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Alpine Space

H2MA

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Final report on green H2 mobility infrastructure gaps in Alpine space

Activity 1.1

May, 2023

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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 (H2) 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 H2 routes.

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CONTENT

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SUMMARY

This report documents the findings of the survey conducted within the context of H2MA Activity 1.1, titled 'Mapping and analysis of Alpine space infrastructure gaps in green H2 mobility vis-à-vis upcoming plans for H2 roll-out in partnership territories'. Project partners mapped their respective territories to identify a) existent and planned hydrogen mobility infrastructure, b) hydrogen mobility targets set in European, national, and regional frameworks and c) discrepancies between the two. The present report analyses the survey results and elaborates on key findings that emerged throughout the analysis, providing policy recommendations for integrated planning solutions.

The report is structured as follows:

- The Introduction provides an outline of Activity 1.1 and the purpose of the report within the H2MA project.
- Section 2 describes the survey and the methodology used for data collection.
- Section 3 outlines the overall findings and presents the results in five categories: a) regional hydrogen strategies and targets, b) national hydrogen strategies and targets, c) HRS per country and region, d) Hydrogen production units per country and region and e) Hydrogen transport arrangement per country and region.
- Section 4 discusses infrastructure gaps in the Alpine space per country and offers policy recommendations.

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1. INTRODUCTION

Hydrogen has the potential to play a significant role in curtailing carbon emissions in the Alps region's transportation sector. From passenger cars to buses, trains and even aviation, hydrogen mobility can have a far-reaching impact and serve as a vital catalyst for the region's green transition. Furthermore, the region's abundant renewable energy sources, particularly hydroelectric power, holds significant potential for scaling up green hydrogen production, thus facilitating the expansion of the hydrogen economy. Numerous Alpine countries have already embraced and implemented a wide range of hydrogen-powered vehicles and infrastructure, creating hubs for hydrogen mobility innovation and research.

Nevertheless, crucial infrastructure gaps persist. EU has set a goal of reaching 1000 Hydrogen Refuelling Stations (HRS) by 2030, with the aim of deploying 500 of them by 2025. As of now, there are 254 HRS in operation throughout Europe. Existing HRS network remains limited and unevenly deployed, while the production and distribution infrastructure has not reached a critical mass, resulting in relatively high costs. Addressing these gaps is imperative for mainstreaming green hydrogen in transportation.

1.1 Activity 1.1

Within the context of Activity 1.1 of the H2MA project, titled "Mapping and analysis of Alpine space infrastructure gaps in green H2 mobility vis-à-vis upcoming plans for H2 roll-out in partnership territories", partners conducted a survey, based on the methodology developed by KSSENA, to identify a) existent and planned hydrogen mobility infrastructure, b) hydrogen mobility targets set in EU, national, and regional frameworks and c) discrepancies between a) and b).

1.2 Final report on H2 mobility infrastructure gaps in Alpine region

The present report, prepared by KSSENA, thoroughly documents and discusses the survey findings, highlighting infrastructure gaps that impede commercial and urban green hydrogen mobility in the Alps. First, it outlines the survey details and the methodology employed for data collection. Subsequently, it presents the verified, cleaned, and corrected results per country. Finally, it delves into the key findings of the data collection and provides policy recommendations to address the identified gaps. In this respect, the report aims to increase the knowledge base and cooperation opportunities within the partnership, and influence policymakers to adopt comprehensive planning solutions for green hydrogen mobility.

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2. SURVEY DESIGN AND METHODOLOGY

To identify H2 mobility infrastructure gaps, a survey has been carried out by the project partners in their respective territories. The survey followed both a quantitative and qualitative research approach that aimed to gain a comprehensive understanding of HRS distribution and targets set for hydrogen deployment in regional, national, and European frameworks. It was implemented through two tools, a research questionnaire in Word and a repository as Excel document. As part of the qualitative survey partners were asked to identify strategies and specific targets. As part of the quantitative survey partners were requested to map their assigned territories and evaluate hydrogen deployment vis a vis identified short- and long-term targets.

2.1 Methodology

To guide and assist partners in their data collection efforts, KSSENA developed a comprehensive methodology based on relevant thematic desk research and literature review. The methodology suggested to address the problem of gaps in the development of hydrogen infrastructure across the Alpine space in three subsequent steps: a) Identify existent and planned infrastructure, b) identify territorial targets for hydrogen deployment set in European, national, and regional frameworks, and c) identify discrepancies between the two. In that way, the second set of data would be used as benchmark against which hydrogen infrastructure gaps could be assessed.

In this respect, the methodology provided:

- Thematic background on HRS, hydrogen production units and transportation arrangements.
- Thematic background on strategies for hydrogen deployment and examples of targets set in national and European plans.
- Detailed guidelines and Key Performance Indicators (KPIs) for the data collection.
- Two tools, a questionnaire in Word and a repository in Excel, to guarantee consistency in data collection.

2.2 Survey's implementation

Partners mapped existent and planned hydrogen infrastructure in EUSALP territories. As planned infrastructure was defined any infrastructure that has already been announced, is under construction, on trial phase, or about to become operational. Data collection thus focused on the three basic components, namely:

i) Hydrogen refuelling stations (HRS)
ii) Hydrogen production units (hydrogen plants)

iii) Hydrogen transport arrangements (hydrogen gas trailers, liquid hydrogen tankers, transmission pipelines).

Moreover, partners identified **measurable hydrogen infrastructure targets by 2030** in regard with the above-mentioned infrastructure components, namely electrolyser capacity, refuelling and supply capacity, HRS, transmission infrastructure. Even though EUSALP territories are all supposed to follow EU policy frameworks, data collection recorded variations from country to country. Lastly, partners offered a first assessment regarding the gaps between current state of play for hydrogen deployment and territorial targets, based on the data collected and following their personal judgment.

2.3 Key Performance Indicators

Key Performance Indicators concerning geographical coverage were set for the data collection. The following table presents the KPIs set for each partner and those reached.

Table 1: KPIs for Regional Targets

PARTNER	KPIS FOR REGIONAL TARGETS	KPIS ACHIEVED
KSSENA	Easter Slovenia	Easter Slovenia
BSC KRANJ	Western Slovenia	Western Slovenia
COD	Burgenland, Lower Austria, Vienna, Carinthia	Upper Austria, Salzburg, Tyrol, Voralberg
4ER	Styria, Upper Austria, Salzburg, Tyrol, Voralberg	Burgenland, Lower Austria, Vienna, Carinthia, Styria
ITALCAM	Stuttgart, Karlsruhe, Oberbayern, Niederbayern, Schwaben	Stuttgart, Oberbayern, Niederbayern
KPO	Freiburg, Tübingen, Oberpfalz, Oberfranken, Mittelfranken, Unterfranken	Stuttgart, Karlsruhe, Freiburg, Tübingen
EMS	Franche-Comté, Alsace	Franche-Comté, Alsace
PVF	Auvergne-Rhône Alpes, Provence-Alpes-Côte d'Azur	Auvergne-Rhône Alpes, Provence-Alpes-Côte d'Azur
CMT	Piemonte, Valle d'Aosta, Bozen-Bolzano	Piemonte, Valle d'Aosta,Bolzen/Bolzano
LR	Liguria, Lombardia, Trento	Lombardia
FLA	Veneto, Friuli-Venezia Giulia	Lombardia

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Table 2: KPIs for National & EU Targets

PARTNER	KPIS FOR NATIONAL & EU TARGETS	KPIS ACHIEVED
KSSENA	EU	Slovenia, EU
BSC KRANJ	Slovenia	Slovenia
COD	Austria	Austria
4ER	-	Austria
ITALCAM	Germany	Germany
KPO	–	Germany, EU
EMS	France	France
PVF	France	France
CMT	–	Italy
LR	Italy	Italy
FLA	–	Italy

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3. SURVEY DATA AND RESULTS

All consortium partners contributed to data collection with cases from their respective territories, even if they occasionally fell short of the specified collection targets outlined in the Methodology. This section presents the results of the survey.

