Interreg Alpine Space

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H2MA

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# Peer-review guidelines on how to jointly develop a common transalpine green H2 route masterplan.

Activity 2.3

June 2024

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**Short description**

H2MA brings together 11 partners from all 5 Interreg Alpine Space EU countries (SI, IT, DE, FR, AT), to coordinate and accelerate the transnational roll-out of green hydrogen (HYDROGEN) infrastructure for transport and mobility in the Alpine region. Through the joint development of cooperation mechanisms, strategies, tools, and resources, H2MA will increase the capacities of territorial public authorities and stakeholders to overcome existing barriers and collaboratively plan and pilot test transalpine zero-emission HYDROGEN routes.

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# Executive summary

This input paper provides the thematic background and guidelines for the implementation of H2MA activity 2.3, namely "Peer-review workshop to establish a common trans- Alpine green H2 mobility masterplan, to advance commercial/long-distance and urban mobility infrastructure planning". During the activity, partners will join a half-day workshop, organized by FLA, to peer-review the A2.2 territorial route designs, and jointly merge them into a common transalpine green H2 masterplan.
To facilitate the process, the input paper provides the context and an overview of the activity (Section 1), the thematic background (Section 2), the peer review framework (Section 3), the relevant steps for carrying out the integration of the territorial plans into the masterplan (Section 4), the organizational (practical and technical) guidelines and a template agenda (Section 5). In the Annex the peer review form is provided.



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# 1 Introduction

## 1.1 Outline of the activity 2.3

Activity 2.3 builds on the previous WP1 and WP2 activities to create a transalpine masterplan for green hydrogen mobility. In particular, the Activity 2.1 employed and tested the "H2MA planning tool" developed from Activity 1.5 to promote hydrogen mobility solutions. Meanwhile the Activity 2.2 focused on conducting Local Working Groups (LWGs) and designing territorial routes, which are crucial for the masterplan's comprehensiveness and integration across different regions.

During Activity 2.3, partners will collaboratively integrate A2.2 territorial route designs into a single transalpine green hydrogen masterplan through a peer review process. All partners will participate in the peer review workshop to share and review their designs. Each partner will present their most viable scenario as a plan. Most viable means the scenario which is rated as the most reliable data input for the H2MA tool, considering the national and regional hydrogen needs, strategies, and predictions. Additional scenarios can be uploaded, if necessary for each region. After reviewing the compatibility between the territorial plans, partners will discuss the main aspects of integrating these different plans into a green hydrogen transalpine masterplan.

Subsequently, FLA will summarize the workshop results and based on these, will present the transalpine masterplan for green hydrogen mobility, including lessons learned and focusing on the process employed to develop the masterplan.

## 1.2 Scope of the H2MA peer review workshop

The primary aim of this document is to provide comprehensive guidelines for assessing the various territorial plans submitted by different entities and evaluating their compatibility. These guidelines are designed to support H2MA partners in the peer review process, facilitating a systematic evaluation and integration of territorial plans. This process will ultimately lead to the creation of green hydrogen routes, forming a supply and distribution network crucial for the Alpine region.



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Green hydrogen routes refer to green hydrogen infrastructure designed specifically for the production, distribution and utilization of green hydrogen (H2).

In the context of the transalpine masterplan, green hydrogen routes could include:

- Production sites: Locations where green hydrogen is produced using renewable energy.
- Distribution networks: Pipelines, roadways, and other transport methods for moving hydrogen from production sites to areas of demand.
- Refuelling stations: Infrastructure for refuelling hydrogen-powered vehicles, including cars, buses, trucks, and potentially trains.
- Storage facilities: Places where hydrogen can be safely stored for future use.
- Integration Points: Nodes that connect various elements of the hydrogen supply chain, ensuring efficient and continuous flow from production to end-use.

## 1.3 Partner's involvement and timeline

The role of the partners in Activity 2.3 includes:

- Submitting detailed territorial green hydrogen route/design scenarios by the formats of a) shapefiles b) accompanying document as well as the summary reports of the LWGs conducted in the process of building up their territorial plans by the 17th of June 2024.
- Participating in the peer review workshop to present their most viable scenarios, review the compatibility of the territorial plans, and discuss the integration of these plans into the masterplan.

## 1.4 Selection of review panel participants

The panel may include, along with H2MA partners, independent specialists and representatives from various institutions, since their participation, would provide valuable insights and perspectives to effectively evaluate and integrate the proposed territorial hydrogen routes into the masterplan.



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## 1.5 Input material

The workshop will utilise the following input materials to facilitate the discussion and synthesis of the transalpine green hydrogen route:

- A partner specific PPT template that describes the most viable scenario from the H2MA tool for each country in a uniform way. Most viable means the scenario which is rated as the most reliable data input for the H2MA tool, considering the national and regional hydrogen circumstances, strategies, and predictions. Additional scenarios can be uploaded, if necessary.

Additionally, the following input will also be collected to be used in the later step of integrating the territorial plans.

- The territorial maps generated by the H2MA tool in shapefile format will be collected to create a comprehensive H2-route file containing all geodata. These maps will depict selected infrastructures for interconnection within each scenario, highlighting key elements such as hydrogen refuelling stations (HRS), H2 production sites, delivery and storage facilities, and transportation links.
- The maps will be accompanied by *Excel files* that provide detailed scenario-based data for green hydrogen route planning. These data are expected to cover both regional mobility and industrial hydrogen needs. The Excel files contain specific data for route planning, including average daily demand, number of HRSs (both onsite and offsite), production capacity, annual production, annual import, onsite production capacity (t/d), annual onsite production (kt/y). Each participant will provide a similar Excel file with data pertinent to their respective scenarios.



