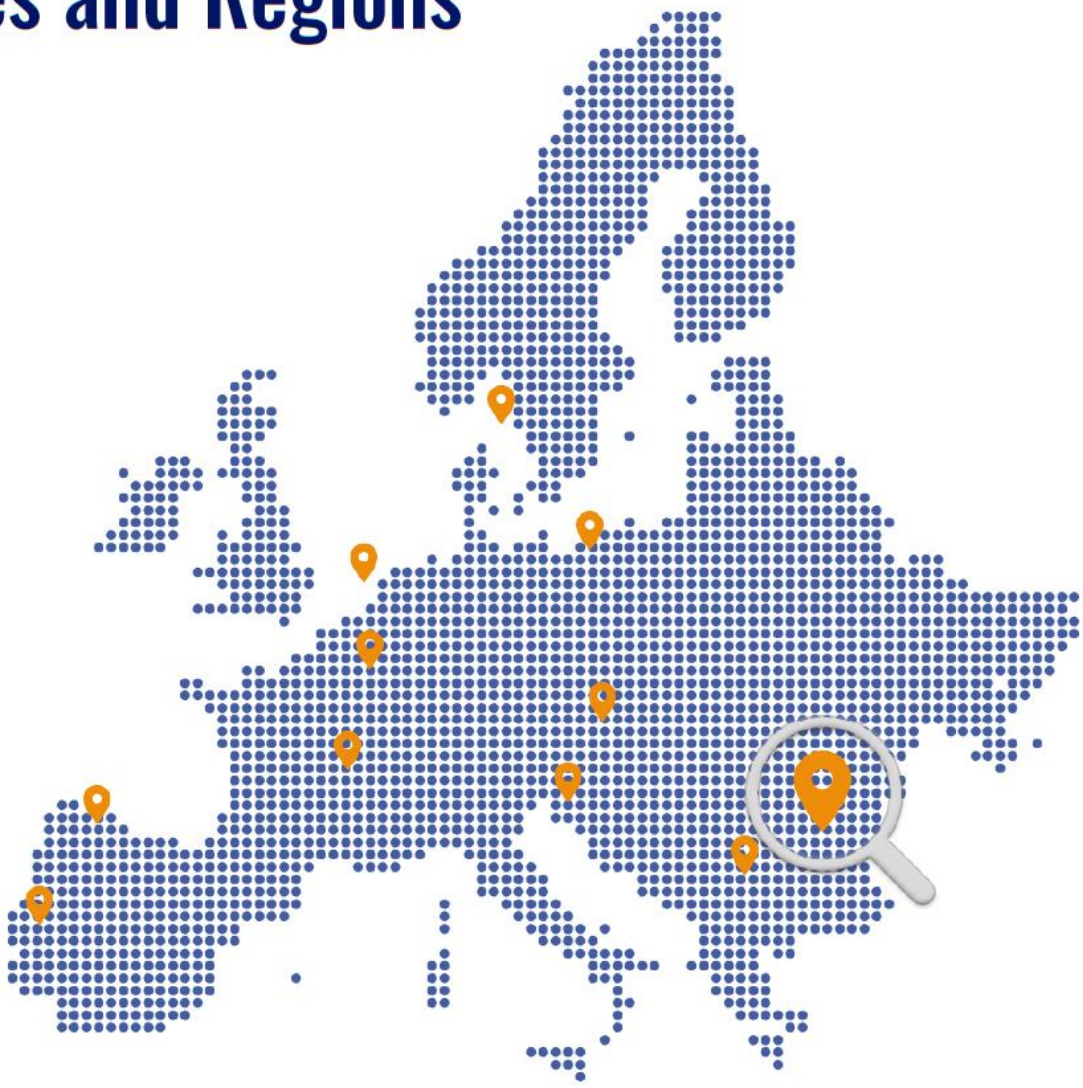
Public summary report

Project Development Assistance for Cities and Regions

October 2021



A REPORT FOR THE FUEL CELLS AND HYDROGEN JOINT UNDERTAKING
AND PREPARED BY SPILETT, ELEMENT ENERGY, WATERSTOFNET, TREZORS AND WISEEUROPA

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1 Foreword from the Fuel Cells and Hydrogen Joint Undertaking

Continuing FCH JU's long-term cooperation with regions, one of our flagship initiatives, the Project Development Assistance, had as objectives to stimulate the interest of various regions and cities towards hydrogen technologies and ultimately to help them develop and put in practice sound plans and projects around these technologies. We wanted to show how important it is to have a comprehensive, unitary approach, which brings the right stakeholders around the right funding and how this can be done taking into account the specific context of each region or city.

Since launching the call for applications in 2020, we have received 35 applications for Project Development Assistance (PDA) from regions across 18 European countries, including from areas with low deployment of hydrogen technologies, such as Central and Eastern Europe. 11 European regions were selected to benefit from direct assistance for developing high quality, integrated hydrogen projects.

But we didn't want to stop there, we envisaged creating a ripple effect. The wide geographic spread and the diverse portfolio of the end-use applications in the regions selected create a great blueprint for the other regions, which were included in the PDA Observers' Network. All of them were able to benefit from the shared knowledge and expertise.

While funding for the projects we assisted is experiencing the typical uncertainty of the transition between Multi-annual Financial Frameworks, and considering the Letters of Intent/Commitment received by the regions, their actual implementation could benefit from a supportive grant-based funding framework. Some examples are: the Recovery and Resilience Facility, the Just Transition Fund or the Innovation Fund for small and large projects.

The 11 PDAs have very concrete plans and may materialise into an overall capital expenditure (CAPEX) totalling between EUR 650 million and EUR 750 million. In addition, this pipeline of candidates to Hydrogen Valleys comes with an average CAPEX of above EUR 50 million, which is considered the threshold for attracting International Financial Institutions, paving the way for reaching an efficient funding and financing combination. The size of the investments in the pipeline put the leverage effect of this pilot PDA procurement at between an impressive x875 and x1015 should all the projects be implemented as planned.

Adding to the success of this pilot are the many outcomes that weren't initially foreseen but yet materialised in value added for these and any other region wishing to pursue the Hydrogen avenue. Among those it is worth mentioning (1) the Policy White Paper which consultancies compiled for Močenok and ended up helping all regions understand and navigate the policy landscape for hydrogen[1]; (2) the template for Requests for Information (RFI), prepared for Zagreb but further used by other PDAs whenever regions were ready to proceed to enquiring with equipment suppliers about the availability, performance, and cost of equipment required by the project; and (3) the FCH-Regions' Hub[2], which we developed to concentrate the relevant information gathered within the FCH JU projects, studies and initiatives, linking regions to specific external sources and complementary initiatives capable of assisting them in the endeavour of deploying regional FCH plans.

This pilot PDA for Hydrogen in regions sets the path for further such initiatives, possibly targeting regions which are not yet involved in the development of hydrogen projects and which could make use of the encompassing advantages of hydrogen as a green energy carrier to ensure local, sustainable and integrated energy solutions.

We would like to encourage all interested regions to get in touch and see how we can help them put in practice their decarbonisation goals with the help of hydrogen projects.

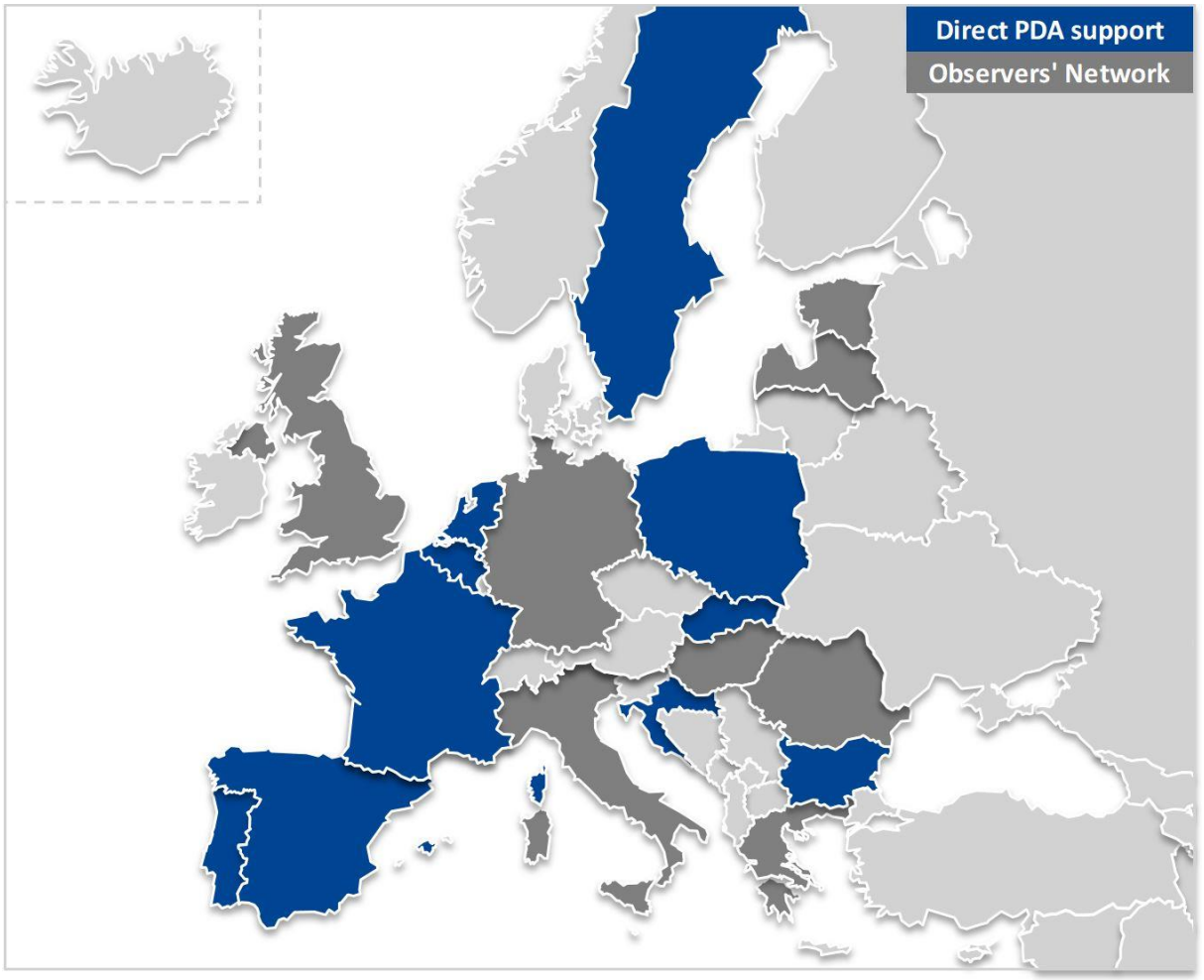
[1] Available at https://bit.ly/3tMQtQl

[2] https://www.fch.europa.eu/page/fch-regions-hub

2 Introduction

The Project Development Assistance for Cities and Regions (PDA) programme launched a call for expressions of interest (EOI) on January 16th, 2020, open to all European cities and regions with an existing concept for a hydrogen and fuel cell deployment project. The aim of the programme was to provide support for at least ten regions or cities to develop detailed work plans for the implementation of hydrogen projects, including at least two projects from the 13 Member States that joined the EU later (EU13)[3]. This support was to be provided in the form of dedicated time from a consultant and manager with expertise in developing innovative hydrogen and fuel cell technology deployment projects.