3.1 Overall findings

Out of the 86 HRS identified by the means of the survey 4 were in Slovenia, 22 in Austria, 11 in Germany, 25 in France, and 24 in Italy. However, most of them (57 out of 86) regard HRS in the planning phase with only 29 currently operational. The transmission systems employed vary, ranging from on-site production and smaller production capacities to a limited number of cases where connection to the pipeline grid is foreseen. It appears that production is primarily taking place on-site rather than in centralised facilities, which also explains why storage options remain limited across the Alpine space.

Ultimately, the survey findings indicate that the hydrogen sector has successfully transitioned beyond the introductory phase and is currently undergoing further expansion and consolidation. The clear political will to further increase hydrogen's use cases provides a basis for assuming that the targets set by local governments can be achieved if this development trajectory is sustained.

3.2 Strategies demonstrating a commitment to hydrogen mobility in the Alps

Partners identified strategies for hydrogen development at the European, national and regional levels. Below are presented the data and targets they have collected.

EUROPEAN LEVEL

At European level, partners identified the following targets:

1. Publicly accessible HRS with a minimum capacity of 2 t/day and equipped with at least a 700-bar dispenser are deployed with a maximum distance of 150km in between them along the TEN-T core and the TEN-T comprehensive network by 2030.
2. Liquid hydrogen shall be made available at publicly accessible refuelling stations with a maximum distance of 450 km in-between them by end of 2030.
3. Measures to promote HRS deployment through national policy frameworks should be submitted to the Commission by 2024.
4. 1000 HRS by 2030, half of which to be constructed by 2025.
5. 1 million tons of renewable hydrogen production by 2024 and up to 10 million tons of renewable hydrogen production by 2030.

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6. 40 GW of electrolyser capacity by 2030 and 100 GW by 2040.
7. 6 million hydrogen-powered FCEVs and other hydrogen-powered vehicles in the European Union by 2030.
8. Consumption of renewable hydrogen: 50% of total hydrogen consumption for energy and feedstock purposes in industry by 2030 and 2,6% of the energy supplied to the transport sector.

[Sources: EU HYDROGEN STRATEGY – Directive on common rules for the internal markets in renewable and natural gases and in hydrogen (proposal), Clean Hydrogen Alliance – A credible pathway for clean hydrogen (broader policy framework), Alternative Fuel Cell Infrastructure Regulation – AFIR, ReFuelEU aviation (FuelEU maritime for waterbone transport]

NATIONAL LEVEL

Partners provided data on national strategies in all participating countries, Slovenia, Germany, Austria, France and Italy. **Additional desk research** conducted by the external expert contracted to support the development of the present deliverable also revealed the following targets.

Slovenia:

1. 5-9 HRS by 2030
2. 974 FCEVs by 2025 and 5549 FCEVs by 2030
3. 137 FCETs by 2025 and 800 FCETs by 2030

[Source: Strategy in the field of market development for the establishment of appropriate infrastructure related to alternative fuels in the transport sector in the Republic of Slovenia, 2017]

Austria:

1. 1 GW of electrolyser capacity by 2030
2. 80% of current fossil hydrogen demand to be converted by green hydrogen until 2030

[Source: Austrian National Hydrogen Strategy]

Germany:

1. 300 operational HRS by 2030

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2. Electolyser capacity of 5[1] GW installed by 2030.
3. 8.000 FCEVs by 2030
4. 1.200 buses by 2030
5. 200.000 FCETs (N3/>12t) by 2030
6. Further develop the Hydrogen railway transportation systems
7. Develop and integrate fuel cell technology in regional aviation (hybrid system)[2]
8. Develop and integrate hydrogen freight water transport.

[Source: National Hydrogen Strategy]

France:

1. 1000 HRS by 2030
2. 6,5 GW electrolyser capacity by 2030
3. 200.000 FCEVs by 2030
4. 5.000 hydrogen buses by 2030

[Source: National Strategy for the Development of Decarbonised Hydrogen in France]

Italy:

1. 40 HRS by 2030
2. 5 GW electrolysing capacity by 2030
3. 4000 FCETs with a potential further ambition to reach 10.000-14.000 units (Up of 50% of existing diesel railroads to be converted to hydrogen).
4. Achieve 2% share of hydrogen in the overall energy mix.

[Sources: Preliminary Guidelines for a Hydrogen National Strategy, National Plan for Recovery and Resilience]

REGIONAL LEVEL

Moreover, project partners identified the following regional policy instruments at regional level.

Austria:

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1 The initially reported electrolyser capacity provided by the partner was 2 GW; however, upon further data cleaning and additional desk research, it was corrected to 5 GW. However, 5 GW was recently changed again to 10 GW, since as of July 2022 Germany reached 5,6 GW electrolyser capacity and as of February 2023 8,1 GW electrolyser capacity. Germany now aims for 10 GW of electrolysis capacity, twice as much as originally planned in the National Hydrogen Strategy.

2 First inland vessel (named ELEKTRA) is currently being tested in Berlin (Brandenburg).

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1. **Vienna**: Hydrogen Strategy of Stadtwerke Wien
2. **Carinthia**: Roadmap: Hydrogen in Carintia
3. **Tyrol**: a) Wasserstoff-Masterplan Tirol, b) H2-Masterplan European Region Tirol-Südtirol-Trentino

Germany:

1. **Freiburg**: Wasserstoff-Roadmap Württemberg
2. **Bavaria**: a) Hydrogen Roadmap Bavaria, b) Bavarian Strategy for Hydrogen

France:

1. **Alsace**: Une stratégie HYDROGÈNE pour le Grand Est 2020-2030
2. **Auvergne-Rhône-Alpes**: Zero Emission Valley for Auvergne Rhône Alpes

Italy:

1. **Piemonte**: Strategia Regionale per l'idrogeno del Piemonte
2. **Bolzen/Bolzano**: Masterplan Idrogeno – Euregio Tirolo – Alto Adige – Trentino

In most cases, these regional strategies demonstrate political commitment of regional authorities to align with national targets for hydrogen development, without specifying, apart from a few exceptions, regional targets. The table below showcases all registered strategies at national and regional levels and relevant specific targets as they have been identified by project partners.

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Table 3: Regional Hydrogen Strategies and Targets

REGION	REGIONAL HYDROGEN STRATEGY		TARGETS			
		Name	HRS	Transport Arrangements	H2 Production	Other
SLOVENIA						
Eastern Slovenia (SI03) (KSSENA)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
Western Slovenia (SI04) (BSC)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
AUSTRIA						
Burgenland (AT11) (4ER)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
Lower Austria (AT12) (4ER)	NO (Under preparation)	H2NÖ	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
Vienna (AT13)	YES	Hydrogen Strategy of Stadtwerke Wien	Not specified	Not specified	Not specified	*Not applicable*
Carinthia (AT 21) (4ER)	YES	Roadmap : Hydrogen in Carinthia	Not specified	Not specified	60 MW/a electrolyser capacity	50 buses
Styria (AT 22) (4ER)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
Upper Austria (AT31) (COD)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
Salzburg (AT32) (COD)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
Tyrol (AT33) (COD)	YES	a) Wasserstoff-Masterplan Tirol b) H2-Masterplan European Region Tirol-Südtirol-Trentino	11 HRS by 2030 (30 HRS by 2050)	Not specified	Not specified	Not specified
Voralberg (AT34) (COD)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
GERMANY						
Sttutgart (DE11) (KPO)	–	–	–	–	–	–
Karlsruhe (DE12) (KPO)	NO	NO				
Freiburg (D13) (KPO)	YES	Wasserstoff-Roadmap Baden-Württemberg	Unknown	Unknown	Unknown	Mobility sector: 1,7 TWh for 2030 and