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# 2 Thematic background

## 2.1 Long distance hydrogen routes challenges

The traditional approach to transporting hydrogen over large distances has three key drawbacks:

- High transportation costs: Moving hydrogen across long distances incurs substantial costs, making it economically unfeasible.
- Higher carbon intensity: Despite hydrogen being a clean energy carrier, the transportation process itself can add to the carbon footprint, especially when traditional methods are used.
- Supply reliability: Ensuring a consistent and reliable supply of hydrogen to distant clients is difficult, impacting its adoption for transportation and stationary power applications.

Furthermore, the supply chain for green hydrogen is highly dependent on the availability and distribution of renewable energy sources, which can be variable and location specific. This adds another layer of complexity to the long-distance transportation of hydrogen.

Given these challenges, it is crucial to explore and implement good practices that can mitigate these issues and facilitate the development of effective long-distance hydrogen routes. The following section will discuss these good practices, providing a comprehensive approach to overcoming the identified challenges.

## 2.2 Good practices when developing long distance hydrogen routes

The development of long-distance hydrogen routes necessitates a multidisciplinary approach that encompasses strategic planning, infrastructure development, technical integration, environmental considerations, economic viability, regulatory compliance, stakeholder engagement, risk management, and the utilization of advanced technological tools like Geographic Information Systems (GIS). Additionally, for cross-border routes involving multiple EU countries and regions, effective international coordination and harmonization of standards are crucial.



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**Strategic planning** must consider the integration of hydrogen infrastructure across different countries, ensuring interoperability and seamless transitions at borders. Establishing a transnational task force involving stakeholders from all participating countries can facilitate coordination and address cross-border challenges. Harmonizing regulatory standards and safety protocols across regions is essential for smooth operation and public acceptance.

**Infrastructure development** starts with strategically locating HRSs along major highways, urban centres, and rural areas to ensure wide accessibility and promote the adoption of hydrogen vehicles. These stations should be equipped with standard refuelling interfaces and safety features to enhance user convenience and safety.

**Hydrogen production and storage** require a balanced approach, incorporating both centralized and decentralized production facilities based on regional resources and demand. Utilizing renewable energy sources for hydrogen production is crucial to reduce the carbon footprint and enhance sustainability.

**Transport and distribution** methods must be optimized for efficiency and cost-effectiveness, utilizing pipelines and trucks to ensure timely and reliable hydrogen delivery. It's essential to assess and mitigate potential energy losses during transportation.

**Technical integration and standardisation** involve implementing interoperable technologies and protocols to facilitate seamless integration across different regions and countries.

Utilising **advanced technological tools** like GIS for mapping, simulation, and optimization can significantly enhance the planning and development process. Investing in research and development for innovative hydrogen technologies, such as improved storage solutions and efficient production methods, is crucial for long-term success.

**Environmental and sustainability** considerations are critical, such as including conducting Environmental Impact Assessments (EIAs) to minimize greenhouse gas emissions and promote the use of renewable energy sources. Hydrogen route development should align with broader sustainability goals and carbon reduction targets, utilizing renewable resources from remote locations.

**Economic viability and funding** should be evaluated through cost-benefit analyses, securing investment, and ensuring regulatory compliance. Engaging with policymakers to align policies and create a supportive regulatory environment is vital for hydrogen infrastructure development. Accessing EU funding mechanisms and subsidies can provide financial support for cross-border projects.

**Risk management and contingency planning** are essential for the successful implementation of hydrogen routes. Identifying potential risks, developing robust risk management strategies, and establishing monitoring mechanisms to track the performance of the hydrogen routes and infrastructure are key components.



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**Stakeholder engagement and social acceptance** strategies are crucial and could involve public consultations and participatory decision-making processes to assess potential social impacts, such as displacement and public health risks, and develop mitigation strategies. Engaging local communities and businesses in the planning and development process can enhance support and acceptance.

## 2.3 Presentation and review of real case studies, including key lessons learnt

***Case study 1: European Hydrogen Backbone (EHB)***

EHB[1] is a project aiming to establish a trans-European hydrogen transport network by repurposing existing natural gas pipelines and constructing new ones. This network will enable the transportation of renewable hydrogen across Europe, supporting the decarbonisation of the sector. The EHB project is a key step towards achieving the European Union's goal of becoming climate-neutral by 2050.

Key lessons learned include reducing costs by using existing infrastructure for hydrogen transport, effective cross-border coordination among EU member states, and designing the network with scalability for gradual expansion. Additionally, the EHB project highlights the importance of collaboration between the public and private sectors to drive innovation and investment in sustainable energy solutions. By using the existing natural gas infrastructure, the transition to renewable hydrogen can be accelerated, paving the way for a greener future in Europe.

[1] EHB (2023). Implementation roadmap -Cross border projects and costs update. Source: EHB-2023-Implementation-Roadmap-Part-1.pdf