By the close of the call for EOI, thirty-six EOI were received from regions across eighteen European countries, including thirteen EOI from EU13 Member States. Eleven of the projects that submitted an EOI were selected to receive funded consultancy support over the period June 2020 – June 2021. Regions that applied for PDA but were not selected to receive direct PDA support were invited to take part in an Observer Network, which provided a series of interactive web-seminars to support the development of regional hydrogen projects.



This public summary report contains summaries of the project plans and work undertaken in each of the selected regions, the activities delivered as part of the observer network, and the expected next steps following the close of the PDA support period.

[3] In May 2004, 10 countries joined the EU15: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovenia and Slovakia. On 1 January 2007, Bulgaria and Romania became members of the EU. The latest country to accede was Croatia, on 1 July 2013.

3 Work completed through PDA

Over the period June 2020 to June 2021, consultancies worked to provide direct project development support to the eleven selected regions. While the consultancies involved in delivering PDA worked collaboratively throughout the duration of the programme to share best practices and discuss approaches to common challenges, each region was assigned a consultancy, with a dedicated project manager and consultant to provide support. Certain regions in EU13 countries were assigned a second consultancy with specific knowledge of developing hydrogen projects in central and eastern Europe.

In addition to the region-specific support delivered in each region, the consultancies also developed several common documents that could be used as a basis for project development in a number of regions. These documents comprised:

- **Policy paper**: as part of the work completed in Močenok, the consultancies compiled a policy white paper to help regions understand and navigate the policy landscape for hydrogen. The paper provides an outline of the legislative environment today and the role hydrogen can play in this framework. It also reviews ambitious policies in place, or under discussion, which provide support for hydrogen production or consumption. This is used to highlight possible area of expansion for hydrogen policy across Member States. The document also outlines some of the key options for intervention in the hydrogen sector going forward based on policy research and pilot activities. This paper will be published on the FCH Regions Hub.

- **Request for information (RFI) template**: several of the regions were at a sufficient level of maturity that they were ready to proceed to enquiring with equipment suppliers about the availability, performance, and cost of equipment required by the project. As part of the support provided to key stakeholders in Zagreb, Element Energy supported the development of RFI templates that were subsequently used to enquire about the availability of articulated fuel cell buses, and (separately) of hydrogen infrastructure. This template was adapted for the case of Gdynia and used to request information for solo buses and articulated buses. Key takeaways from this exercise were:

    - RFIs can be used in regions that are looking for specific technical and cost data, ahead of procurement procedures for a commercially available piece of equipment.

    - For more niche equipment requests (e.g. ship retrofitting, articulated buses), where less companies would be able to fill the request, engaging directly with the suppliers was found to work better as standard offering aren't available and fewer companies are willing or able to respond to an RFI.

  The FCH JU will maintain the RFI templates for vehicles and infrastructure and use them as a basis to support regions seeking to find further information about the technical specifications, costs, and availability of different hydrogen and fuel cell technologies.

Summaries of work completed in each of the selected regions is provided in Section 4.

4 Work undertaken in each region

The following section details the work undertaken by the consultancy team to develop the concepts for hydrogen projects in the selected regions into detailed work plans.

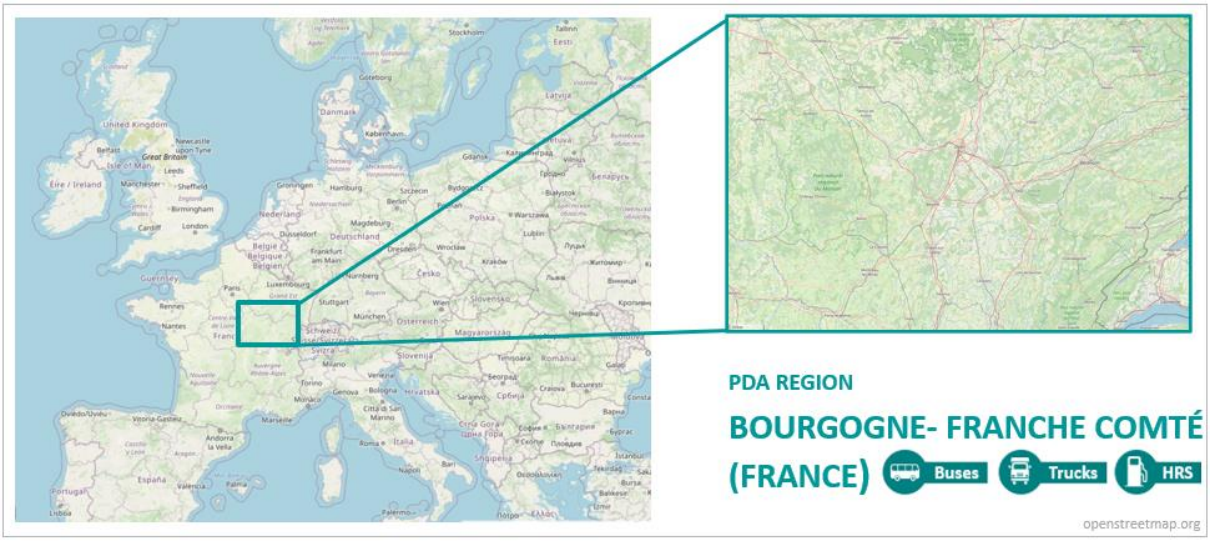
4.1 Asturias

The Asturias project aims to develop a full ecosystem of hydrogen production, transport, distribution and use of hydrogen in several sectors. Several initiatives are part of this ecosystem. The first initiative will build 45 MW of electrolyser capacity in the coal mining valleys in the centre and south of Asturias ("Cuencas Mineras asturianas"), to supply a fleet of public transport vehicles, and for injection in the gas distribution grid. The second initiative will build two green hydrogen production facilities in the centre of Asturias. One will supply a hydrogen refuelling station for heavy vehicles, and the other will be used to test the injection of hydrogen in a combined cycle turbine, to prepare for the future increase of hydrogen concentration in the gas grid. The third initiative is the installation in two phases of 200 MW of onshore electrolyser capacity and 5 MW of offshore electrolyser capacity, connected to a new 100 MW onshore wind farm and a 250 MW offshore wind farm off the coast of Asturias. Hydrogen will be used for local industries (steel manufacturing, shipyards), injection in the gas grid, transport, and export to other European countries. The Region of Asturias and the local energy agency FAEN have been coordinating the ReCoDe initiative during the PDA programme, which aims to facilitate synergies in the overall Asturian hydrogen ecosystem. This will contribute to the energy transition of the region, and to the development of new manufacturing industries in the hydrogen sector.

Overall, support from the Project Development Assistance programme has helped the partners involved in the ecosystem to build the component parts of a complete hydrogen ecosystem in Asturias from hydrogen production to end uses. Consultancy support has initiated collaboration with the stakeholders involved in the future hydrogen value chain. Advice and detailed information on technical aspects of some components of the projects have been provided. This has included the provision of information on best practices and key learnings observed in other European city and regional hydrogen mobility projects. Discussions with key equipment suppliers were also initiated to refine the technical specifications of the project. Information about relevant European funding calls has also been shared with the partners, along with analysis of the recommended funding opportunities based on the economic and technical characteristics of the project. For the final output, the consultants have written a project specification report, presenting the detailed characteristics of the full Asturian ecosystem that has been supported: regional and national energy and hydrogen context, technical specifications of the infrastructure and the vehicle, estimated budget, location of the deployments in Asturias, cost and funding strategy, and implementation strategy. The report will be a key asset for the Region of Asturias, the FAEN and

the partners for future funding applications. For the Region of Asturias and FAEN, this is also essential for their ongoing coordination work of the ReCoDe initiative, which aims to attract more stakeholders in Asturias to develop activities related to green hydrogen, and to eventually have an operating large-scale network of electrolysers by 2030.

4.2 Bourgogne-Franche-Comte



The Bourgogne-Franche-Comté Region (BFC Region) has the ambition to become a positive energy territory by 2050. Hydrogen is one of the pillars of this objective, with the BFC Region adopting a regional hydrogen roadmap at the end of 2019. This roadmap commits EUR 90 million to the hydrogen sector, including EUR 18 million for the mobility sector and EUR 52 million for the purchase of 3 hydrogen trains. A number of key projects are emerging in the BFC region, with most notably several hydrogen ecosystems gathering different mobility applications, and occasionally industry or stationary applications. However, to date these projects have tended to have been developed at local level without overarching co-ordination from the regional government. The ambition of the BFC Region is to coordinate, and create links between, these projects and deployments at a regional level, with the objective to group these projects in a single regional project and secure funding for its development.

PDA support initially focused on defining the scope of a coordinated regional project from a number of separate concepts for hydrogen projects in the region. An interview conducted with the project leaders led to the development of an integrated regional project concept gathering the deployment of 101 to 105 heavy vehicles, between 2022 and 2026. These heavy vehicles are 65 fuel cell buses and 36 to 40 fuel cell refuse trucks. These deployments are distributed between 7 cities. Several additional deployments have already been funded, benefitting from regional, national and European sources. The vehicles deployed will decrease CO_2 emissions, by avoiding the emission of about 6,200 tons of greenhouse gases (GHG) per year, and will improve local air quality, by avoiding the emission of 53 tons of NOx and 1.7 tons of particulate matter (PM) per year.