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						12,9 TWh in 2050
Oberbayern (D21) (ITALCAM)	YES	a) Hydrogen Roadmap Bavaria b) Bavarian Strategy for Hydrogen	400 HRS	Connexion to the European Hydrogen Backbone (EHB) by 2035.	1000MW electrolysis capacity	First hydrogen-powered train to be pilot-tested in 2024
Niderbayern (D22) (ITALCAM)	YES					
Oberpfalz (D23) (KPO)	YES					
Oberfranken (D24) (KPO)	YES					
Mittelfranken (D25) (KPO)	YES					
Unterfranken (D26) (KPO)	YES					
Schwaben (DE27) (ITALCAM)	YES					
FRANCE						
Franche-Comté FRC2) (EMS)	–	–	–	–	–	–
Alsace (FRF1) (EMS)	YES	Une stratégie HYDROGÈNE pour le Grand Est 2020-2030	30 HRS	5 production units, 90 000 tonnes/year of green hydrogen (equivalent to 600 MW)	Not specified	1200 Fuel Cell Electric Vehicles (FCEVs) 750 bus, 100 barges
Auvergne - Rhône-Alpes (FRK2) (PVF)	YES	Zero Emission Valley for Auvergne Rhône Alpes	20	3	Unknown	1200 of all types of vehicles, 1 hydrogen railroad
Provence-Alpes-Côte d'Azur (FRL0) (PVF)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*
ITALY						
Piemonte (ITC1) (CMT)	YES	Strategia Regionale per l'idrogeno del Piemonte	Align with national targets	Align with national targets	Align with national targets	Align with national targets
Valle d'Aosta (ITC2) (CMT)	–	–	–	–	–	–
Liguria (ITC3) (LR)	–	–	–	–	–	–
Lombardia (ITC4)	NO	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*	*Not applicable*

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(LR)						
Bozen/Bolzano (ITH1) (CMT)	**YES**	Master plan Idrogeno – Euregio, alto Adige, Tirolo	12 HRS	Align with national target	–12 sites 6MW production for each	Targets 2030:–660 H2 Buses and 750,000 heavy journey by H2 tracks
Trento (ITH2) (LR)	–	–	–	–	–	–
Veneto (ITH3) (FLA)	–	–	–	–	–	–
Friuli-Venezia Giulia (ITH4) (FLA)	–	–	–	–	–	–

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Table 4: National Hydrogen Strategies and Targets

COUNTRY	NATIONAL HYDROGEN STRATEGY	TARGETS			
		HRS	Transport Arrangements	H2 Production	Other
Slovenia	Strategy in the field of market development for the establishment of appropriate infrastructure related to alternative fuels in the transport sector in the Republic of Slovenia, 2017	5-9 HRS by 2030	Unknown	Unknown	974 FCEVs by 2025, 5559 by 2030 137 FCETs by 2025, 800 by 2030
Austria	National Hydrogen Strategy	Not defined	Rededication of one line segment each of the West Austria Gas Pipeline (WAG) and the Trans Austria Gas Pipeline (TAG) BY 2030	1 GW electrolysing capacity by 2030	80% of current fossil hydrogen demand to be converted by green hydrogen until 2030
Germany	National Hydrogen Strategy	300 HRS by 2030	There are currently three regional hydrogen networks: a) 240 km in the Ruhr area, b) 150 km in the Central German chemical triangle, c) 30 km in Schleswig-Holstein. No other targets for transport arrangements (e.g., pipelines or other) are specified.	5[3] GW electrolysing capacity by 2030	800.000 FCEVs 1200 buses (FCEBs) 200.000 FCETs (N3/>12t) to run on green hydrogen by 2030. Deutsche Bahn Cargo is currently working on Hydrogen railway transportation systems. Develop and integrate fuel cell technology in regional aviation (hybrid system) Freight water transport: first inland vessel (named ELEKTRA) is currently being tested in Berlin (Brandenburg).
France	The national Hydrogen Strategy has three priorities: a) Decarbonising industry through the emergence of a French electrolysis industry b) Developing heavy-duty mobility with carbon-free hydrogen c)Support research, innovation and skills development in order to the uses of tomorrow	1000 HRS by 2030	There are two interconnexion projects: A Pipeline project to connect France to Spain (from Marseille to Barcelona): the subsea pipeline is expected to transport some two million tonnes of hydrogen per year, equivalent to 10% of Europe's	Unknown	By 2030, France plans to have: a) 300 000 H2 light vehicles b) 5000 H2 heavy vehicles c) 1000 H2 boats d) 250 H2 trains

3 The initially reported price provided by our partner was 2 GW; however, upon further data cleaning and additional desk research, it was corrected to 5 GW.

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	7 million euros will be dedicated to the strategy.		projected consumption at the time of commissioning (by 2030). The other project aims at converting two existing gas pipelines to 100% hydrogen transport, interconnecting Völklingen, Perl (Saarland), Bouzonville and Carling (Moselle). The 70 km network will have a transport capacity of up to 20,000 m^3/h. 1,200 km of pipeline will be planned between Fos-Marseille and the Grand-Est region. Another pipeline will be connecting the Dessenheim area with the Chalampé-Ottmarsheim industrial zone by 2028, as well as Mulhouse for its mobility needs. The pipeline will have the capacity to transport 125,000 metric tons of hydrogen per year, equivalent to the production of 900 MW of electrolysis capacity.		
Italy	a) Preliminary Guidelines for a Hydrogen National Strategy b) National Plan for Recovery and Resilience	40 HRS by 2030	NO	5 GW electrolysing capacity by 2030	4000 FCETs, with a potential further ambition to reach 10.000-14.000 units (Up to 50% of existing diesel railroads to be converted to hydrogen. Another target is for hydrogen to comprise 2% of the overall energy mix.

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3.3 Green hydrogen mobility infrastructure identified in EU Alpine regions

This subsection presents the data gathered by project partners after having mapped their assigned territories, using the Excel repository and the Questionnaire.

HRS:
The first infrastructure component concerns HRS. By looking only at the operational HRS, the deployment of hydrogen mobility infrastructure appears to be extremely limited. However, taking into consideration also the planned HRS, the overall hydrogen landscape demonstrates relatively significant improvement. The table below showcases the distribution of HRS based on the national Alpine share (pertaining to the respective parts of each country within the Alps) and the operational stage (existing and planned).

Table 5: HRS existent and planned in Alpine EU regions

National Alpine Region	HRS	Existent	Planned
Slovenia	4	2	2
Austria	22	8	14
Germany	11	10	1
France	25	7	18
Italy	24	2	22

Hydrogen Production Units:

The second infrastructure component examined in the survey concerned Hydrogen Production Units. Although geographical proximity is not a prerequisite for supplying an HRS, this infrastructure component helps assess the available production capacity within the region. Many of the already operating units are directly linked to an HRS, indicating that hydrogen production is dependent of demand. Nevertheless, the upcoming units currently in the planning phase are anticipated to have a substantially greater production capacity, which will further boost overall supply. The table below illustrates the distribution of Hydrogen Production Units based on the national Alpine share (pertaining to the respective parts of each country within the Alps) and the operational stage (existing and planned).