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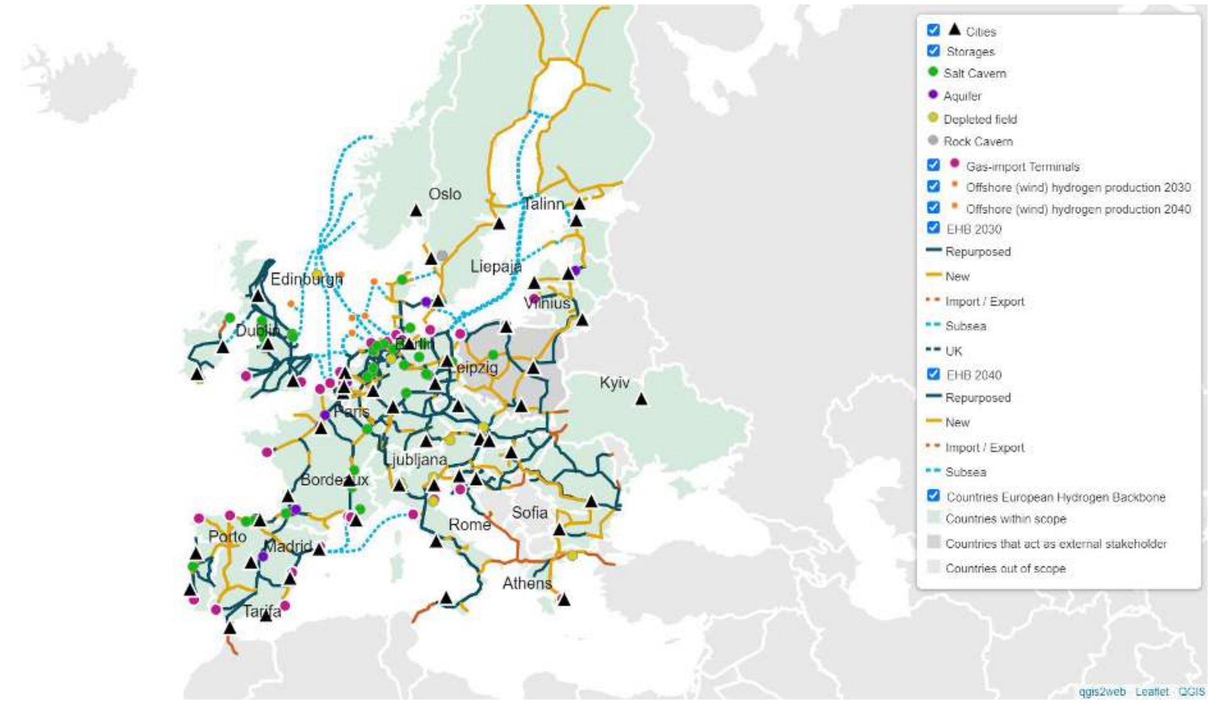


Source: https://ehb.eu/maps/202307/index.html#4/53.00/13.01

However, large-scale infrastructure projects like EHB require substantial financial investment, which can be challenging to secure, especially for cross-border initiatives involving multiple stakeholders. The main strategy involves leveraging a combination of public-private partnerships, EU funding mechanisms, and strategic investments from member states.

***Case study 2: Hydrogen Infrastructure for European Transport (H2ME)***

H2ME[2] is a large-scale European initiative (run 2015-2022) that focused on expanding hydrogen refuelling infrastructure across multiple countries. It aims to create a unified network to support hydrogen transport and usage across Europe. The H2ME project has revealed both progress and challenges in the adoption of Fuel Cell Electric Vehicles (FCEVs) and Hydrogen Refuelling Stations (HRS). The main challenges the H2ME project faced included scarcity of refuelling infrastructure, permitting bottlenecks, limited vehicle offerings from Original Equipment Manufacturer (OEMs), high costs compared to Battery Electric Vehicles (BEVs), low utilization levels of existing HRS, and regulatory uncertainties.

[2] https://h2me.eu/about/hydrogen-refuelling-infrastructure/


*Source: https://h2me.eu/about/hydrogen-refuelling-infrastructure/*

Recommendations derived from stakeholder insights and project analyses emphasise the imperative for scale to drive down costs, sustained financial support for the roll-out of FCEVs and HRS, consistent policy frameworks, and clear market signals to instil OEM confidence in scaling production. Furthermore, calls are made for strategic HRS deployment plans to prepare for AFIR, enhanced equipment reliability, and designs tailored to high utilisation to meet fleet expectations effectively. These insights demonstrate the ongoing need for collaborative efforts and sustained financial support beyond the H2ME project to overcome barriers and propel the widespread adoption of hydrogen mobility solutions to decarbonise transport across Europe.

**_Case study 3: North Sea Wind Power Hub (NSWPH)_**

NSWPH is a proposed project aiming to create a large-scale renewable energy hub in the North Sea. The project includes the production of green hydrogen and its transportation across multiple European countries including the Netherlands, Germany, and Denmark.



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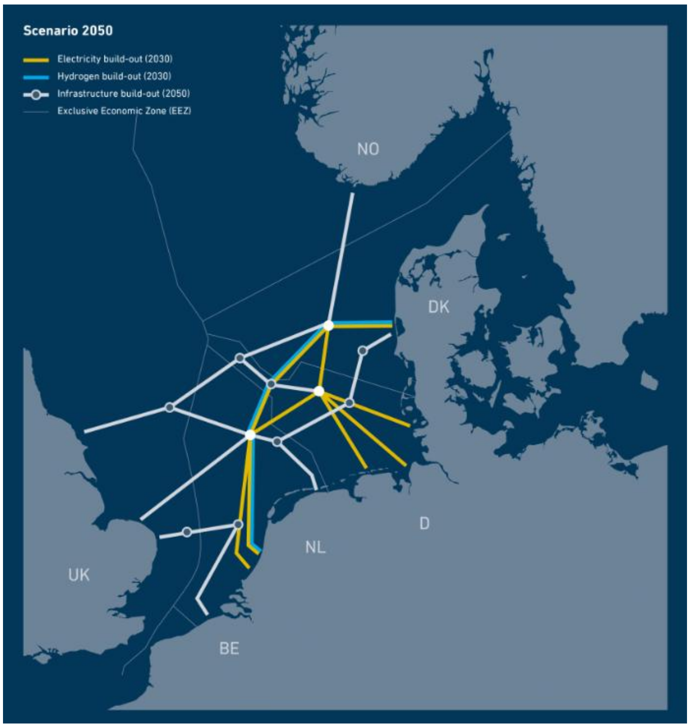
The NSWPH masterplan outlines a roadmap for establishing a major hydrogen transport route across Europe, emphasizing the importance of regional cooperation and integrated planning in developing a sustainable hydrogen network. It involves collaboration between governments and major energy companies, extensive feasibility studies, and a comprehensive infrastructure plan including offshore wind farms, hydrogen production facilities, and transnational pipelines.