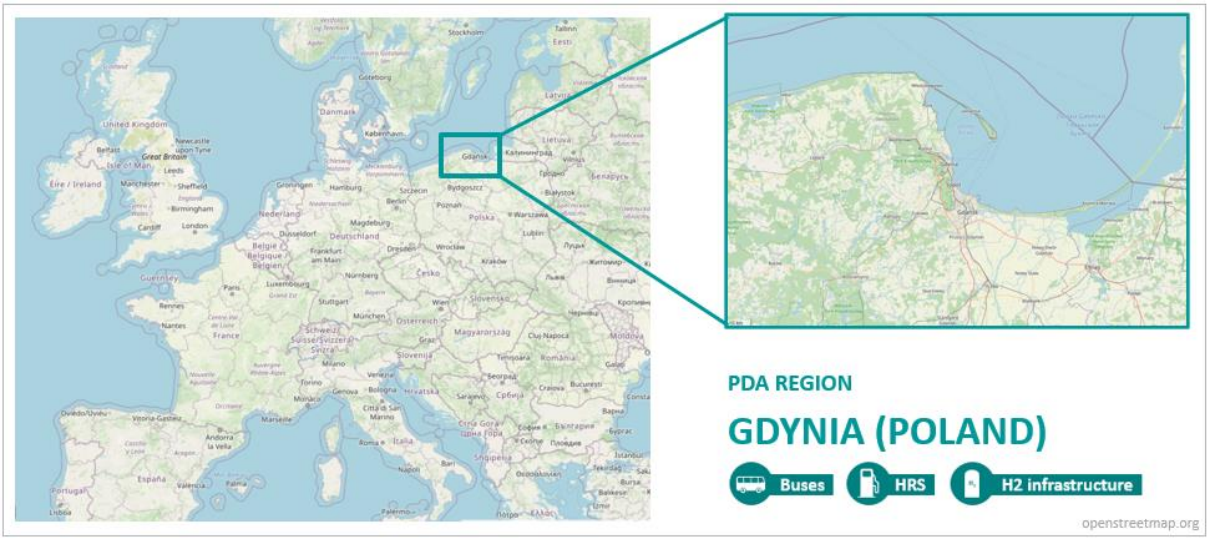
In a second phase, PDA support focused on the means to materialise the regional project, providing information on best practices and key learning observed in similar European projects, and on current and future European funding opportunities. The consultancy worked with the region to support the analysis of the technical and financial feasibility of the project, and develop detailed plans for implementation.

A final report summarising the project, describing the technical and financial characteristics of the regional deployment, has been delivered to the BFC Region. This report presents the regional and national energy and hydrogen context, the technical specifications of the different infrastructures and vehicles, an estimated budget

for the regional project, the location of the deployments in the region, a cost and funding strategy, and an implementation strategy.

The 7 projects constituting the regional project are working to secure national funding for the purchase of vehicles and production and distribution infrastructure, for instance through regional and national sources. In parallel, following PDA support, it is expected for the regional project to apply for European funding for the purchase of vehicles and production and distribution infrastructure to further increase the funding rate. Other means to improve the economic competitivity of the deployments will be explored, such as the possibility to acquire a funding on the purchase of green hydrogen through a support mechanism included in the 2020 national hydrogen strategy and currently under development.

4.3 Gdansk, Gdynia, Tczew, Wejherowo



Poland's National Energy and Climate Plan for the years 2021-2030 sets ambitious climate and energy goals. The national climate targets are also defined by the Polish Energy Policy 2040 aiming to energy transition towards a zero-emissions system founded on innovation, sustainable economic growth, increased efficiency, and competition. On January 14, 2021, the Ministry of Climate and Environment submitted for public consultations the draft "Polish Hydrogen Strategy until 2030 with a perspective until 2040" - a document setting ambitious but realistic goals for the development of the use of hydrogen technologies in Poland. Amongst the objective is the use of hydrogen as an alternative fuel in transport.

The four neighbouring cities Gdansk, Gdynia, Wejherowo and Tczew ("4cities") in Northern Poland aim to jointly procure and deploy 91 fuel cell buses in their regional public transport as part of their decarbonisation strategy. A total of 51 solo and 40 articulated buses is planned to be replaced to reach a share of between 8% and 54% of the operated fleet in the cities until 2028, reducing GHG emissions by 2.847 t / year and NO_x emissions by 3.892 kg / year.

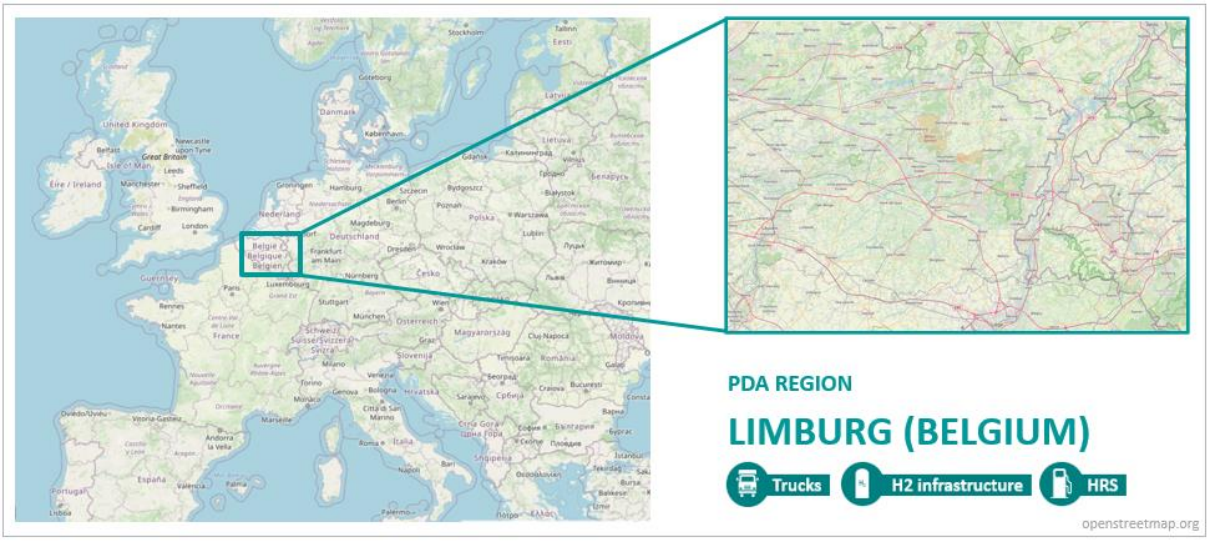
The developed concept assumed the initial testing phase in 2023-2024, which will include refuelling of the Gdansk, Gdynia and Tczew bus fleet (9 buses) at the public HRS, built and operated by Grupa LOTOS in Gdansk. The hydrogen available at this HRS will be delivered from the neighbouring LOTOS refinery plant and produced from steam methane reforming. All buses of the Wejherowo bus fleet will fuel at their own near-depot HRS, consuming green hydrogen from an on-site electrolysis plant (1 MW). After the initial phase, each of the remaining three cities will install own HRS on or near their bus depots and jointly procure hydrogen delivery. The 4cities will jointly operate a central bus workshop to service and maintain the 91 FC buses.

At a later stage of implementation, further transport applications may be included to scale-up the hydrogen production in the region and decarbonize transport. First ideas include fuel cell trains and ships to the Hel Peninsula as well as regional freight transport. The project may collaborate with the ongoing Pure H2 project from Grupa LOTOS AS, funded by the Connecting Europe Facility.

The total CAPEX of the project is estimated to sum up to EUR 65.83 million. It is envisaged applying for funding in the “Green Public Transport” programme of the Polish government, offering very attractive financial support mechanisms, such as the possibility of up to 90% funding of the purchase costs (CAPEX) of new hydrogen buses, and up to 50% of the costs of modernization or construction of infrastructure. This may reduce the investment costs to be paid by the 4cities to EUR 17.35 million. Other, less favourable funding options exist, providing a backup solution for some of the municipalities.

The project timeline is defined according to a ramp up strategy individual to each municipality and co-financing from the Polish "Green Public Transport" the programme of the National Fund for Environmental Protection and Water Management. The procurement of the first 15 buses, 2 HRS and 1 electrolyser is planned to start in 2022, allowing the first phase of the project to begin in 2023. Another wave of procurement including 33 buses and 1 more HRS should follow in 2024, launching phase 2 in 2025. Finally, a last procurement plan to reach the final bus fleet size of 91 buses and including a fourth HRS will take place, allowing for the final phase to start around 2028.

4.4 Limburg



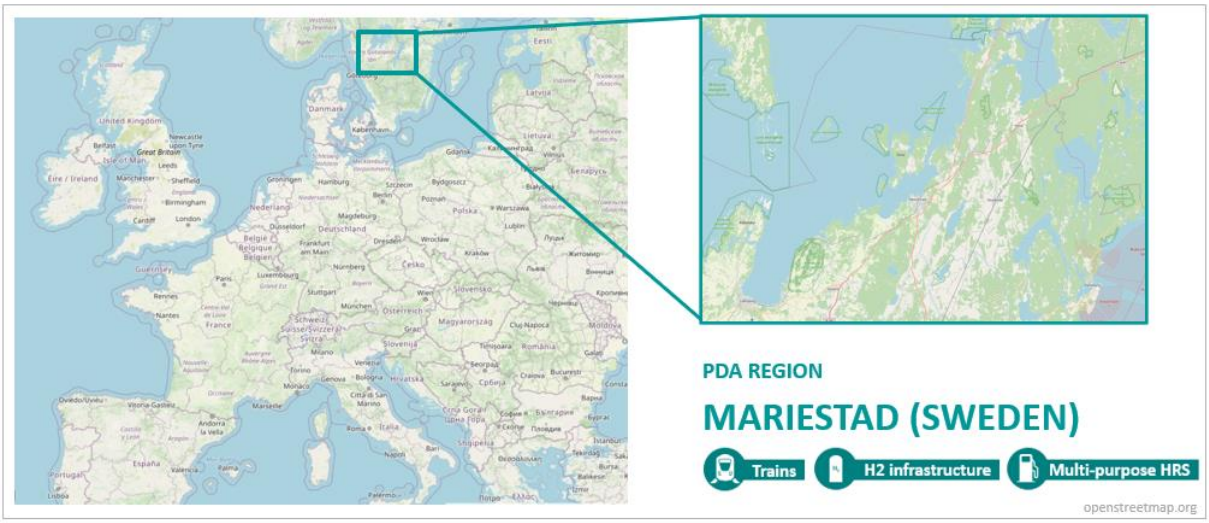
The pilot project in Genk is a first step towards a hydrogen ecosystem in the region of Limburg. The project partners intend to develop a hydrogen refuelling station for the supply of green hydrogen to heavy duty and logistics transport end-users as well as a small fleet of hydrogen powered refuse trucks. Possibly also a fleet of smaller hydrogen vehicles could be leveraged by the development of a station. Initially, end-users will primarily consist of transport and distribution services (several heavy-duty trucks and 7 shunters) and garbage collection providers (1 refuse truck). At this stage, the pilot project will deliver around 578 kg H2/day, based on the estimated offtake. In the future, possibly also public transport buses could be incorporated as well as company cars and delivery vans of smaller organisations.

Although several key project partners have confirmed their interest in proceeding with the project, some barriers push the originally intended timeline backwards to some extent. Firstly, the technological availability of fuel cell powered shunters has resulted in delays on the side of the off-take. Secondly, both the future owners of the refuelling station and the refuse truck are in need of financial support in the form of subsidies, for which they

are awaiting suitable calls at the regional, national or European level. To keep the momentum of the consortium strong until these barriers are overcome, developments are now ongoing to realise a short demonstration with several applications by the end of 2021, possibly using a mobile refuelling station.