Table 6: Hydrogen Production Units existent and planned in Alpine EU regions

National Alpine Region	Hydrogen Production Units	Existent	Planned
Slovenia	3	2	1
Austria	17	2	15
Germany	4	2	2
France	21	2	19
Italy	19	6	13

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Hydrogen Transport Arrangements:

The third infrastructure component that was investigated in the survey concerned the preferred hydrogen transportation methods adopted in each national Alpine region. These transport options include connection to the pipeline network, Hydrogen Gas Trailers, and Liquid Hydrogen Tankers, with the latter capable of transporting larger quantities of hydrogen compared to Gas Trailers. The survey revealed that four out of five countries are currently implementing the interconnection of HRS with production plants via pipelines. This represents a crucial milestone in the development of the hydrogen economy, although it still requires additional time for full implementation. Information on the use of Hydrogen Gas Trailers and Liquid Hydrogen Tankers is limited, indicating that either the data was unavailable and could not be collected, or that on-site production sufficiently meets the hydrogen demand, rendering transportation unnecessary. The table provided below showcases the connection to the pipeline grid in the respective parts of each country within the Alps.

Table 6: Connexion to pipeline grid within the Alpine EU regions

National Alpine Region	Existent connexion with Pipelines	Planned	Km
Slovenia	NO	NO	N/A
Austria	YES	YES	131,6 km
Germany	YES	YES	95 km
France	YES	YES	75 km
Italy	YES	YES	Not specified

The three tables below present in detail all the data that the partners managed to collect in the framework of the survey with the help of the two tools (Excel repository and Word Questionnaire), categorized by country and region. In instances where a partner conducted a search but could not locate the required data, it is denoted as 'unknown'. If a partner did not provide any information for an already identified infrastructure component, it is marked as 'not specified'. In cases where a partner did not meet the Key Performance Indicators (KPIs), it is indicated as 'data not provided by partner' or '-'.

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Table 5: HRS existent and planned per country and region

REGION	NAME/ LOCATION	Status	STORAGE CAPACITY (Kg)	REFUELLING CAPACITY	VEHICLES SERVED (BAR)	On TEN-T	If no, how far away from TEN-T	Onsite production	Interface with production
SLOVENIA									
Eastern Slovenia (SI03) (KSSENA)	HRS at the Therma Power Plant, Šoštanj (Savinja region)	**Planned**	**3000**	**8200**	**350 (trucks)**	**NO**	**12,3 km**	**YES**	**NO**
Western Slovenia (SI04) (BSC)	Petrol d.d. Lesce, Gorenjska	**Existent**	**36**	**36 kg**	**350**	**NO**	**47,7km to the South Baltic - Adriatic, 52,8km to Tarvisio - West Baltic - Adriatic**	**NO**	**Via hydrogen gas trailers**
	Salonit Anhovo Anhovo 1, 5210 Deskle, Goriška	**Existent**	**Unknown**	**Unknown**	**350 & 700**	**NO**	**46km to Baltic-Adriatic and Mediterranean**	**YES**	**On-site pipeline system**
	Gorenjske Elektrarne Bleiweisova, Kranj, Gorenjska	**Planned**	**200**	**200 kg**	**700**	**NO**	**On the West to Tarvisio 73,7km, to the South, 30,4km**	**YES**	**NO**
AUSTRIA									
Burgenland (AT11) (4ER)	No existent or planned HRS								
Lower Austria (AT12) (4ER)	SANGroup Herzogenburg	**Existent**	Not specified	**100 kg**	**700 (passenger cars)**	**NO**	**12 km**	**YES**	**NO**
	OMV Wiener Neudorf	**Existent**	Not specified	Not specified	**700 (passenger cars)**	**YES**	**N/A**	**NO**	**Hydrogen Gas trailers**
Vienna (AT13) (4ER)	OMV Shuttleworthstraße 10 1210 Wien	**Existent**	Not specified	Not specified	**700 (passenger cars)**	Not specified	Not specified	Not specified	Not specified
	Stadtwerke Wien Leopoldau	**Existent**	Not specified	Not specified	**350 (urban buses)**	Not specified	Not specified	Not specified	Not specified
	Wien Energie, Wiener Netze, Nussbaumallee 21, 1110 Wien	**Planned**	Not specified	Not specified	**350 (urban buses)**	**NO**	**~15 km**	**YES**	Not specified

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Carinthia (AT 21) (4ER)	OMV Villach (exact location to be defined)	**Planned**	Not specified	Not specified	**350**	**YES**	**N/A**	**NO**	Not specified
	Großglockner	**Planned**	Not specified	Not specified	**700**	**NO**	Not specified	Not specified	Not specified
Styria (AT 22) (4ER)	OMV, Graz	**Existent**	**Unknown**	Not specified	**700 (cars)**	**YES**	**N/A**	**NO**	**Hydrogen Gas trailers**
	HyCentA, Graz	**Existent**	**Unknown**	Not specified	Not specified	**NO**	**3 km**	**YES**	Not specified
Upper Austria (AT31) (COD)	OMV, Marchtrenk	**Planned**	Not specified	Not specified	Not specified	**YES**	**N/A**	**NO**	**Hydrogen Gas trailers (connection with the OMV Refinery at Schwechat**
Salzburg (AT32) (COD)	Gutmann GmbH Thalgau	**Planned**	Not specified	Not specified	**700 (cars)**	**YES**	**N/A**	Not specified	Not specified
Tyrol (AT33) (COD)	OMV Innsbruck	**Existent**	Not specified	Not specified	**700 (cars)**	**YES**	**N/A**	**NO**	**Hydrogen Gas trailers**
	MPreis Völs	**Existent**	Not specified	Not specified	**350 (heavy-duty trucks)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	Zillertalbahn Mayerhofen Zillertal	**Planned**	**500**	*Not specified*	**350 (Trains)**	**NO**	**33 km**	**YES**	**Via pipelines**
	Zillertalbahn Jenbach	**Planned**	**500**	*Not specified*	**350 (Trains)**	**YES**	**N/A**	**NO**	**Hydrogen Gas trailers**
	Telfs	**Planned**	*Not specified*	*Not specified*	*Not specified*	**NO**	*Not specified*	*Not specified*	*Not specified*
	Imst	**Planned**	*Not specified*	*Not specified*	*Not specified*	**NO**	*Not specified*	*Not specified*	*Not specified*
	Reutte	**Planned**	*Not specified*	*Not specified*	*Not specified*	**NO**	*Not specified*	*Not specified*	*Not specified*
	TIWAG, Kufstein	**Planned**	*Not specified*	*Not specified*	*Not specified*	**YES**	**N/A**	**YES**	**Via pipelines**
	Kitzbühel	**Planned**	*Not specified*	*Not specified*	*Not specified*	**NO**	*Not specified*	*Not specified*	*Not specified*
	Landeck	**Planned**	*Not specified*	*Not specified*	*Not specified*	**NO**	*Not specified*	*Not specified*	*Not specified*
	Lienz	**Planned**	*Not specified*	*Not specified*	*Not specified*	**NO**	*Not specified*	*Not specified*	*Not specified*

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Voralberg (AT34) (COD)	No existent or planned HRS								
GERMANY									
Sttutgart (DE11) (KPO)	Shell, Sindelfingen	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	Shell, Wendlingen	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	Stuttgart – Flughafen (airport)	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	TotalEnergies, Fellbach		*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
Karlsruhe (DE12) (KPO)	TotalEnergies Rastatt	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	TotalEnergies Karlsruhe	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	Shell, Pforzheim	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
Freiburg (D13) (KPO)	Geisingen	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	TotalEnergies Freiburg	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	Fraunhofer ISE Freiburg	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	ASF Freiburg	**Planned**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
Tubingen (D14) (KPO)	OMV, Metzingen	**Existent**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
Oberbayern (D21) (ITALCAM)	*DATA NOT PROVIDED BY PARTNER*								
Niderbayern (D22) (ITALCAM)	*DATA NOT PROVIDED BY PARTNER*								
Oberpfalz (D23) (KPO)	*DATA NOT PROVIDED BY PARTNER*								
Oberfranken (D24) (KPO)	*DATA NOT PROVIDED BY PARTNER*								
Mittelfranken (D25) (KPO)	*DATA NOT PROVIDED BY PARTNER*								