*Source: https://northseawindpowerhub.eu/a-blueprint-the-new-energy-highways*

The project is organised focusing on four overarching topics: system integration, technical feasibility, cost and benefits, and regulation and market design:

- System integration involves identifying multiple electricity corridors in the North Sea to connect offshore wind locations and transport energy via hubs to shore.
- Technical feasibility involves determining the technical design principles for individual system elements of a hub-and-spoke project, including substructure, high voltage direct current (HVDC) infrastructure, offshore electrolysis, and hydrogen infrastructure.
- Cost and benefits calculations are done using cost-benefit analysis methodologies developed for the hub-and-spoke concept.
- Regulation and market design decisions are made by national and European governments to provide sufficient investment clarity for hub-and-spoke projects and offshore wind roll-out.



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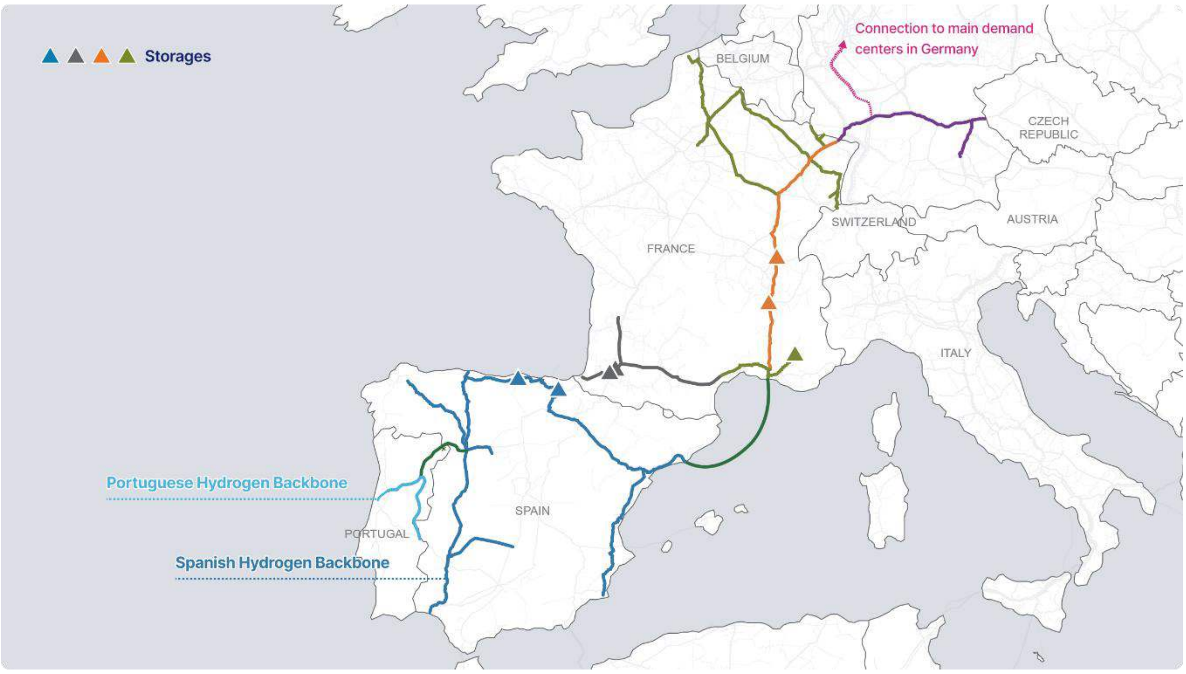
***Case study 4: H2Med project***

H2Med project[3] aims to establish a hydrogen corridor connecting Southern Europe with Central and Northern Europe, utilising the existing natural gas infrastructure for hydrogen transport. H2Med intends to connect significant hydrogen production locations in Southern Europe, mainly Spain and Portugal, with key industrial hubs and hydrogen consumption centres throughout Europe. This geographical coverage is critical for maintaining a consistent supply of hydrogen to high-demand areas.




*Source:* `https://h2medproject.com/the-h2med-project/`

The project focuses on the creation of green hydrogen with renewable energy sources such as solar and wind power. This integration contributes to minimising the carbon footprint and aligning with the EU's decarbonisation objectives.

H2Med receives strong regulatory and policy support on both the national and EU levels. This assistance comprises financial incentives, accelerated permitting processes, and harmonised legislation to facilitate cross-border hydrogen transportation. The project is designed to be scalable and flexible, allowing for gradual development and expansion based on demand.

In this context, the H2Med project could offer some insights for partners in peer review and masterplan development including utilising existing infrastructure, ensuring strategic coverage of production and consumption areas, integrating renewable energy, utilizing regulatory support, planning for scalability, and fostering cross-border collaboration.

[3] https://h2medproject.com/



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# 3 Peer review framework

## 3.1 Objective

The overall objective of the peer review workshop is to support the development of a transalpine green hydrogen masterplan, which will a) define transnational green hydrogen routes across the Alpine Road network, and b) pinpoint optimal locations for green hydrogen infrastructure. In particular, the workshop will serve as a platform that will allow partners to examine, discuss and optimise the green hydrogen mobility plans developed in Activity 2.2.

In this context, the peer-review framework will provide guidelines, criteria, and recommendations to support H2MA partners in a) assessing the green hydrogen routes developed in the context of Activity 2.2, b) pinpointing compatibility gaps between the routes, and c) identifying areas of improvement in order to merge the routes into a common transalpine Masterplan.

## 3.2 Purpose

The peer review and assessment of the routes is an essential step for their merging into a functional, economically viable transalpine green hydrogen masterplan since it will allow partners assess already prepared routes, iron out potential inconsistencies and inefficiencies and ensure that the Masterplan meets the foreseen quality standards and criteria (to be delineated in the following section). In particular, the peer review is expected to assess, inter alia, the following issues.

**Quality assurance**
The peer review process will provide a second level of quality control for the separate routes developed during Activity 2.2 (i.e., beyond the Local Working Groups), assessing the quality of design (including, efficiency, environmental impact, coverage, compliance with EU guidelines) and reviewing the different points of view, characteristics, needs and challenges of the territories participating in the project in order to ensure that these will be taken into account during the development of the Masterplan and incorporated in the final design.