The Project Development Assistance that was provided to the coordinating stakeholder, the Provincial Development Society (POM Limburg), supported the project throughout its preparations. Initially the expectations and ambitions were aligned in collective meetings in which general information on possible applications and developments was provided to the partners. After alignment of ambitions, the consortium was formalised as the “Hydrogen Society Limburg”, announced in a press release. Based on the ambitions of the partners, the hydrogen refuelling station was then dimensioned and its economic viability evaluated through NPV and cost structure calculations. For the partners intending to invest in vehicles, Total Cost of Ownership calculations were done based on quotations or available prices. Overall information and considerations on technologies, price developments, subsidies and opportunities were shared with the partners in an overarching document. All partner-specific calculations were shared with the concerned partners through individual documents, and elaborated on in individual meetings. Where possible, contacts were facilitated - also outside of the consortium - to encourage the exploitation of all possible opportunities in the region.

4.5 Mariestad



Sweden is one of the leading Member States of the European Union in terms of ecological transition. Despite its performance, Sweden needs to keep reducing its transport related emissions at a fast pace to achieve the goals set by the Swedish climate act. The Fossil Free Sweden office has issued a strategy for fossil free competitiveness, using hydrogen technologies. This strategy acknowledges the current development of FCH trains in Europe and encourages this type of initiative in the country. The Västra Götalands county is the second largest electricity consumer in Sweden, after Stockholm County. Its high demand for electricity aligns with a high potential for renewable energy production, which has started to be deployed in the region. The Mariestad, Gullspång, Götene, Lidköping and Vara municipalities being at the head of the initiative, have reached installations of 260 MW of PV and windmills today.

The municipality initiative aims at transforming the Kinnekullebanan railway, a 121-kilometer-long single-track railway line transporting commuters between Håkanstorp and Gårdsjö, in the Västra Götalands county, from diesel to hydrogen trains. The line is currently operated by 8 diesel-fuelled trains with a daily mileage of approx. 585 km each, but the fleet will have to be renewed starting from 2028. The project idea of investing into hydrogen trains, fuelled by regional green hydrogen, fits into the latest requirements for climate action in the region and is expected to bring benefits to the Biosphere Natural Reserve area crossed by the line.

A **pre-testing phase** to evaluate performance of the hydrogen trains on the Kinnekullebanan railway is planned for August 2021, following an offer from Alstom to bring 1 iLint visiting train and a mobile Hydrogen Refuelling Station (HRS) for the duration of two weeks.

The experiences with this test phase will be used to validate assumptions and current project planning of the **pilot project (2022 to 2026)**. The pilot project aims at operating 2 hydrogen trains in a daily operation on top of the 8 diesel trains on the Kinnekullebanan. In addition, 10 fuel cell (FC) buses will be procured and fuelled at the 2 multi-vehicle-HRS to be installed at each end of the train line. The green hydrogen in this phase will be produced locally by 2 electrolysers with a daily capacity of 1 MW each. Both, the HRS and electrolysers at each end of the train line will have the capacity to fuel both trains, adding invaluable redundancy to the system. They back each other up and build the starting infrastructure set-up for the ramp-up phase following the pilot project.

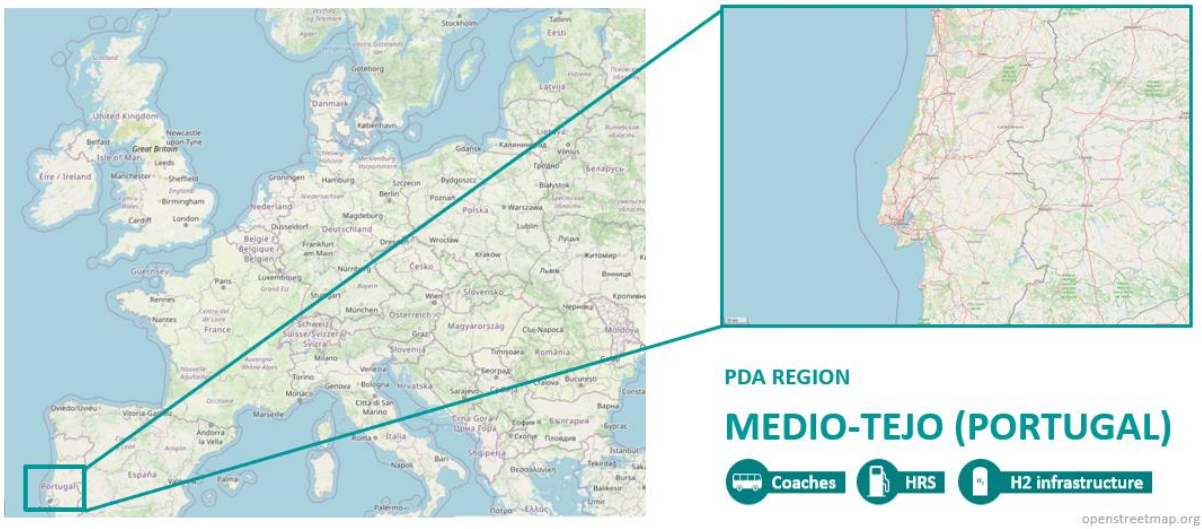
Based on the experiences of the pilot phase, decisions will be taken to the renewal strategy of the diesel- with hydrogen-fuelled trains, starting from 2028. The **transition phase** also includes a ramp up of the FC bus fleet to reach a final fleet size of 50 buses to be served in the 5 municipalities, and the procurement of minimum 3 more HRS to install fuelling capacities in each of the 5 participating municipalities along the line. The green hydrogen will be produced via electrolysis or using thermolysis to recycle plastic waste to hydrogen.

Starting the transition of the complete train fleet to hydrogen from 2028 on, system ramp-up in the transition phase already starts from 2026, introducing 50 FC buses in circulation throughout the 5 municipalities, and 200 individual service cars owned by the municipalities in addition to the 10 FC trains on the Kinnekullebanan.

The expected CAPEX of the pilot phase sums up to EUR 22.3 million. EU Taxonomy, the Resilience and Recovery Facility, and EU Innovation Fund will be addressed to finance the activities, and a co-funding private investor has already joined the project team for the long-term perspective of the regional hydrogen economy. A 50% funding of CAPEX would allow the project to reduce the total cost of ownership (TCO) to a competitive Diesel level.

For the pilot project time scale, a public-private partnership (“Coop”) has been selected as the best option for the governance model. The initial shareholder group will include the Gullspång, Götene, Lidköping, Vara and Mariestad municipalities, and the private investor. On the long term, the governance model could be scaled up, by integrating other municipalities of the Skaraborg region, industry, citizens, NGO and research organizations. Innovative business concepts for the Coop that have been discussed within the PDA project in Mariestad include a “H_2 train as a service” (leasing of fuelled and maintained trains), provided by a third party to the transport authority. The same concept may apply to the operation of hydrogen infrastructure and road vehicles (“mobility as a service”).

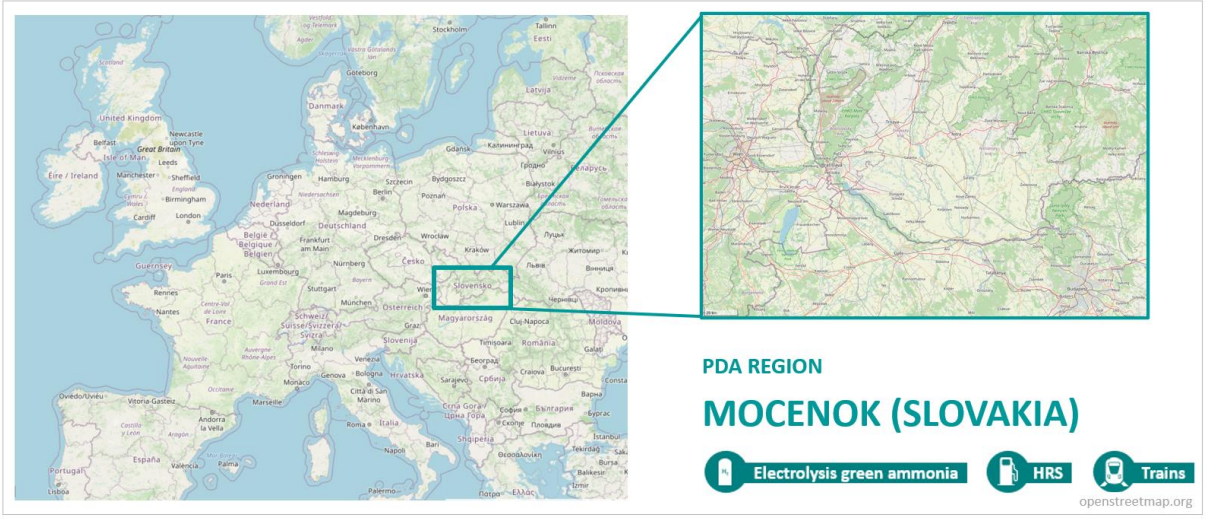
4.6 Médio Tejo



The Médio Tejo project aims to build a full green hydrogen supply chain in the region, including the production of green hydrogen, its transport and distribution, and its use in transport applications and for injection in the gas grid. Hydrogen will be produced in an electrolyser supplied by renewable electricity. For hydrogen distribution, the objective is to deploy several hydrogen refuelling stations, tailored to the types and numbers of fuel cell vehicles deployed. It will create a region-wide network to facilitate refuelling of fleets. The main transport use will be a fleet of 12 fuel cell coaches to operate on a new circular route linking 6 small and medium-size cities in Médio Tejo. The objective is also to progressively integrate 17 coaches on the existing lines, so the inhabitants can benefit from low carbon public transport to travel between and within the municipalities. Other vehicles for public services, including vans and refuse trucks for waste collection, will be deployed. The project has several potential configurations and scales currently being finalised. Finally, hydrogen will be used for injection into the gas grid, to decarbonise heating in industries and domestic appliances.

Overall, support from the Project Development Assistance programme has helped the partners involved in the ecosystem to develop a complete hydrogen ecosystem in Médio Tejo. Consultancy support has included numerous stakeholder interviews to include them in the process of the regional project development, including with potential H2 producers, vehicle suppliers and industrial actors. This has enabled the partners to refine the specification of the ecosystem and to initiate collaboration as part of the project. The support also included a detailed analysis of the Médio Tejo context in terms of transportation, industries, gas distribution and transmission: analysis of data of public vehicle fleets, fossil fuel consumption in key industrial sectors, gas networks. This has led to the identification of several opportunities of local green hydrogen demand, based on the most promising applications for hydrogen use, that could contribute to the reduction of greenhouse gas emission and fossil fuel reliance in Médio Tejo. These opportunities have then been integrated into the project plans in different configurations, with the development of budget and technical specifications over the course of the PDA. For the final output, the consultancy has written a detailed project specification document presenting the regional and national energy and hydrogen context, technical specifications of the infrastructure and the vehicles, estimated budget, location of the deployments in Médio Tejo, cost and funding strategy, and implementation strategy. The outputs of the PDA programme will be essential for local policy makers and will be used as a basis for future funding applications that will be necessary to proceed to the deployment phase.