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Unterfranken (D26) (KPO)	*DATA NOT PROVIDED BY PARTNER*								
Schwaben (DE27) (ITALCAM)	*DATA NOT PROVIDED BY PARTNER*								
FRANCE									
Franche-Comté FRC2) (EMS)	Mob'Hy (Fahyence) 1 Rue Jean Baptiste Dumaire, 57200 Sarreguemines, France	**Existent**	**N/A**	**25 charges per day 40kg/per day**	**350 (heavy-duty trucks)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	Colruyt Solvay Usine de Tavaux Avenue de la République 39500 TAVAUX	**Existent**	**N/A**	**15 kg per day**	**350 (heavy-duty trucks)**	**YES**	**N/A**	**NO**	**Hydrogen Gas Trailers**
	Pays de Montbéliard Agglomération|Grand Belfort Communauté d'Agglomération Rue de Leupe, 90400 Sevenans, France	**Planned**	**N/A**	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	*Not specified*
	MaHyTec Dole, Bourgogne-Franche-Comté, France	**Planned**	**N/A**	*Not specified*	*Not specified*	*Not specified*	Not specified	**YES**	**Solely on-site production**
	Grand Belfort|Syndicat Mixte des Transports en Commun|Hynamics Danjoutin, France	**Planned**	**N/A**	*Not specified*	*Not specified*	*Not specified*	Not specified	**YES**	**Solely on-site production**
Alsace (FRF1) (EMS)	R-ENR (Filiale de R-GDS) 14 Place des Halles, 67000 Strasbourg, France	**Planned**	**N/A**	*Not specified*	*Not specified*	**YES**	**N/A**	**YES**	**Solely on-site production**
	GRTgaz Haut-Rhin, France	**Planned**	**N/A**	*Not specified*	*Not specified*	*Not specified*	Not specified	Not specified	**N/A**
	Hynamics|Borealis Ottmarsheim, France	**Planned**	**N/A**	*Not specified*	*Not specified*	*Not specified*	Not specified	**YES**	**Solely on-site production**
	Linde France Chalampé, France	**Planned**	**N/A**	*Not specified*	*Not specified*	*Not specified*	Not specified	*Not specified*	

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	ÉS|EDF HYDRO EST|HYNAMICS Strasbourg, France	**Planned**	**N/A**	*Not specified*	*Not specified*	**YES**	**N/A**	**YES**	**Solely on-site production**
Auvergne - Rhône-Alpes (FRK2) (PVF)	GNVERT Saint-Priest: Auvergne-Rhône-Alpes	**Existent**	**200**	**200 kg**	**350 (buses)**	**YES**	**N/A**	**NO**	**Hydrogen trailers (Clermont-Ferrand H2 production)**
	ENGIE Lyon, Auvergne-Rhône-Alpes	**Existent**	**80**	**80 kg**	**700 (cars)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	GNVERT Moûtiers, Auvergne-Rhône-Alpes	**Existent**	**100**	**200 kg**	**700 (cars)**	**YES**	**N/A**	**NO**	**Hydrogen trailers (Clermont-Ferrand H2 production)**
	GNVERT Saint-Egrève, Auvergne-Rhône-Alpes	**Existent**	**200**	**200 kg**	**350 (buses)**	**NO**	**42 km**	**NO**	**Hydrogen trailers (Clermont-Ferrand H2 production)**
	Hympulsion (Région Auvergne-Rhône-Alpes, Michelin, Engie, la Banque des Territoires et le Crédit Agricole) Lyon, Auvergne-Rhône-Alpes	**Planned**	**800**	**400/800**	**700 (cars)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	Hympulsion|Région Auvergne-Rhône-Alpes Lyon, Auvergne-Rhône-Alpes	**Planned**	**N/A**	**1000**	**350 (heavy-duty trucks)**	**YES**	**N/A**	**YES**	**Solely on-site production**
Provence-Alpes-Côte d'Azur (FRL0) (PVF)	ENGIE Le Castellet, Provence-Alpes-Côte d'Azur	**Existent**	**2**	**2 kg**	**700 (cars)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	GREENGT Cavaillon, Provence-Alpes-Côte d'Azur	**Planned**	**45**	**45/15mn**	**350 (heavy-duty trucks)**	**YES**	**N/A**		
	HYNOVAR (Consortium: CCI du Var, ENGIE Cofely, Circuit Paul Ricard, Bateliers de la Côte d'Azur, HySeas)	**Planned**	**N/A**	*Not specified*	**200-350 (vessels)**	**YES**	**N/A**	**YES**	**Solely on-site production**

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	Provence-Alpes-Côte d'Azur, Toulon								
	Akuo Energy – Direction du projet, Développeur, Fournisseur d'énergie renouvelable Marseille, Provence-Alpes-Côte d'Azur	**Planned**	**N/A**	*Not specified*	**350 (heavy-duty trucks)**	**YES**	**N/A**	**NO**	**Hydrogen Gas Trailers**
	Kem One Fos-sur-Mer, Provence-Alpes-Côte d'Azur	**Planned**	**N/A**	**20**	**200-350 (vessels)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	NepTech Aix-en-Provence, Provence-Alpes-Côte d'Azur	**Planned**	**N/A**	*Not specified*	**200-350 (vessels)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	GEOGAZ Lavéra Lavéra, Provence-Alpes-Côte d'Azur	**Planned**	**300**	*Not specified*	**350 and 700 (all vehicles)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	Capenergies (porteur)|Air Liquide (coordinateur), Fos-sur-Mer, Provence-Alpes-Côte d'Azur	**Planned**	**N/A**	**100**	**350 (heavy-duty trucks)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	Hynamics|Communauté d'Agglomération Cannes Pays de Lérins, Cannes, Provence-Alpes-Côte d'Azur	**Planned**	**N/A**	*Not specified*	*Not specified*	**YES**	**N/A**	**YES**	**Solely on-site production**
ITALY									
Piemonte (ITC1) (CMT)	Snam 4 Mobility Arquata Scrivia (Alessandria province – Piedmont)	**Planned**	**Unknown**	**Unknown**	**350 and 700 (heavy-duty trucks and buses)**	**YES**	**Near A7 (Highway)**	**NO**	**Pipelines**
	Snam 4 Mobility Belforte Ovada (Alessandria Province – Piedmont)	**Planned**	**Unknown**	**Unknown**	**)350 and 700 (heavy-duty trucks and buses)**	**YES**	**Near A7 (Highway)**	**NO**	**Pipelines**