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**Discrepancies in the design philosophy**

The green hydrogen routes, prepared in the context of A2.2, were developed individually by H2MA in cooperation with local stakeholder groups. Consequently, the approach and the network design philosophy that are adopted by the partners are expected to reflect the needs, challenges and maturity of the territorial green hydrogen ecosystems as well as broader characteristics of the respective countries (including, regulations, strategies, resources). This can lead to potential discrepancies in the design philosophy of the corresponding networks, particularly with regards to the green hydrogen production (centralised vs decentralised) and transportation (pipelines vs road transportation, compressed vs liquefied hydrogen), which will, ideally, need to be ironed out in order to ensure a functional and efficient transalpine network.

**Compatibility between the hydrogen routes**

Although efforts have been made by partners to ensure the efficiency and viability of the individual hydrogen routes as well as their compliance to the EU guidelines, it is possible that uncritically merging the different routes to form a transalpine Masterplan could introduce inefficiencies in the overall design. These could be related indicatively (a more detailed discussion is presented in the following section) from gaps in the network coverage, overlaps in the placement of Hydrogen Refueling Stations (HRS), unoptimised network design, which naturally arise when merging separately developed networks.

**Environmental risk management**

All partners are expected to have taken into account environmental considerations and examined potential environmental risks when designing the territorial green hydrogen mobility plans. Nevertheless, it is possible that the impact of the proposed network on neighboring countries/regions has not been fully assessed due to lack of knowledge or available information. In this context, the peer-review process will allow a more large-scale approach on environmental risk analysis, allowing partners to mitigate any overlooked risks.

## 3.3 Route assessment guidelines

### 3.3.1 Overall criteria and requirements

For the green hydrogen Masterplan to provide a realistic option for the deployment of green hydrogen infrastructure in the Alpine area it needs to comply to a number of design criteria and requirements. These include the following.



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**Geographical coverage**
The plan should provide sufficient coverage for the Alpine area in order to facilitate the adoption of green hydrogen mobility technologies, particularly in hard-to-electrify sectors, such as long-range transportation. At a minimum, this requires that the refuelling station network connects the main population centres in the Alpine area and has adequate density along the major highways to support long-range traffic passing through the region. Furthermore, major cities should have a sufficiently dense and optimised hydrogen refuelling station network to support the operation of hydrogen powered fleets (e.g., in urban transportation or emergency services) as well as the growing use of fuel cell vehicles by the general public.

**Efficiency**
A major aspect of the transnational cooperation in the deployment of hydrogen infrastructure is to achieve economies of scale and ensure the optimization of the operational efficiency of the hydrogen supply chain from production to end-use. This involves assessing and minimizing the costs required for hydrogen production, storage, and transport through a suitable selection of employed technologies and an optimised network design (e.g., reducing the distance between green hydrogen production and consumption sites).

**Environmental impact**
The design and technical specifications of the transalpine network should try to limit the impact of the green hydrogen infrastructure on the local ecosystems (e.g., being located inside protected areas). In this context, it would be advisable (in the future) to potentially assess and mitigate potential impacts on local biodiversity, ecosystems, and water resources and ensure that land use for hydrogen infrastructure does not adversely affect agricultural land, natural habitats, or protected areas. Furthermore, efforts should be made to limit greenhouse gas emissions throughout the hydrogen supply chain (e.g., in the transportation of hydrogen).

**Compliance with national and EU guidelines and frameworks**
The Masterplan should a) be aligned with existing guidelines and frameworks (indicatively, the TEN-T regulation) in order to facilitate its integration within the EU green hydrogen infrastructure planning, and b) comply with regional and national regulations and standards. This entails abiding by environmental protection regulations, zoning and land use restrictions, and safety requirements for the production, storage, and transportation of hydrogen.



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### 3.3.2 Focus areas for the peer review process

Based on the above discussion the following are some potential issues/challenges that partners could focus their attention to during the peer review process. These issues and challenges have been divided into 2 broad categories, namely a) the assessment of the individual routes' adherence to the broad design requirements, established during the past project activities, and b) an examination of the compatibility between the different routes. Naturally, partners can further expand this list based on their own preferences, needs and priorities.

**Assessment of individual routes**

As a preliminary step towards the development of the transalpine Masterplan, partners are expected to review and assess the separate network designs. Areas that the partners could focus on include the following.

Network coverage

The network should ideally provide adequate coverage for the corresponding geographical area. This is particularly relevant for important population centers, major transportation hubs and highways passing through the area, as these concern key potential markets for green hydrogen in the mobility sector (i.e. long range transportation, urban transportation, emergency services).

Cost effectiveness

The cost effectiveness of a network is of paramount importance as it will directly determine the competitiveness of green hydrogen mobility vis-à-vis other alternative options (e.g., electromobility). This category encompasses a number of different aspects (indicatively, production costs, transportation costs, energy costs) related to the design and location of the green hydrogen infrastructure that impact the consumer price of green hydrogen.

Scale

The network should be able to produce enough green hydrogen to meet the total expected demand of the corresponding geographical area and distribute it to the primary consumption areas. As a result, the partners are advised to ensure that the expected production capacity and the scale and extent of the distribution network are aligned with the future projections for green hydrogen demand.



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Alignment to EU regulations and strategies

It is essential that the network designs are aligned with major EU regulations, guidelines and strategies. This may include adherence to EU (and national) environmental regulations (e.g., pertaining to biodiversity protection), EU guidelines for transportation networks (e.g., TEN-T regulation) and EU hydrogen initiatives, particularly pertaining to the deployment of green hydrogen infrastructure). Consequently, partners are advised to assess the compliance of the routes to major EU policies, focusing on the above-mentioned areas.