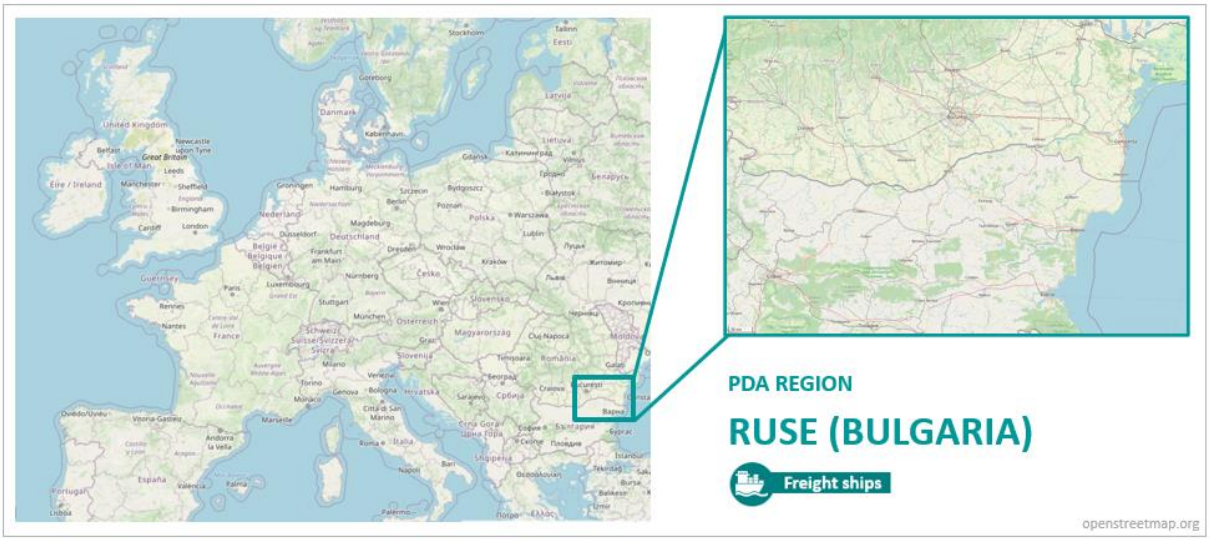
4.7 Močenok



The H2Muctynic project aims to build the first green hydrogen supply chain in Slovakia. The project will install up to 50 MW of purpose-built renewable energy sources to support the operation of a 20 MW electrolyser on the Duslo ammonia facility in Močenok. The facility will be used to provide balancing services to the grid and to produce low- or zero-carbon hydrogen as a green replacement to the fossil-fuel feedstock currently used in the ammonia production process. A proportion of the hydrogen produced will be dedicated to transport use cases to demonstrate the technical and commercial feasibility of hydrogen refuelling stations and fuel cell electric vehicles. As the first planned fuel cell deployment in the country, the project will begin with a pilot demonstration of two fuel cell multiple unit trains which will be designed and built by local manufacturer ŽOS Vrutky, and deployed on regional routes by national railway carrier, Železničná spoločnosť Slovensko (ZSSK). After a successful demonstration, the project then aims to enter a second phase from 2027 to scale up hydrogen demand from transport applications. This includes plans to expand the fleet of fuel cell multiple units to replace all 12 vehicles operating on the regional route between Nové Zámky and Prievidza.

Support from the Project Development Assistance programme has helped local stakeholders develop H2Muctynic from a concept to a near-implementable project. Consultancy support has brought the stakeholders together to define the technical specifications for a full green hydrogen supply chain which has allowed requests for information to be issued to suppliers. This has led to the development of a detailed project plan outlining the scope and objectives of the project, where and how infrastructure will be built and operated and the key actions the project needs to take to overcome legislative barriers. A detailed business case was also developed for the project, outlining the different costs encountered at each area of the supply chain. This led to the compilation of a funding request of between EUR 104.6 million and EUR 116.5 million, for which the project was advised to advocate for national funding through the recognition of the project as an Important Project of Common European Interest and by applying for support from the Modernisation Fund and the Green Deal (e.g. Just Transition). To aid the next phase of the project, PDA support also defined an implementation plan providing a clear governance structure, a list of key tasks, a proposed project timeline and a detailed risk register. This document can be used as a foundation to drive progress whilst funding and policy support is secured. It can be updated over time as the project develops to reflect new partners and technical developments.

4.8 Ruse

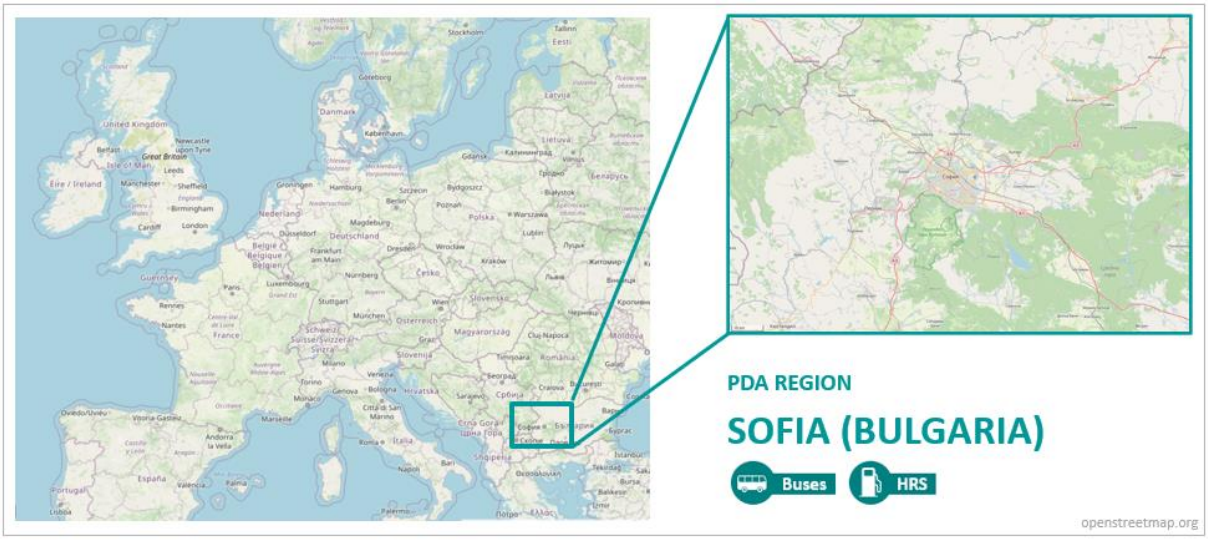


The Ruse hydrogen project will kick start the activities planned by Bulgarian partners of the Green Hydrogen @ Blue Danube Important Project of Common European Interest (IPCEI), by retrofitting an existing tugboat with a zero-emission hybrid battery and fuel cell drivetrain and operating the vessel on the Danube River. The vessel will be refuelled at Port Ruse East using a novel mobile refuelling solution and low carbon hydrogen produced from an electrolyser located at the Ruse East bus depot. The electrolyser will be supplied with power from a new photovoltaic park, also located at the bus depot. In addition to use in the tugboat, hydrogen will also be used to fuel a fleet of twenty 12m fuel cell buses, operated on public transport routes in the city as part of the Ruse Municipal fleet.

Significant technology development and expertise created through this initial phase of the project will pave the way for hydrogen production and transport at scale, that will enable Bulgaria to achieve the goal of exporting low-cost low carbon hydrogen to northern Europe via the Danube River transport axis. In addition to the mitigation of emissions from marine vessels and buses, the project is also expected to have significant local environmental benefits by reducing the impact of air pollution on the Danube River region ecosystem.

PDA support developed the concept for the Ruse project and allowed the project to engage Bulgarian River Shipping as a key stakeholder, who will own and operate the tugboat. Consideration of the required performance of the tugboat and buses allowed technical specifications for the project to be developed, and calculations of the demand for hydrogen in the project were performed. Following this, the specifications of the hydrogen production equipment and refuelling solution were determined. Financial analysis of the project enabled detailed project budgets to be set out to inform the funding request, and the consultancy team provided a strategy to enable the Ruse project to acquire sufficient funding to proceed to implementation. It is expected that the project will be funded through Bulgarian national funding by designation of the project as an IPCEI, and funds such as The Recovery and Resilience facility, for which Ruse will apply to following the PDA support period.

4.9 Sofia

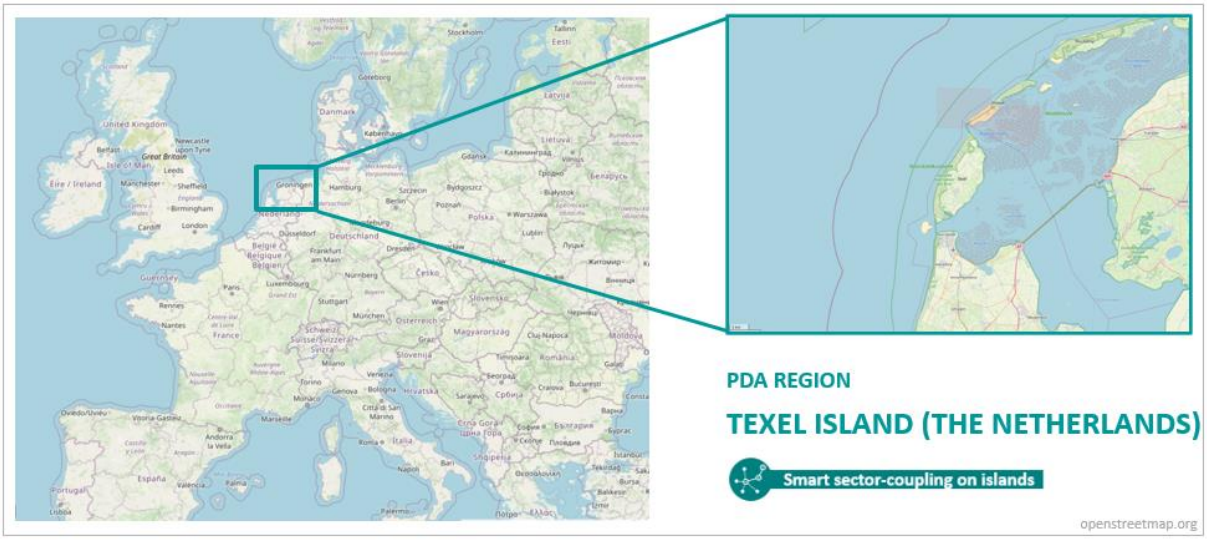


The Sofia hydrogen project will be a flagship deployment of hydrogen transport in Bulgaria, demonstrating the efficacy of hydrogen fuel cell technology in public transport applications. A combination of new and retrofitted hydrogen fuel cell vehicles will be demonstrated on public transport routes across Sofia by public transport operator Stolichen Elektrotransport. This will include the procurement of 24 standard fuel cell buses and 6 inter-city fuel cell buses, as well as retrofitting 30 trolley buses with hydrogen range extenders to allow them to travel on expanded routes across the city. Low-carbon hydrogen will be provided by an integrated electrolyser and refuelling station located at the bus depot. Electricity to supply the electrolyser will be sourced from a photovoltaic park, located on land owned by Sofia Municipality, who will own and operate all infrastructure related to the project. The electricity will be transmitted through the DC trolleybus grid, thereby increasing the efficiency of hydrogen production and reducing electrolyser system capital costs by mitigating the need for a rectifier (which would be required if using AC grid electricity). This innovative solution also allows solar electricity production for hydrogen to be decentralised in an urban space without incurring grid fees for the distribution of green electricity.