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	Snam 4 Mobility Torrazza Piemonte (Metropolitan City of Torino – Piedmont)	**Planned**	**Unknown**	**Unknown**	**350 and 700 (heavy-duty trucks and buses)**	**YES**	**Near A4 (Highway)**	**NO**	**Pipelines**
	Sapio -keropetrol Vicolungo (Province Novara – Piedmont)	**Planned**	**Unknown**	**Unknown**	**350 (heavy-duty trucks)**	**YES**	**Near A4 (Highway)**	**NO**	**Liquid Hydrogen Tankers**
	Milano -Serravalle Tortona (Alessandria Province – Piedmont)	**Planned**	**Unknown**	**Unknown**	**350 (heavy-duty trucks)**	**YES**	**Near A7 (Highway)**	**NO**	**Liquid Hydrogen Tankers**
Valle d'Aosta (ITC2) (CMT)	***Sol Spa, Pollen***	**Planned**	**N/A**	**N/A**	**350 and 700 (heavy-duty trucks and buses)**	**No**	**> 100 Km Near A5(Higway)**	**N/A**	**N/A**
Liguria (ITC3) (LR)	*DATA NOT PROVIDED BY PARTNER*								
Lombardia (ITC4) (LR)	ATM Milano Milano (MI)	**Existent**	**35**	**200**	**350 (buses)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	Milano Serravalle-Milano Tangenziali A51 Carugate Est	**Planned**	**333 at 500 bars 115 at 900 bars + trailers**		**350 and 700 (all vehicles)**	**YES**	**N/A**	**NO**	**Hydrogen Gas Trailers**
	Milano Serravalle-Milano Tangenziali A51 Carugate Ovest	**Planned**	**333 at 500 bars 115 at 900 bars + trailers**		**350 and 700 (all vehicles)**	**YES**	**N/A**	**NO**	**Hydrogen Gas Trailers**
	Sapio srl - Keropetrol Spa Mantova (MN)	**Planned**	**1440 kg at 500 bars and 340 kg at 900 bars**	**1000**	**350 and 700 (heavy-duty trucks and buses)**	**NO**	**3,4**	**NO**	**Pipelines**
	ENI Spa Mobility San Donato Milanese (MI)	**Planned**	Not specified	Not specified	**Not specified**	**Not specified**	**Not specified**	**Not specified**	**Not specified**
	Snam 4 Mobility Spa Torre d'Isola (PV)	**Planned**	Not specified	**Not specified**	**Not specified**	**Not specified**	Not specified	**Not specified**	**Not specified**
	Milano Serravalle-Milano Tangenziali A50 Rho Ovest	**Planned**	**333 at 500 bars 115 at 900 bars + trailers**	**Not specified**	**350 and 700 (all vehicles)**	**YES**	**N/A**	**NO**	**Hydrogen Gas Trailers**
	Ferrovienord	**Planned**	Not specified	**1800**	**350**	**NO**	**Not specified**	**YES**	**Hydrogen Gas**

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	Brescia (Borgo San Giovanni)				**(trains)**				**Trailers**
	Ferrovienord Edolo	**Planned**	Not specified	**1644**	**350 (trains and buses)**	**NO**	**100**	**YES**	**Hydrogen Gas Trailers**
	SEA Aeroporto Milano Malpensa, Ferno (VA)	**Planned**	200	**400**	**350 (buses)**	**YES**	**N/A**	**YES**	**Solely on-site production**
	Ferrovienord Iseo	**Planned**	Not specified	Not specified	**350 (trains and buses)**	**NO**	**30**	**YES**	**Hydrogen Gas Trailers**
Bozen/Bolzano (ITH1) (CMT)	*Autostrada del Brennero (A22) Vipiteno*	**Planned**	**N/A**	**N/A**	**350 and 700 (heavy-duty trucks and buses)**	**YES**	**< 1km to A22 (Highway)**	**YES**	**Solely on-site production**
	Alperia green power Brunico	**Planned**	**N/A**	**N/A**	**350 and 700 (heavy-duty trucks and buses)**	**NO**	**32 km toA22 (Highway)**	**YES**	**Solely on-site production**
	Sasa, Merano	**Planned**	**N/A**	**N/A**	**350 (buses)**	**NO**	**HRS is in Bus Depot**	**YES**	**Solely on-site production**
	Sasa , Bolzano	**Planned**	**N/A**	**N/A**	**350 (buses)**	**NO**	**HRS is in Bus Depot**	**YES**	**Solely on-site production**
	Sasa , Brunico	**Existent**	**N/A**	**N/A**	**350 and 700 (heavy-duty trucks and buses)**	**NO**	**HRS is in Bus Depot**	**yes**	**Solely on-site production**
	IIT, Bolzano	**Existent**	**N/A**	**N/A**	**350 (buses)**	**YES**	**< 1km to A22 (Highway)**	**YES**	**Solely on-site production**
	IIT, Bolzano	**Planned**	**2000 at 500 bars and 300 at 900 bars**	**N/A**	**350 and 700 (heavy-duty trucks and buses)**	**YES**	**< 1km to A22 (Highway)**	**YES**	**Solely on-site production**
Trento (ITH2) (LR)	*DATA NOT PROVIDED BY PARTNER*								
Veneto (ITH3) (FLA)	*DATA NOT PROVIDED BY PARTNER*								
Friuli-Venezia Giulia (ITH4) (FLA)	*DATA NOT PROVIDED BY PARTNER*								

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Table 6: Hydrogen Production Units existent and planned per country and region

REGION	NAME/ LOCATION	Status	Type of Hydrogen	Production Capacity (kg/day)	Storage Capacity (kg)	Uses of hydrogen (e.g. Mobility, Other)	Connection to pipeline grid	Connexion to HRS
SLOVENIA								
Eastern Slovenia (SI03) (KSSENA)	Thermal Power Plant Šoštanj Šoštanj (Savinja region - SI034)	**Existent**	**Black/Brown**	**32**	**48**	**Other industries**	**NO**	**NO**
	Thermal Power Plant Šoštanj Šoštanj (Savinja region - SI034)	**Planned**	**Green**	**8200**	**30.000**	**Mobility sector**	**NO**	**YES**
Western Slovenia (SI04) (BSC)	Salonit Anhovo Anhovo 1, 5210 Deskle, Goriška	**Existent**	**Green**	**unknown**	**unknown**	**Mobility sector and other industries**	**NO**	**YES**
	Petar Petrič barracks Bleiweisova, Kranj, Gorenjska	**Existent**	**Green**	**8kg/h=192kg/day; max capacity 16-20T/per year**	**storage 600kg/ for 3 days**	**Mobility sector and other industries**	**NO**	**YES**
AUSTRIA								
Burgenland (AT11) (4ER)	PanHy, Zurndorf	**Planned**	**Green**	**60 MW**	**unknown**	**Other industries**	**YES**	**NO**
Lower Austria (AT12) (4ER)	SAN Group, Herzogenburg	**Existent**	**Green**	**100**	*Not specified*	**Mobility Sector**	**NO**	**YES**
	OMV OMV Refinery Schwechat	**Planned**	**Green**	**10 MW-PEM Electoliser**	*Not specified*	**Other industries**	**NO**	**NO**
Vienna (AT13)	Wien Energie, Vienna Simmering	**Planned**	**Green**	**1300**	*Not specified*	**Mobility sector**	**NO**	**YES**
Carinthia (AT 21) (4ER)	Infineon, Villach	**Planned**	**Green**	**500**	*Not specified*	**Mobility sector**	**NO**	**YES**
	Biopure GmbH, Launsdorf	**Planned**	**Green**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	*Not specified*
	Wörthersee Schiffahrt, Klagenfurt	**Planned**	**Green**	*Not specified*	*Not specified*	**Mobility sector**	*Not specified*	*Not specified*
	Verbund AG, Rosegg/St. Jakob	**Planned**	**Green**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	*Not specified*
	Operation of a H2 mini-bus Municipality St. Stefan/Gailtal	**Planned**	**Green**	*Not specified*	*Not specified*	**Mobility sector**	*Not specified*	*Not specified*
	H2 Beer Micheldorf	**Planned**	**Green**	*Not specified*	*Not specified*	**Other industries**	*Not specified*	*Not specified*
Styria (AT 22) (4ER)	Project "Hotflex" Mellach	**Existent**	**Green**	**86 kg/day - SOFC Electrolyser with a**	**Unknown**	**Other industries**	**YES**	**NO**

