod przyszłe instalacje wodorowe.
8. Pełna implementacja do 2030 roku koncepcji Pomorskiej Doliny Wodorowej kreującej konsorcja inwestujące w czyste technologie wodorowe w oparciu o regionalnych liderów
9. Wykorzystanie potencjału Hydrogen Europe oraz aktywnej obserwacji dobrych praktyk europejskich (wizyty studyjne), celem implementacji rozwiązań produkcji wodoru(szczególnie porty morskie)
10. Wykorzystanie w postaci projektu konsumującego efekty realizacji projektu Nordycko – Bałtyckiego Korytarza Wodorowego

W drugiej części warsztatu zainicjowana została dyskusja dotycząca dwóch podstawowych aspektów:

1. Celów krótko – i długoterminowych stojących przed Pomorze, z których wypływają zadania zdefiniowane pierwszej wersji dokumentu Wodorowego Planu Działania
2. Znaczenia i formy tworzącej się gospodarki wodorowej na Pomorzu i roli zielonego wodoru w strategii województwa pomorskiego jako narzędzia rozwoju gospodarczego i instrumentu dekarbonizacji

Zasadnicza dyskusja oparta została o element definiowania celów strategicznych, które Województwo Pomorskie może przyjąć do analizy i rozważyć realizację poprzez alokowanie zasobów oraz decyzji strategicznych i współpracę z administracją centralną.

Zdaniem uczestniczących w warsztacie przedstawicieli Zamawiającego – ekspertów Departamentu Rozwoju Gospodarczego Urzędu Marszałkowskiego – kluczową cechą Wodorowego Planu Działania w warstwie użyteczności dokumentu powinna być synchronizacja wskazanych aktywności, działań i projektowanych decyzji interesariuszy na czele z Samorządem Województwa Pomorskiego z definicją celów strategicznych, które zoperacjonalizują wytyczone kierunki strategiczne, zawarte w dokumencie strategicznym „Pomorskie na lekkim gazie" z końca 2022 roku.

SAMORZĄD
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W obszarze przyszłego modelu gospodarki wodorowej na Pomorzu poza dyskusją o znaczeniu regionalnych narzędzi finansowania inicjatyw z obszaru R&D dotyczących rozwoju technologii wodorowych, jak również systemów wsparcia projektów dekarbonizacyjnych w przyszłym okresie programowania unijnego na lata 2028 – 2034 – istotnym instrumentem wartym uwagi jest model oparty o **wielkoskalowe magazynowanie wodoru np. opartego o infrastrukturę kawern solnych, obecnie pełniących funkcję strategicznych magazynów gazu – Gas Storage Poland w Kosakowie.**

Ten scenariusz rozwoju gospodarki wodorowej oparty może być o będące obecnie w fazie przygotowywania studiów wykonalności projektów wodorociągów w północnej Europie np. Bałtycko-Nordycki Korytarz Wodorowy (NBHC), projekt mający na celu stworzenie infrastruktury do transportu zielonego wodoru pomiędzy Finlandią, Estonią, Łotwą, Litwą, Polską i Niemcami. W projekt zaangażowanych jest sześciu operatorów systemów przesyłowych z krajów partnerskich: Gasgrid (Finlandia), Elering (Estonia), Conexus Baltic Grid (Łotwa), Amber Grid (Litwa), **GAZ-SYSTEM (Polska)** i ONTRAS (Niemcy).

Uczestnicy warsztatu zgodnie przyznali, że projekt magazynowania wodoru może mieć uzasadnienie dla regionu Pomorza i rodzi także szanse w powiązaniu go z produkcją wodoru na miejscu, blisko jego konsumpcji ponieważ modele biznesowe oparte na produkcji ciągłej (baseload) z wykorzystaniem niestabilnych źródeł energii, bez zabezpieczenia magazynami wodoru(H_2), są narażone na poważne ryzyko kosztowe.

Hydrogen Action Plan for the Pomeranian Province

Gdynia 29 November 2025