PDA support has enabled the Sofia project to develop technical specifications for all aspects of the project, including characteristics of the trolley bus range extender and of the electrolyser and refuelling solution. Financial analysis has been developed based on the characteristics of the project, which serves to inform the required funding request. As a flagship project for Bulgaria, the Sofia project expects that the funding gap will be covered by Bulgarian national funding from the Recovery and Resilience Facility, the Modernisation Fund, and other national funding programmes. An implementation plan has been developed for the project, which will act as a working document to track project implementation against budgets, timelines, and risks, and sets out a governance and tasks structure for project delivery.

The development of Bulgarian expertise in retrofitting vehicles with fuel cell drivetrains is a central component of the Bulgarian strategy to develop the hydrogen and fuel cells sector as a new economic activity for the country. Sofia has signed a commitment with fellow region Stara Zagora to together develop and export knowledge and skills on vehicle retrofitting across the rest of the country, which will be initiated by the Sofia project.

4.10 Texel



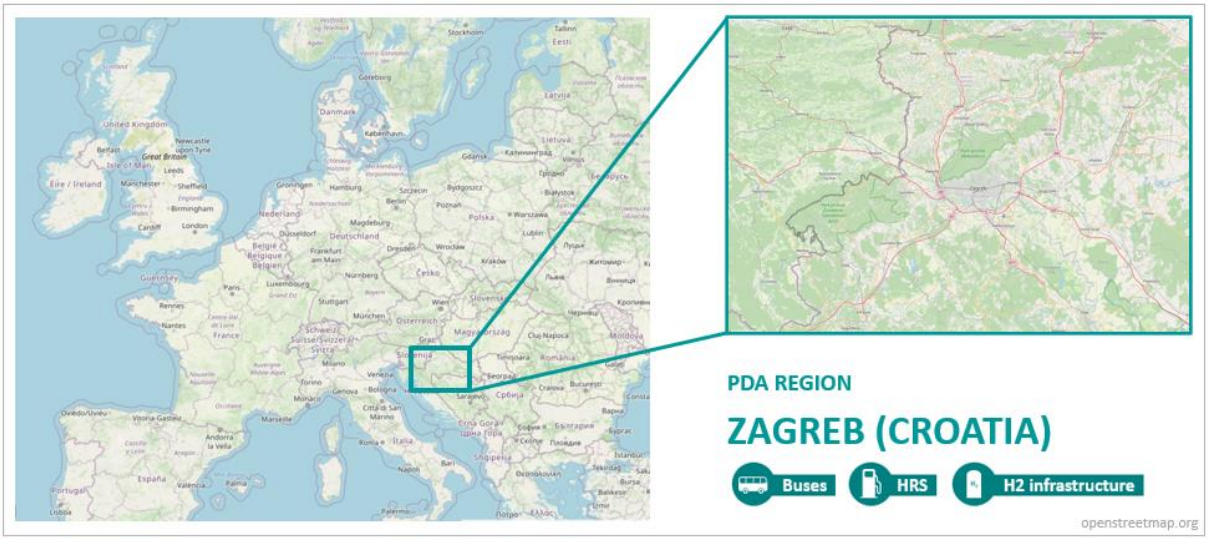
The Texel Island is embarking upon a transition towards sustainability and self-sufficiency in which hydrogen is foreseen to play an important role in decarbonising sectors like mobility, residential and maritime as well as (renewable) energy storage and grid congestion management. A hydrogen blueprint for islands was worked out during the PDA which centred around the indigenous production of green hydrogen and oxygen from the existing 2MWp renewable energy PV field at the wastewater treatment plant on the island. The electrolyser will be integrated in the existing smart grid and energy management system of the complete waste and pump water system of the island. Hydrogen therefore will be the next, big step, towards an energy self-sufficient island, since the water system is already energy neutral on the renewable energy.

A 1 MW electrolyser will produce green oxygen that may initially be utilised at the wastewater treatment plant itself for oxygen aeration and ozone production in the future. Ozone can be used to further improve the water quality by removing micro-pollutants, which results in cleaner water on the Texel island, included in the Nature 2000 nature areas' farmlands and Unesco World Heritage Wadden Sea. The green hydrogen produced can be utilised for decarbonisation purposes. In the scope of the PDA are zero-emission refuse trucks, street sweepers, public transport, taxi services, personal vehicles, light commercial vehicles, residential and recreational buildings and a living lab for auxiliary power provision on a research vessel.

A scale-up scenario is foreseen in which an increase in hydrogen demand in the future can be accommodated as much as possible. A blueprint concept in which green oxygen and hydrogen are produced and consumed on the island to facilitate the transition towards cleaner energy and water would, at least in concept, be replicable to other islands and/or regions.

During the PDA, tools, including a custom-made model to determine and evaluate the value proposition electrolysis can have for a wastewater treatment plant and consumers on the island have been further developed and strengthened and individual business cases have been developed and tailored for each end-user. The financial gap has been explored. The overall project has been pitched to potential regional, national and EU funding organisations to create interest and support to the development of the blueprint hydrogen value chain concept. The development of a local ecosystem on hydrogen requires support and an appropriate mix of regional, national, and European funds will allow the creation of a multiplier effect and stimulate the implementation of the blueprint. The overall investment portfolio is around EUR 12 million.

4.11 Zagreb



The Zagreb project will use 600kg/day of hydrogen for public transport in the City of Zagreb, with deployment expected in 2025. This demand will be provided by a fleet of fuel cell buses owned and operated by Zagreb Electric Tram (ZET) on public transport routes across the city with full support of the City of Zagreb. While the project intends to use articulated fuel cell buses, it is understood that this technology is not yet commercially available. Therefore, the project has developed a mitigation strategy to, instead, use standard fuel cell buses should articulated buses be unavailable at the required timings. While the exact number of buses has been designed to be flexible to provide 600kg/day of hydrogen demand, it is expected that this will be equivalent to around 20 articulated, or 32 standard fuel cell buses.

Over the course of the PDA support, plans for low-carbon hydrogen production at one of Croatian nation oil company (INA) refineries have been developed to guarantee a source of low-carbon hydrogen will be available for the project. This hydrogen will fuel the buses at a hydrogen refuelling station located in Zagreb, at the Podsused depot. A strategy for the procurement of low-carbon hydrogen for the City of Zagreb has been set out through the PDA support - procuring hydrogen through a public tender, using a long-term take-or-pay agreements to provide guaranteed hydrogen demand for hydrogen suppliers. This contracting structure and provision of a financial contribution from the City of Zagreb towards the refuelling infrastructure installation at Podsused depot, is designed to attract competition from hydrogen suppliers, allowing the City of Zagreb to extract the best possible value-for-money hydrogen for the project.

To support the development of more detailed project budgets and technical specifications, the PDA support allowed INA and ZET to publish requests for information (RFIs) and send these to technology suppliers. The final 'Project Business Case' deliverable includes information on the context, scope and technical specifications of the project, a strategy for project implementation and a financial analysis of the costs involved in operating hydrogen buses compared with diesel alternatives. The latter was used to set out a provisional funding strategy for the project. The project budget is expected to be in the range of EUR 38 million to EUR 50 million, which will be covered by a range of City of Zagreb operational programme funding and EU and Croatian national funding.

5 Observer Network activities

In addition to the development of the eleven selected projects, the PDA programme also provided several activities to support all regions which applied to receive PDA but were not selected to receive direct support, to develop their own project concepts. These activities largely took the form of web-seminars, often featuring interactive elements and providing regions with the opportunity to ask questions to the FCH JU and other EU funding and financing bodies, consultancies, and FCH technology suppliers. Observer Network activities were kicked off in September 2020 and continued until May 2021.

The Observer Network activities included:

- **FCH technology supplier database**: the consultancy team reached out to known European suppliers of FCH equipment, to request up-to-date information on their product offering, pricing, and the availability of their products across Europe (locations, timelines, minimum orders, supply capacity, etc.). Information gathered from suppliers willing to provide information was shared with regions in the observer network to support their understanding of which technologies are currently commercially available. A list of all the known European suppliers and fuel cells and hydrogen technologies (whether they responded to requests for information or not) was provided to regions to allow them to enquire about equipment relevant to their particular project.
- **Peer review web-seminars**: regions that were not selected to receive direct PDA support were invited to present their project to the members of the Observer Network and consultancy team and receive direct feedback. For the regions that opted to do so, a representative from the project gave a short presentation about the project and key questions that remained to be answered to enable further development. Afterwards the consultancies and regional representatives discussed potential solutions to issues that were brought forward and best practices that could be employed in the project to maximise its chances of success.
- **Funding and financing web-seminar**: representatives of the FCH JU and other experts on European hydrogen project funding and financing opportunities presented an overview of the scope and applicability of various European and national funding sources. Regions in the Observer Network were then given the opportunity to participate in a Q&A session with the funding experts.
- **Technology readiness web-seminar**: a survey sent to the Observer Network identified that the most popular end use for hydrogen is in fuel cell buses and trucks. Tailoring it to the interests of the Observer Network, the consultancy team provided an overview of the status of the fuel cell bus and truck sectors. Organisations that had previously participated in projects to deploy fuel cell buses and trucks gave

presentations on their experiences, updates on the status of the sector, and recommendations for best practice in similar projects. Observer regions were given the opportunity to participate in a Q&A with all of the presenters.

- **Technology supplier web-seminars**: two web-seminars were held, during which suppliers of FCH technologies were invited to present their technology offering to the Observer Network, expanding on how regions may best engage with them. The subjects of web-seminars were:
    - **Hydrogen distribution and refuelling equipment**
    - **Hydrogen production equipment**

For more mature regions, it is expected that the content of these web-seminars would be sufficient to support them to achieve sufficient maturity to apply for project funding and reach the implantation phase. Less mature regions could use the content of the Observer Network to develop their project in advance of future PDA calls for EOI, to improve their chances of success by increasing project maturity.

6 Lessons learnt through the delivery of PDA support

6.1 Introduction

To understand how to best deliver future PDA support, the consultancy team collated a number of 'lessons learnt' throughout the PDA programme. These lessons and recommendations for how PDA could be tailored in future to adapt to the needs of regional hydrogen projects are detailed below across several areas:

- **Structuring PDA support:** the impact of the selection of projects, timelines for PDA delivery, and FCH JU role in delivery of support, and lessons learnt on how the FCH JU, and consultancy team can design the structure of future PDA programmes to make support effective for regions.