**Compatibility assessment**

This process aims to assess the compatibility of the different network designs that were separately created by each Local Working Group in order to facilitate the development of a functional transalpine Masterplan. This is particularly pertinent for neighbouring routes, in which case the design of the network near the border can be particularly important. The following are some potential issues that the partners can focus on.

Gaps and overlaps in the hydrogen station network

In cases of routes located in neighbouring territories / countries it is important to examine whether there are gaps in the spatial coverage of the Hydrogen Refuelling Station network (i.e., distance between refuelling stations). These gaps can potentially occur near the border areas even if the separate networks are well-designed and can reduce the overall functionality of the network. On the other hand, it is also possible that there can be an above average station density near the border of two areas leading to overlaps and reduced network efficiency.

Discrepancies in the network design approach

There are currently a number of different options in the design of green hydrogen ecosystem; indicatively, this includes centralised vs decentralised (i.e., in the refuelling stations) hydrogen production or the transportation of hydrogen through pipelines or specialised vehicles. Although the centralised production and the use of a pipeline network are expected to be the long-term best options, in the short term the optimal choice depends on the maturity of the green hydrogen ecosystems (including, existing infrastructure, current and future demand). As a result, it is important for partners to examine potential differences in the network philosophy as they could potentially hamper the functionality of the transalpine Masterplan.



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Network inefficiencies

The simple merging of the individual designs can introduce inefficiencies in the Masterplan, even when these designs are separately optimised. As an example, the supply of hydrogen to stations near the border areas might become more financially viable if one takes into account the production capacities of the neighbouring territories / countries and includes cross-border transportation options. Consequently, partners are advised to carefully identify potential areas of improvements that may arise as a result of the merging of the separate hydrogen networks.



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# 4 Masterplan development

## 4.1 Objective

As described above, the primary objective of the Masterplan is to design a comprehensive and cohesive Alpine hydrogen mobility network that will integrate the individual territorial plans developed by project partners. By harmonising the diverse infrastructural elements, strategic approaches, and technological standards across different regions and countries, the masterplan will ensure an efficient, reliable, and sustainable hydrogen supply chain from production to end-use.

## 4.2 Merging territorial route designs

Following the identification of areas of improvement in the individual route designs, partners are expected to further fine-tune the routes (if necessary) and address any compatibility issues as a prerequisite to the merging of the routes. The section will provide some broad guidelines on addressing these issues in order to facilitate the optimisation of the Masterplan design. Nevertheless, partners are encouraged to further adapt or potentially go beyond these guidelines based on the results of the peer review process.

### 4.2.1 Fine tuning individual routes

To optimise the design of the individual routes (indicatively, in terms of infrastructure placement, production costs, and coverage) partners are advised to exchange practices and approaches that have been employed during the development of the individual routes in order to further fine tune the plans. In this context, they could utilise on their own, where possible, or through external experts, various models for optimising the placement and design of HRSs. These models aim to maximise coverage, minimise network overlaps, and cover the demand from both heavy and light-duty vehicles. Similarly, they assist in determining the optimal placement and capacity of production facilities to reduce transportation costs effectively.

Examples of such models include:

- **Spatial optimisation and accessibility models**: they use GIS and spatial data to determine best location for HRSs based on population density, existing infrastructure, traffic patterns, and proximity to highways. Then, they analyse metrics to ensure that HRSs are located within reasonable distance from potential users, considering both urban and rural settings as well as complying with EU regulations and goals regarding set distances. H2MA tool is an example of this



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category. Another one is ESRI's ArcGIS Network Analyst[4] tool which uses analyse transportation networks and optimize service areas, ensuring accessibility and compliance with regulatory standards.

- **Demand-driven and traffic simulation models**: they predict hydrogen demand using traffic data, vehicle registrations, and potential future adoption rates of hydrogen vehicles. Then, they simulate traffic flows to determine high-traffic areas and corridors where HRS would be most beneficial, especially for heavy-duty vehicles with specific route requirements. An example of such model is the open source MATSim[5] (Multi-Agent Transport Simulation Toolkit). MATSim uses detailed traffic data and simulations to predict travel behaviour and demand, helping to identify optimal HRS locations based on predicted future use.
- **Cost-effectiveness and Multi-Criteria Decision Analysis (MCDA) models**: they evaluate the economic viability of different HRS placements based on factors like installation costs, operational costs, potential revenue from fuel sales, and subsidies. Additionally, they incorporate multiple criteria such as accessibility, environmental impact, and stakeholder preferences into the decision-making framework to prioritize HRS locations. An example is the Analytic Hierarchy/Network Process (AHP/ANP)[6] which can be used to weigh multiple criteria (e.g., accessibility, environmental impact, economic feasibility) in decision-making. When combined with cost-benefit analysis, it helps prioritize HRS locations that are economically viable and meet other strategic objectives.
- **Network flow models**: they optimise the placement of HRS within a network context to ensure efficient coverage and minimize travel distances for hydrogen delivery trucks. An example is the TransCAD[7] which is a GIS-based transportation planning software that optimizes network flows and spatial placement of HRSs. It helps ensure efficient coverage and minimal travel distances for hydrogen delivery trucks.

In this context, partners are advised to collectively examine and discuss potential solutions, utilising tools such as the H2MA tool in combination with other models and taking also into account the evaluation of the compatibility assessment in order to ensure that the final route configuration will be fully compatible with the other routes, allowing their margining into a functional, optimised Masterplan.

[4] https://www.esri.com/en-us/arcgis/products/arcgis-network-analyst/overview
[5] https://matsim.org/
[6] https://doi.org/10.1080/0013791X.2013.855856
[7] https://www.caliper.com/tcovu.htm



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### 4.2.2 Addressing compatibility issues

As discussed in section 2, compatibility between individual routes (particularly in neighbouring territories) is a crucial parameter to consider during the preparation of the transalpine masterplan. In this context, the following practical suggestions will support partners in addressing the issues that were identified during the peer review process.