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				max capacity of 150 kW				
	Gabersdorf, Gabersdorf [4]	**Planned**	**Green**	**450**	**Unknown**	**Mobility sector**	**NO**	**NO**
Upper Austria (AT31) (COD)	No existent or planned Hydrogen Production Units							
Salzburg (AT32) (COD)	H2-Hub Salzburg Salzburg City	**Planned**	**Green**	*Not specified*	*Not specified*	**Mobility sector**	**NO**	*Not specified*
Tyrol (AT33) (COD)	Mpreis, Völs	**Planned**	**Green**	**1300**	**700**	**Mobility sector**	**NO**	**YES**
	Power2X Kufstein, Kufstein	**Planned**	**Green**	**2250**	*Not specified*	**Other industries**	**YES**	**YES**
	Zillertalbahn, Mayrhofen	**Planned**	**Green**	**1400**	**500**	**Mobility sector**	**NO**	**YES**
	Plansee, Breitenwang	**Planned**	**Green**	**1600**	*Not specified*	**Other industries**	**NO**	**NO**
Voralberg (AT34) (COD)	No existent or planned Hydrogen Production Units							
GERMANY								
Sttutgart (DE11) (KPO)	No existent or planned Hydrogen Production Units							
Karlsruhe (DE12) (KPO)	No existent or planned Hydrogen Production Units							
Freiburg (D13) (KPO)	Reallabor H2- Wyhlen, Wyhlen	**Existent**	**Green**	**400**	*Not specified*	*Not specified*	**NO**	**NO**
	Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW), Wyhlen	**Existent**	**Green**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	*Not specified*
	Albbruck, Albbruck	**Planned**	**Green**	**8000**	*Not specified*	**Mobility sector**	**YES**	**YES**
	Mülldeponie Eichelbuck, Freiburg	**Planned**	**Green**	*Not specified*	**2000-3000**	**Mobility sector**	**NO**	*Not specified*
Oberbayern (D21) (ITALCAM)	*DATA NOT PROVIDED BY PARTNER*							
Niderbayern (D22) (ITALCAM)	*DATA NOT PROVIDED BY PARTNER*							
Oberpfalz (D23) (KPO)	*DATA NOT PROVIDED BY PARTNER*							
Oberfranken (D24) (KPO)	*DATA NOT PROVIDED BY PARTNER*							

4 Trailer filling station (in which the compressed hydrogen is filled and transported to customers in industry and the project move2zero (hydrogen buses in Graz))

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Mittelfranken (D25) (KPO)	*DATA NOT PROVIDED BY PARTNER*							
Unterfranken (D26) (KPO)	*DATA NOT PROVIDED BY PARTNER*							
Schwaben (DE27) (ITALCAM)	*DATA NOT PROVIDED BY PARTNER*							
FRANCE								
Franche-Comté FRC2) (EMS)	No existent or planned Hydrogen Production Units							
Alsace (FRF1) (EMS)	No existent or planned Hydrogen Production Units							
Auvergne - Rhône-Alpes (FRK2) (PVF)	Air Liquide, Grenoble: Auvergne-Rhône-Alpes	**Existent**	**Green**	**40 kg**	**700 kg**	**Mobility sector**	**NO**	**YES**
	GNVert, Chambéry: Auvergne-Rhône-Alpes	**Existent**	**Green**	**40 kg**	**700 kg**	**Mobility sector**	**NO**	**YES**
	CNR Lyon, Auvergne-Rhône-Alpes	**Planned**	**Green**	**700 kg**	*Not specified*	**Mobility sector**	**NO**	*Not specified*
	Storengy Étrez, Auvergne-Rhône-Alpes	**Planned**	**Green**	**400 kg**	**44.000 kg**	**Mobility sector**	**NO**	*Not specified*
	Ugitech Ugine, Auvergne-Rhône-Alpes	**Planned**	**Green**	**500 kg**	*Not specified*	*Not specified*	**NO**	*Not specified*
	Thevenin & Ducrot Chamboeuf, Auvergne-Rhône-Alpes	**Planned**	**Green**	**720 kg**	*Not specified*	*Not specified*	**NO**	**NO**
	Compagnie Nationale du Rhône Saint-Fons, Auvergne-Rhône-Alpes	**Planned**	**Green**	*Not specified*	*Not specified*	**Mobility sector**	**NO**	*Not specified*
	Hynamics|Domo Chemicals Saint-Fons, Auvergne-Rhône-Alpes	**Planned**	**Green**	**30.000kg**	*Not specified*	*Not specified*	**NO**	*Not specified*
	Sitom Nord-Isère Bourgoin-Jallieu, Auvergne-Rhône-Alpes	*Not specified*	**Green**	*Not specified*	*Not specified*	*Not specified*	**NO**	*Not specified*
	Ville de Chateauneuf Chateauneuf, Auvergne-Rhône-Alpes	*Not specified*	**Green**	*Not specified*	*Not specified*	**Other industries**	**NO**	*Not specified*
	Hympulsion (Région Auvergne-	*Not*	**Green**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	*Not specified*

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	Rhône-Alpes, Michelin, Engie, la Banque des Territoires et le Crédit Agricole) Lyon, Auvergne-Rhône-Alpes	*specified*						
Provence-Alpes-Côte d'Azur (FRL0) (PVF)	Capenergies (porteur) | Air Liquide (coordinateur) Fos-sur-Mer, Provence-Alpes-Côte d'azur	**Planned**	**Green**	*Not specified*	*Not specified*	*Not specified*	*Not specified*	*Not specified*
	Durance Lubéron Verdon Agglomération (DLVA)|Engie|Storengy|Air Liquide, Manosque, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**27.000**	*Not specified*	**Mobility sector**	**NO**	**NO**
	GRTgaz, Fos-sur-Mer, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**17 / h**	*Not specified*	**Other industries**	**NO**	*Not specified*
	ENGIE|Total Châteauneuf-les-Martigues, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**13**	*Not specified*	**Mobility sector**	**NO**	*Not specified*
	GazelEnergie Meyreuil, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**400.000**	*Not specified*	**Other industries**	**NO**	*Not specified*
	Hynamics|Communauté d'Agglomération Cannes Pays de Lérins, Cannes, Provence-Alpes-Côte d'azur	**Planned**	**Planned**	**1600**	*Not specified*	**Mobility sector**	**NO**	*Not specified*
	H2V Industry, Fos-sur-Mer, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**200K**	*Not specified*	**Other industries**	**NO**	*Not specified*
	Hynamics, Gardanne, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**400**	*Not specified*	**Mobility sector**	**NO**	*Not specified*
	Hynamics, Nice, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**800**	*Not specified*	**Mobility sector**	**NO**	*Not specified*
	PLENESYS Valbonne, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**~140**	*Not specified*	**Mobility sector**	**NO**	*Not specified*
	Verso Energy Miramas, Provence-Alpes-Côte d'azur	**Planned**	**Green**	*Not specified*	*Not specified*	**Mobility sector**	**NO**	*Not specified*