- **Delivering PDA support:** best practices developed by consultancies throughout their experience of delivering PDA support to all the selected regions, to provide the most value to the region and long-lasting impacts beyond the support period.

- **Delivering PDA support in EU13 countries:** specific lessons learnt on delivering PDA support to regions located in EU13 countries, where projects may be less mature, and the deployment is often among the first for that country.

- **Ensuring project delivery following PDA support:** best practices for ensuring that regions go on to deliver their project in the year following PDA support, and recommendations to ensure that future PDAs are effective at ensuring projects are delivered.

The lessons learnt exposed bellow were often common to many, if not all, of the supported regions. The consultancy team have agreed on these lessons based on their collective experience of delivering PDA support.

6.2 Structuring PDA support

Factors external to the regional project were found to influence the progress made in that project; parameters such as timing, project selection, and FCH JU involvement should therefore be considered when designing the overall structure of the PDA programme.

Timelines

Consultancies found that starting PDA support in June can cause projects to lose momentum at the start, as the summer is a lower activity period, and therefore PDA is delayed in starting until September. Developing trust relationships with stakeholders and setting up regular meetings from the start of the project is key to ensuring work is completed over the entire year of PDA and sets expectations from the region of the commitment required to deliver their project. The consultancy team would therefore recommend that the PDA support period is not started just before, or during the summer, which would allow both regional stakeholders and consultancy teams to start working efficiently from the start of the project.

There were also challenges in developing funding plans since many EU-level funding programmes had not announced which topics will be supported in upcoming calls. Ideally, the timing of PDA would be such that the final month(s) of the support period coincide with the release of funding calls. The consultancy team recognize that this might be impractical however and would therefore recommend that if this is not possible the FCH JU and other European funding experts use facilities such as the Observer Network seminars to provide as much information and assurance on the availability of funding for regional hydrogen projects as possible.

FCH JU involvement

Public support from the FCH JU can provide regions with the credibility needed to garner support with local and national decision makers, to encourage project funding and the development of policy support for hydrogen. This could be provided through the development of an FCH JU 'seal of approval' given to regions that have successfully completed a PDA programme, or by a letter of support given to regions by the FCH JU.

As a trusted voice in Europe, regions also give significant weight to information provided by the FCH JU. This effect is amplified in the case where the FCH JU engages with the region directly – either via call or by a representative visiting the region. Engagement from the FCH JU can not only inform a region, but also provide assurance of the European support for hydrogen in general, and the regional project specifically. A two-way exchange of information can also help keep the FCH JU better informed of the challenges faced by regional hydrogen projects.

The funding session provided by the FCH JU and other experts as one of the Observer Network web-seminars was found incredibly useful by the regions in attendance. Only regional project leads were invited to this session however, when a wide range of stakeholders from the selected projects would be interested to understand, and apply for, European funding opportunities. It is therefore recommended that future PDAs provide similar web-seminars on funding but open these seminars to all regional stakeholders in (at least) the supported projects.

Selection of projects

A challenged faced by certain projects, was the fact that the region had applied with several separate concepts for hydrogen projects across the region. A significant portion of time at the start of PDA in the region was dedicated to developing a unified project concept from the number of projects that were included in the application. This created significant challenges for the consultancy since detailed work plans could only be developed after this first phase. To be able to use the full duration of the programme for project development, future PDAs should favour projects that are already united as a single concept (which may feature several different technologies to be deployed) as an eligibility criterion for receiving PDA.

6.3 Delivering PDA support

While by its nature, PDA is different in every region it is delivered in, consultancies were able to draw out the common lessons learnt on optimising the delivery of support to maximise the impact of the programme on the selected regions.

Defining PDA scope and roles

Given that the scope of support that PDA can provide is broad, covering a number of potential activities and deliverables, many of the regions were found to be unclear on what the exact needs of their project was to bring it to the required level of maturity. Setting out the exact scope of activities to be completed throughout PDA and expected deliverables in collaboration with the regional stakeholders at the start of the project should be made a priority by consultancies, to manage expectations from the region. While clear objectives for the specific project should be set out and reiterated throughout the year, the specific activities that are required to achieve this goal can be flexed in response to the needs of the region and new challenges that come to light over the duration of the support period.

By setting out the scope and deliverables at the start of the project, consultancies can work alongside the region to identify the responsibilities of stakeholders already involved in the project and understand where there is a need to bring in new stakeholders to be responsible for certain aspects of the project. In the case that a new stakeholder needs to be on board, consultancies had to work with regional stakeholders to set out the responsibilities of that stakeholder and identify types of companies that might be able to take on the role. Local knowledge is crucial in new stakeholder identification, and regional contacts should lead in the task to reach out to potential new stakeholders and invite them to join the delivery group.

In addition to providing clear direction to stakeholders, setting expectations for the deliverables resulting from PDA can also be used to ensure that projects use the support wisely. By making clear how much consultancy time is available to each project from the outset, stakeholders are forced to engage with the project and prioritise the activities that will deliver the most benefit to the region.

If the required deliverables include a quantitative analysis (for example, financial analysis), models should be developed from the start of the project using indicative numbers, which can be provided by the consultancy. Models can then be refined with more accurate numbers and handed over to the local project team to own throughout project implementation. Developing models for each project early and refining them over the course

of PDA, rather than waiting until all project specifications are in place is very useful for regions to understand the factors influencing the ultimate results of their project.

Expectations from regions on the role of consultants varied significantly from region to region, with some expecting consultants to deliver work with only few input, and other regions taking a more proactive role in developing the project. Ensuring that an engaged project lead from the regional side is involved in the project is essential and confirms lessons learnt from previous support programmes. The consultants found that, while they can take on the role of project lead temporarily to drive action within the project, the ultimate responsibility lies with the regional project lead and delivery group. This must be made clear to regions at the outset, as the PDA support is intended to help the region become empowered and informed to make their own decisions to increase the changes of project delivery following the support period.

Maintaining a flexible approach to project plans

For some of the PDA projects, the original scope was found to be unfeasible by the consultancy team. Consultancies should maintain a flexible approach to the original scope of projects and advise the region on how they may be adapted to achieve a realistic business case. This may include increasing or decreasing the scope of the project, including or excluding certain stakeholders and changing contracting arrangements, or refining the choice of technology to be deployed. The ultimate responsibility for changing the scope of the project, however, lies with the region.

Providing confidence to stakeholders throughout the course of PDA support

A key result of PDA, particularly on projects that will be the first deployment of hydrogen in the region, or even country, is building local enthusiasm for, and confidence in, hydrogen and fuel cell technology. This should be viewed as a continuous process to be completed both over the course of PDA and in the period following support. The regional project lead should ensure a regular dialogue with local and national policy makers and politicians, to keep them informed about the planned project for the purposes of continuity in the time after PDA support has closed. The project lead can be supported by consultancies, who can provide assurance and expertise on best practice from the implementation of other hydrogen projects in Europe. Early and regular engagement with these groups can raise the profile of the project and allow regulatory and policy support to be implemented that will be required to enable the deployment of the project.

Engaging with national hydrogen associations

Consultancies found that a key stakeholder to include in each of the projects was to include a representative from the national hydrogen association. This was particularly important in the projects in Central and Eastern Europe. This mutually beneficial relationship between consultancies and national hydrogen associations allowed consultancies to learn more about the local context for the projects, while hydrogen associations were given a platform to promote hydrogen within their country.

Representatives from these organisations are generally enthusiastic about the projects and have sufficient technical background to allow consultancies to train them to perform certain analytical tasks. Wherever possible, the approach of training a region to assess and understand the project themselves is preferred to the region relying on the consultancy to perform these tasks, allowing skills and expertise to be developed in the country and continuity for the project beyond the close of PDA support.

Providing contacts to regions

A simple and effective action that can be taken by consultancies is to put regions in contact with relevant businesses, and more mature hydrogen regions that have achieved the goals that the supported region is working towards. Consultancies will have better awareness of projects that have already been completed, and key providers of hydrogen equipment, so that they can reach out to the relevant people for a region. It was found that for some regions, leveraging the credibility given to them by the consultancy helped them get better engagement with the target organisations. The initial outreach should therefore be conducted by consultancies but calls and meetings should be led by the regions to allow them to network directly with the contact and gather the information on their own terms. These contacts will be able to provide best practice and guidance to regions

beyond the close of PDA.

Giving clear actions between meetings

To deliver support to the selected projects, consultancies set up regular meetings with the stakeholder 'delivery group' to track progress and discuss next steps. To ensure all stakeholders are engaged with the project, clear actions should be sent out to the group to be completed by the next meeting, with clear owners assigned to each action. Tasks should be provided in sufficient granularity that the action can be 'ticked off' by the next meeting, and not overlooked as 'in progress' for a number of meetings.

Providing clear actions lists can also help consultancies to overcome the language barrier that was a challenge in some regions – by writing down actions for stakeholders, the tasks can be translated without the embarrassment that would prevent a stakeholder from asking clarifying questions in a call. To support this, consultancies should make it clear that they can be contacted in the event a certain task is causing challenges and check in with stakeholders on key tasks in between meetings.

Developing performance-based specifications

Many of the regions sought to fully understand technical specifications of hydrogen equipment before they felt able to release a request for information or an invitation to tender. The consultancy team notes, however, that at the early stage of maturity of hydrogen technologies, standard technical specifications for equipment (particularly production and refuelling equipment) is yet to be developed. Therefore, regions do not need to fully develop technical specifications for the equipment required, but rather to understand what the performance requirements of the equipment they wish to procure are. Equipment providers are then invited to design a technical solution that will fulfil these performance requirements. For example, rather than specifying the equipment involved in a refuelling station, the region can state the number of vehicles that need to be refuelled in a certain period, and the regeneration time of the station.

6.4 Delivering PDA support to EU13 countries

A key aim of the PDA programme was to deliver support to at least two EU13 countries, to encourage the deployment of hydrogen across all countries in Europe. Ultimately, PDA supported five projects in EU13 countries: Gdynia, Poland; Mocenok, Slovakia; Ruse and Sofia, Bulgaria; Zagreb, Croatia. These projects were often front-runners in hydrogen technologies in their respective countries. The below lessons learnt relate specifically to how PDA can best be delivered to maximise its impact on projects in countries with little experience in hydrogen technologies.

Starting at the right scale

A key point that consultancies were able to provide important context on for EU13 countries was the optimal scale of project that will provide a business case to initiate hydrogen deployment, while remaining a feasible scale for a first deployment. No general answer can be given to this question, as small-scale projects will be expensive on a total cost of ownership basis (cost per km travelled by a vehicle, for example), but as the scale of a project increases, as does its total cost. Consultancies can, however, advise on how the cost of equipment and hydrogen price decreases while the scale of a project increases, and the impact of increasing scale on the absolute funding amount required. Regions can then use this information, and local context on budget and funding available to determine the scale of project they are willing to commit to.