**Gaps and overlaps in refuelling station network coverage**

In cases of gaps or overlaps in the refuelling station placement (naturally, these are relevant concepts and depend on the expected local hydrogen demand) in the areas where two individual hydrogen routes meet, it is advised that the responsible partners review the station placement in the areas under examination, potentially utilising the H2MA tool to facilitate this process. In this context, partners should carefully assess a) expected hydrogen demand, and b) the current or future placement of green hydrogen infrastructure (i.e., pipelines, production facilities) in the neighbouring territories in order to pinpoint the optimal placement of the hydrogen refueling station.

**Differences in the design philosophy**

In cases of discrepancies in the network design philosophy (see Section 2 for more details), partners are advised to first assess the impact of these discrepancies on the operation and viability of the network. If these discrepancies directly undermine the viability of the unified Masterplan, partners should explore solutions that improve the alignment of the different routes.

In this context, partners are first advised to pinpoint the causes of these differences in the design philosophy. If these stem from actual differences in the maturity of the local hydrogen ecosystem or differences in the regulatory frameworks, partners are advised to identify compromises that could improve the overall harmonisation of the individual plans. If there are no such constraints it is advisable that the responsible partners, make changes to fully align the individual plans that have these issues.

**Inefficiencies in the production and distribution infrastructure**

As discussed, design inefficiencies can take place even when the individual routes are optimised (see Section 2 for more details). In case partners identify potential transregional synergies that can arise as a result of a more refined placement of hydrogen infrastructure (e.g., utilising hydrogen produced in a different country/region when this is more economically viable due to reduced transportation costs) it is advised that the foreseen location of the hydrogen infrastructure is adjusted accordingly, always taking into account the overarching constraints (e.g., production capacity of established infrastructure).



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**Environmental impact**

Partners should identify whether the individual routes have a transnational / transregional environmental impact. If such a case arise, partners are advised to identify modifications in the prepared routes (e.g., changes in the placement of the distribution network or production facilities) that mitigate the environmental risks, while maintaining the overall cost-effectiveness of the network.

It is important to note that throughout this process partners should further fine tune the Masterplan based on any modifications made on the initial design. As an example, a change in the placement of refuelling stations or hydrogen production plants could require subsequent changes in the hydrogen distribution infrastructure. Such changes should also be taken into account when discussing the viability of available options as they could directly impact the overall cost-effectiveness or other characteristics of the proposed network. It is thus important for partners to be aware of such potentialities in order to preserve the functionality of the final Masterplan.



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# 5 Organisation of the workshop

## 5.1 Date and structure of the workshop

FLA will host virtually the Peer review workshop on 19th of June 2024 starting at 14.30 CEST (half day duration). The working language will be English, and participants are expected to have a sufficient knowledge of the language to be able to fully participate in discussions. Project partners have the freedom to expand the participation to other stakeholders and external experts if they deem it conductive to increasing the overall impact of the workshop. Effort should also be made to invite stakeholders and experts that have already participated in previous project activities and are thus more invested in the project and more aware of its scope and objectives.
Participation is expected to be confirmed through the shared Google form.

## 5.2 Suggested procedure.

The peer review workshop will be conducted over a period of three and a half hours, divided into three indicative parts:

**Introduction and reports from the local working groups**
The session will begin with a five-minute opening segment where the host FLA will welcome all participants and outline the objectives of the workshop. Over the next 45 minutes, each partner will present their reports and main outcomes from their Local Working Groups (LWG). This session will provide an update on the progress of territorial route identification and the proposed infrastructure locations, which will be illustrated using maps produced by the H2MA tool.
Subsequently, each partner will define the scenario they have selected as the most feasible, explaining its key characteristics and assumptions. Each partner is advised to provide a visualisation of the plan and the designed green hydrogen routes. This could also include showing the planned hydrogen routes in comparison to the TEN-T corridors in the same area, and describing how the proposed design integrates with the TEN-T corridor as well as other significant areas, highways, hubs, and cities within the region.
In addition, partners are advised to elaborate on hydrogen production facilities, the selected hydrogen distribution methods, such as pipelines and trucks, also reporting on potential synergies with existing infrastructure.
The final 15 minutes of this part will be dedicated to presenting the first draft of the Peer Review Guidelines by FLA. This presentation will introduce the criteria and methods proposed for conducting the peer reviews, setting the stage for the subsequent discussion.



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**Peer-review discussion**

All H2MA partners and stakeholders will participate in the open discussion, and they will collaboratively assess the peer review guidelines, potentially making suggestions for further improvements.

Following these, participants are expected to review the territorial plans, first assessing their key properties (i.e., coverage, scale, cost effectiveness and alignment to EU regulations and strategies). Subsequently, partners will review the compatibility of the different plans with each other, pinpointing compatibility gaps and areas of improvement. Throughout this process, partners are advised to explore and discuss options to further optimise the plans (e.g., through changing infrastructure placement). In this context, partners are recommended to share practices and approaches utilised by them during the development of the territorial plans in order to facilitate knowledge transfer and overall improve the effectiveness of the process.

Furthermore, partners are advised to seek the optimal arrangements to more smoothly carry out the peer-review process. For example, to address compatibility issues, it might prove more efficient (depending also on the number of the identified issues) for partners to work within smaller groups comprising partners responsible for preparing the territorial plans that have compatibility issues.

**Wrap-up and conclusion**

After the 15-minute break, in a 15-minute session FLA will summarize the key points discussed during the open discussion.

The final 30 minutes will focus on reviewing the conclusions of the workshop. This will include the definition of the next steps for the merging of the territorial plans into the masterplan and setting deadlines for any follow-up actions. The session will conclude with a brief overview of the workshop's outcomes and any additional remarks from the facilitators.

## 5.3 Suggested agenda

The indicative agenda is presented here.

**Draft Agenda**



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**14.30 - 18.00 CEST**

**Part I - Introduction and report from the LWG**

**14.30 - 15.30 CEST**

| Time allocated | Topic | Speakers |
|---|---|---|
| 00.05 | Opening | Domenico Vito, FLA |
| 00:45 | LWG reports | H2MA partners |
| 00:15 | Presentation of the first draft Peer review Guidelines | FLA |

**Part 2 - Discussion on the Peer Reviews guidelines**

**15.30 - 16.30 CEST**

| Time allocated | Name | Surname |
|---|---|---|
| 01:00 | Open Discussion | All H2MA partners and stakeholders |

***16:30 – 16.45 Break***

**Part 3 - Wrap Up and conclusion.**

**16.45 - 17.30 CEST**

| Time allocated | Name | Surname |
|---|---|---|
| 00:15 | Summary of Discussion | Domenico Vito, FLA |
| 00:30 | Conclusions | Domenico Vito, FLA |



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# ANNEX: PEER REVIEW FORM

| | |
|---|---|
| **Reviewer Name (Partner/Stakeholder):** | |
| **Plan/Scenario:** | |
| **Route** | |
| **Date** | |

| | |
|---|---|
| **I. Assessment of territorial plan** | |
| **1. Coverage** | |
| **Overall, does the proposed plan sufficiently cover the targeted territory?** | Yes ☐ No ☐<br>Comments: |
| **Does the proposed plan connect key economic centres, industrial hubs, and transportation corridors?** | Yes ☐ No ☐<br>Comments: |
| **Are the HRSs located in a way that minimises consumers' travel time and delays?** | Yes ☐ No ☐<br>Comments: |
| **Other** Click here to enter | Yes ☐ No ☐<br>Comments: |

| | |
|---|---|
| **2. Cost effectiveness** | |
| **Does the network design effectively minimize the overall costs associated with hydrogen production?** | Yes ☐ No ☐<br>Comments: |

| | |
|---|---|
| **Are there unnecessary overlaps in the placement of hydrogen infrastructure (taking into account foreseen demand)?** | Yes ☐ No ☐<br><br>Comments: |
| **Does the design of the distribution network minimise transportation costs and energy losses?** | Yes ☐ No ☐<br><br>Comments: |
| **Does the plan take into account existing or planned hydrogen infrastructure?** | Yes ☐ No ☐<br><br>Comments: |
| **Is the network placement strategically aligned with anticipated future demand for green hydrogen?** | Yes ☐ No ☐<br><br>Comments: |
| **Other** Click here to enter | Yes ☐ No ☐<br><br>Comments: |
| **3. Scale** | |
| **Is the expected production capacity and the scale and extent of the distribution of the network aligned with the future projections of green H2 demand?** | Yes ☐ No ☐<br><br>Comments: |
| **Other** Click here to enter | Yes ☐ No ☐<br><br>Comments: |
| **3. Compliance with EU policies** | |
| **Overall, is the plan aligned with EU hydrogen goals and guidelines?** | Yes ☐ No ☐<br><br>Comments: |



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| | |
|---|---|
| **Is the distance between HRSs aligned with the EU targets?** ***(For reference, the EU target for heavy trucks for the TEN-T core network by 2030 is the availability of at least one HRS every 200km by 2030)*** | Yes ☐ No ☐<br><br>Comments: |
| **Is storage capacity per HRS aligned with the EU targets?** ***(For reference, the EU target for heavy trucks is for an HRS to have a minimum daily capacity of at least six tonnes of H2, with at least two dispensers per stations)*** | Yes ☐ No ☐<br><br>Comments: |
| **Do the proposed routes comply with local, regional, and EU regulations and standards?** | Yes ☐ No ☐<br><br>Comments: |
| **Other** Click here to enter | Yes ☐ No ☐<br><br>Comments: |
| **4. Environment impact** | |
| **How would you rate the performance of the plan in terms of overall carbon footprint? Please provide suggestions for further improvements.** | High ☐ Moderate ☐ Low ☐<br><br>Suggestions: |
| **Have potential impacts on local biodiversity, ecosystems, and water resources been properly assessed and mitigated?** | Yes ☐ No ☐<br><br>Comments: |
| **Are there any other environmental aspects that need to be addressed?** | Yes ☐ No ☐<br><br>Comments: |



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| **II. Compatibility assessment** | |
|---|---|
| **Gaps and Overlaps in the Hydrogen Station Network** | |
| **Are there gaps in the spatial coverage of the network when combined with other territorial routes (i.e., taking into account the entire Alpine area)? Please specify.** | Yes ☐ No ☐<br><br>Comments: |
| **Are there any overlaps in refuelling station placement when taking into account the other territorial routes? Please specify.** | Yes ☐ No ☐<br><br>Comments: |
| **Other** Click here to enter | Yes ☐ No ☐<br><br>Comments: |
| **Discrepancies in Network Design Approach** | |
| **Please report on any differences in the design philosophies (i.e. centralized vs. decentralized production, transportation methods) between this route and other territorial routes.** | Response: |
| **How would you assess the potential impact of these differences on the functionality of the Masterplan?** | High ☐ Moderate ☐ Low ☐<br><br>Comments: |
| **Other** Click here to enter | Response: |



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| Network Inefficiencies | |
|---|---|
| **How would you rate the overall efficiency of the network when taking into account the other territorial plans?** | High ☐ Moderate ☐ Low ☐<br><br>Comments: |
| **Please, report on areas of improvement or potential issues that will arise after the merging of the different network designs?** | Comments: |
| **Other** Click here to enter | Yes ☐ No ☐<br><br>Comments: |

| III. Additional Comments |
|---|
| **Overall Assessment:** |
| **Key Strengths:** |
| **Key Weaknesses:** |
| **Please provide any additional comments or suggestions to improve the integration of territorial plans into the Alpine H2 mobility masterplan:** |



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