Language barrier

For some regions in Central and Eastern Europe, the need to complete the project in English presented a challenge. In these situations, the engagement of national hydrogen associations can be particularly helpful. If the FCH JU would like to deliver PDA support to smaller regions in EU13 countries, they may also consider providing a budget for a translator to attend meetings.

Another useful tool to promote communication between stakeholders in regions where a language barrier was a significant challenge was to hold dedicated workshops between partners in their native language. Although the

consultant will not necessarily attend the workshop, they can set the meeting, provide an agenda, talking points, and reference materials. This ensures that none of the local stakeholders are left out of the loop and can regularly provide input into the project. Consultancies are often best placed to initiate these workshops.

Context of making hydrogen an economic activity

For EU13 regions, hydrogen is not just a tool to support delivery of decarbonisation target: it can also be an opportunity for economic development. In countries where budget is limited, informing decision makers of the potential economic benefits of investment in the energy transition, is often a greater motiving factor that the contribution towards emissions reductions. This is crucial, as EU13 countries have often not yet implemented policy support that will be required to make a business case for hydrogen projects.

In Bulgaria, the development of hydrogen as an economic activity was a key focus of the projects. Low-cost hydrogen production from solar and export to Northern Europe, and the development of facilities for retrofitting vehicles in the country were key features of the projects that will create economic benefits for Bulgaria. A key aspect of the project plans included the dissemination of learning and skills to other regions to accelerate the scale of hydrogen activities in the country.

Developing policy and regulatory support for first deployments

For some EU13 regions, the supported PDA project will be the first deployment of hydrogen technology in that country. This leads to an additional need for the development of policy and regulatory support in the country to enable the project.

Beyond financial support for hydrogen, consultancies were also able to help projects engage with regulators to remove regulatory barriers for the deployment of hydrogen technologies. This is particularly relevant for permitting for hydrogen infrastructure. While the regions that engaged with regulators did not face any strong barriers to the deployment of hydrogen infrastructure over the course of PDA support, early engagement is highly encouraged to inform regulators of plans and identify barriers well ahead of time. The HyLaw project is a particularly useful reference that can be provided to regulators.

Engaging with industry

Availability of hydrogen and fuel cell equipment in Central and Eastern Europe is still a challenge for projects in these regions. Manufacturers will often require an order of a minimum scale before they will consider delivering and providing servicing to equipment in these regions or will only provide equipment to Central and Eastern Europe at increased timelines or costs. This is something that should be made clear by consultancies to regions so that the scope of the project can be decided accordingly, however we note that the landscape of hydrogen equipment supply may evolve in the time preceding regional procurement.

Consultancies were able to connect regions with relevant suppliers to discuss product offerings, minimum order volumes, maintenance packages, and timescales for delivery. Previous experience indicates that joint procurement between regions (particularly those located in different member states) can be incredibly challenging, however joint efforts can be simplified while remaining effective by regions releasing invitation to tender on a coordinated timeframe. This will aim to reach the required scale for multiple providers to target the Central and Eastern European market.

6.5 Ensuring project delivery following PDA support

The FCH JU has set a target for each of the supported regions to proceed to project implementation within a year of the close of the PDA support period. While all the regions have the full intention to go ahead with their projects, this is subject to a number of uncertainties that could not be fully resolved during the support period. The following lessons learnt detail the key risks to implementation common to many of the supported projects and provide suggestions for how these can be resolved in future PDAs to maximise the number of projects that proceed to implementation.

Project funding

For all the supported projects, a key prerequisite for implementation following the support period is the acquisition of sufficient funding. The total budget of each project could not be covered in its entirety by the municipalities, leaving a funding gap for each project of the order of millions of Euros. This gap will need to be covered by some combination of National and/or European funding sources.

Writing funding applications was not within the scope of PDA services and is a task that must be taken on by each of the regions. The applications for European funding sources are not straightforward, and regions will be competing with much more experienced regions and companies for funding from sources such as the Green Deal or Innovation Fund. To further complicate the process of acquiring funding for regions, many European funding sources will only support one aspect of the project rather than the entire project (e.g. CEF funding only for infrastructure). The project is therefore reliant on being successful in multiple competitive funding applications to proceed to delivery when the bid is being written by regional representatives who do not have significant experience in writing successful funding bids. This therefore reduces the chances of sufficient funding for the project being acquired. Support from the European Investment Bank for regions to write funding applications will be highly beneficial for many of the PDA regions.

A further challenge for consultancies when developing funding plans was the timing of European funding calls. Many of the European funding streams have not yet been released and will only provide funding for specific topics. Since consultancies cannot know ahead of time whether one of the topics will be suitable for the regions, regions have simply been advised to monitor funding calls for relevant opportunity. This could be resolved by strategically timing the final month(s) of PDA to coincide with the release of European funding calls.

Capacity building for regions

In any hydrogen newcomer region in general and EU13 regions in particular, which have less experience with hydrogen and fuel cell technologies, the first deployment is a good opportunity to start building knowledge and skills locally, to prepare them for the scaling-up of hydrogen in years to come. Consultancies should always include in their implementation plans, details of how skills can be brought into the country on several levels (training for technicians, academic expertise, management of hydrogen projects, policy, and regulatory expertise, etc.), and disseminated as widely as possible.

PDA can act as a mechanism to train members of the project delivery group with the skills required to deliver the project. Where possible, consultancies should aim to provide 'coaching' for local actors to be able to complete project management and analysis tasks themselves, and all models should be developed well ahead of the close of PDA to allow them to be passed on to delivery group members. This ensures continuity of the project following the close of PDA and empowers local actors to take ownership of the project and develop future hydrogen projects independently.

Contracting structures with industry

This PDA could only be applied for by a local authority, however many of the selected projects had existing stakeholder groups that included representatives from private industry. This can create a challenge for projects when it comes to public procurement.

For any public organisation working with industry, the public organisation is required to achieve the best possible value-for-money using public funding to procure equipment and services. When a private company is involved in the project delivery group, it is important to clarify the basis on which they will be involved in the project. While industry can be a useful supporter of hydrogen projects by providing advice and information, if the company is intending to sell products or services to the project, this can be done on one of two bases:

- **Industry agrees to be involved in the project on a non-profit basis**: in this case, all calculations on price must be 'open book' to ensure that industry will not make a return on investment. In return, industry is guaranteed access to the non-financial benefits of participation in the project and will have the opportunity to develop their hydrogen offering without participating in a competitive tender.

- **Procurement is completed via competitive tender**: in the case that industry is not willing to participate in the project on a non-profit basis, the public entity will need to procure equipment and services on a competitive basis. A decision will need to be taken as to whether to exclude the industry partner from the project delivery group to comply with public procurement rules – this will be dependent on the specific project set up and public procurement procedures in the region.

Including industrial players in the project delivery group can, however, be beneficial for the region. PDA can be used to support local industry in Central and Eastern Europe to develop hydrogen capabilities; this will be needed to allow regions to access the full economic benefits of hydrogen as the sector grows. Building local capacity to provide hydrogen-related products and services should be considered a priority to allow regions in Central and Eastern Europe.

Developing standard procurement templates

At the current level of hydrogen maturity, a standardised offer for hydrogen and fuel cell equipment is not currently available on the market. This presents a challenge for regions seeking to procure equipment, as authorities must develop their own procurement documents (written in such a way as to meet all the needs of the region, but not so as to increase the cost of the equipment) and evaluate the responses (which will involve not just financial evaluation, but also examination of technical aspects of the offers to ensure they meet the needs of the region).

This issue will become simpler over time as standard market offerings are developed, but until then local authorities will need support to procure equipment that meets their performance specifications without costing more than is required. Support could be provided to the region on how to write tender documents and go about procurement. Following the receipt of the offers, support will also be needed to perform a technical review of the offers and check contracts.

6.6 Conclusions on lessons learnt

As with any first-of-a-kind project, PDA has been an excellent opportunity to develop shared learnings on how to best provide support to develop hydrogen projects in regions across Europe. While consultancies have applied their extensive experience from developing hydrogen projects to maximise the chances of each of the projects reaching the implementation phase, the process of providing PDA to regions has resulted in several new lessons learnt and best practices on developing hydrogen projects. These lessons have been shared above to demonstrate how the FCH JU, consultancies, and regions, can best structure and deliver PDAs in future, to increase their impact on the selected regions.

7 Next steps

Following the close of the PDA support period on 7th June 2021, the eleven selected regions are expected to proceed to project implementation in the coming year. While all regions are committed to the delivery of their projects, this remains contingent on the results of the next stage of each project. Specific next steps for each supported region have been identified as part of their final deliverables. As with any ambitious project, each of the supported regions is aware of a number of potential risks that could cause delays, or prevent, project implementation. Wherever possible, PDA has supported the selected regions to identify these risks and put in place mitigation measures that will be enacted should these risks arise, to maximise the chances of each project being implemented.

For all projects, a crucial next step is to close the funding gap through a range of measures that have been identified during the PDA support period, such as acquisition of National or European funding, or the implementation of national policy support for hydrogen. While PDA support was designed to develop project plans to a position where regions would be ready to apply for National and European funding opportunities, the development of funding applications was out of scope for PDA.

While it is hoped that the Observer Network activities have enabled some observer regions to proceed to developing their own detailed implementation plans, the FCH JU recognises that some regions will still require direct support to prepare for implementation of projects. The regions in the Observer Network that feel they would benefit from direct consultancy support will be invited, alongside any other European regions with concepts for hydrogen projects, to apply for future PDA support. Further details of the launch of future PDAs are expected to be announced in the second half of 2021.

8 Conclusions

The FCH JU has funded consultancy support to help European regions to progress their concepts for hydrogen and fuel cell projects. Of thirty-six applications, eleven regions were selected to receive support over the period June 2020 – June 2021, and the regions that were not selected to receive direct support were invited to join the Observer Network.

This public summary report has detailed the activities completed as part of the delivery of Project Development Assistance to both supported and observer regions. This work supported eleven selected regions to develop concepts for regional hydrogen projects into detailed plans, in preparation for implementation. Observer Network activities, open to all regions that applied for PDA support, were delivered on a variety of technical and financial topics, aimed to give regions information to support their understanding and development of their hydrogen projects.

Over the course of delivering PDA support, the consultancies have noted several best practices and lessons learnt that can be applied by the FCH JU, consultancies, and regions in future PDAs to maximise the chances of projects reaching the implementation phase. Consultancies have made recommendations to the FCH JU regarding how future PDAs could be improved and projects could be supported beyond the scope of PDA. The design of future PDA support may also be informed by surveys that were filled by both supported and observer regions at the start, mid-point, and end of PDA support.

The PDA has supported the selected projects to be ready to proceed to the implementation phase, and it is expected that most of these will proceed to delivery. PDA support has helped selected regions to identify the next steps required to move forward with implementation and risks that will need to be monitored and mitigated in the next phase. Delivery of these projects will result in significant benefits for the regions and will kick-start the use of hydrogen in several new geographic regions in Europe.

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