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	Hynoé|Les Sorgues du Comtat Monteux, Provence-Alpes-Côte d'azur	**Planned**	**Green**	**400**	*Not specified*	**Other industries**	**NO**	*Not specified*
	Akuo Energy – Direction du projet, Développeur, Fournisseur d'énergie renouvelable Marseille, Provence-Alpes-Côte d'azur	**Planned**	**Green**	*Not specified*	**400/800**	**Mobility sector**	**NO**	**NO**
ITALY								
Piemonte (ITC1) (CMT)	RF -Idra, Gattinara (vercelli province – Piedmont)	**Planned**	**Green**	**Unknown**	**Unknown**	**Other industries**	**YES**	**NO**
	Sarpom an Martino di trecate (Novara -Piedmont)	**Planned**	**Green**	**Unknown**	**Unknown**	**Mobility sector**	**NO**	**NO**
	FILMS spa Premosello Chiovenda	**Planned**	**Green**	**Unknown**	**Unknown**	**Other industries**	*Not specified*	**NO**
Valle d'Aosta (ITC2) (CMT)	*Cogne acciai speciali*	**Planned**	Green	**Unknown**	**Unknown**	**Other Industries**	**Unknown**	**NO**
	Compagnia Valdostana delle acque	**Planned**	Green	**Unknown**	**Unknown**	**Other Industries**	**Unknown**	**NO**
Liguria (ITC3) (LR)	*DATA NOT PROVIDED BY PARTNER*							
Lombardia (ITC4) (LR)	SAPIO PRODUZIONE IDROGENO OSSIGENO S.r.l. Caponago (MB)	**Existent**	*Not specified*	*Not specified*	**1.600.000**	**Mobility sector and other industries**	**NO**	**NO**
	AIR LIQUIDE ITALIA PRODUZIONE srl, Ferrera Erbognone (PV)	**Existent**	*Not specified*	*Not specified*	**4.000.000**	**Other industries**	*Not specified*	*Not specified*
	SIAD SpA, Osio Sopra (BG)	**Existent**	*Not specified*	*Not specified*	**5.660.000**	**Other industries**	*Not specified*	*Not specified*
	Eni Spa Sannazzaro de' Burgondi (PV)	**Existent**	*Not specified*	*Not specified*	**20.000.000**	**Other industries**	*Not specified*	*Not specified*
	SAPIO PRODUZIONE IDROGENO OSSIGENO S.r.l. Mantova (MN)	**Existent**	**Blue**	**3.200**	**9.500**	**Mobility sector and other industries**	**YES**	**YES**
	H2Iseo Edolo production Edolo (BS)	**Planned**	**Green**	**2285**	**1425**	**Mobility sector**	**NO**	**YES**
	H2Iseo Brescia production Brescia (BS)	**Planned**	**Green**	**2285**	**4237**	**Mobility sector**	**NO**	**YES**
	Sapio impianto Mantova Mantova (MN)	**Planned**	**Green**	**1.500.000**	**5000**	**Mobility sector and other industries**	**YES**	**YES**
	Rafmetal	**Planned**	**Green**	**83.000**	**0**	**Other industries**	**YES**	**NO**

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	Mura (BS)							
	Lucchini Spa Verolanuova (BS)	**Planned**	**Green**	**77.000**	**500**	**Mobility sector**	**NO**	**NO**
	OLGA (EU project) Aeroporto Milano Malpensa, Ferno (VA)	**Planned**	**Green**	**400**	**0**	**Mobility sector**	**NO**	**YES**
	H2Iseo Iseo production Iseo (BS)	**Planned**	**Green**	**1.142**	**2998**	**Mobility sector**	**NO**	**YES**
Bozen/Bolzano (ITH1) (CMT)	*Itt, Bolzano/Bolzen*	**Existent**	**Green**	**400**	**Unknown**	**Mobility sector**	**NO**	**YES**
	Itt, Bolzano/Bolzen	**Planned**	**Green**	**5000**	**2000/500bar - 300/900bar**	**Mobility sector**	**NO**	**YES**
Trento (ITH2) (LR)	*DATA NOT PROVIDED BY PARTNER*							
Veneto (ITH3) (FLA)	*DATA NOT PROVIDED BY PARTNER*							
Friuli-Venezia Giulia (ITH4) (FLA)	*DATA NOT PROVIDED BY PARTNER*							

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Table 7: Hydrogen Transport Arrangements existent and planned per country and region

REGION	PIPELINES		Hydrogen Gas Trailers		Liquid Hydrogen Tankers	
	Existent	Planned	Existent	Planned	Existent	Planned
SLOVENIA						
Eastern Slovenia (SI03) (KSSENA)	NO	NO	NO	NO	NO	NO
Western Slovenia (SI04) (BSC)	NO	NO	NO	Unknown	NO	NO
AUSTRIA						
Burgenland (AT11) (4ER)	NO	YES (24,4 km)	NO	NO	NO	NO
Lower Austria (AT12) (4ER)	NO	YES (32, 2 km)	*Not specified*	*Not specified*	*Not specified*	*Not specified*
Vienna (AT13)	NO	NO	NO	YES	NO	NO
Carinthia (AT 21) (4ER)	NO	NO	*Not specified*	*Not specified*	*Not specified*	*Not specified*
Styria (AT 22) (4ER)	NO	YES (75 km)	*Not specified*	YES	*Not specified*	*Not specified*
Upper Austria (AT31) (COD)	NO	*Not specified*	*Not specified*	*Not specified*	*Not specified*	*Not specified*
Salzburg (AT32) (COD)	NO	NO	*Not specified*	*Not specified*	*Not specified*	*Not specified*
Tyrol (AT33) (COD)	NO	NO	*Not specified*	*Not specified*	*Not specified*	*Not specified*
Voralberg (AT34) (COD)	NO	NO	*Not specified*	*Not specified*	*Not specified*	*Not specified*
GERMANY						
Sttutgart (DE11) (KPO)	NO	NO	*Not specified*	*Not specified*	*Not specified*	*Not specified*
Karlsruhe (DE12) (KPO)	NO	NO	*Not specified*	*Not specified*	*Not specified*	*Not specified*
Freiburg (D13) (KPO)	NO	YES (15 km and ~80 km)	NO	YES	NO	NO
Oberbayern (D21) (ITALCAM)	YES	YES	YES	YES	NO	NO
Niderbayern (D22) (ITALCAM)	YES	YES	–	–	NO	NO
Oberpfalz (D23) (KPO)	–	–	–	–	–	–
Oberfranken (D24) (KPO)	–	–	–	–	–	–
Mittelfranken (D25) (KPO)	–	–	–	–	–	–
Unterfranken (D26) (KPO)	–	–	–	–	–	–
Schwaben (DE27) (ITALCAM)	–	–	–	–	–	–
FRANCE						
Franche-Comté FRC2) (EMS)	*Not specified*	*Not specified*	*Not specified*	*Not specified*	*Not specified*	*Not specified*

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Alsace (FRF1) (EMS)	YES (45km)	YES (30 km)	NO	NO	NO	NO
Auvergne - Rhône-Alpes (FRK2) (PVF)	NO	NO	YES	NO	YES	NO
Provence-Alpes-Côte d'Azur (FRL0) (PVF)	NO	YES	YES	NO	YES	NO
ITALY						
Piemonte (ITC1) (CMT)	NO	YES	NO	NO	*Not specified*	YES
Valle d'Aosta (ITC2) (CMT)	–	–	–	–	–	–
Liguria (ITC3) (LR)	–	–	–	–	–	–
Lombardia (ITC4) (LR)	NO	NO	*Not specified*	*Not specified*	*Not specified*	*Not specified*
Bozen/Bolzano (ITH1) (CMT)	–	–	–	–	–	–
Trento (ITH2) (LR)	–	–	–	–	–	–
Veneto (ITH3) (FLA)	–	–	–	–	–	–
Friuli-Venezia Giulia (ITH4) (FLA)	–	–	–	–	–	–

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4. DISCUSSION

This section discusses the findings of the survey presented in the previous section, categorised by country, and offers policy recommendations to achieve green hydrogen's widespread transnational adoption, based on the findings of the survey.

4.1 Key findings

The survey carried out across the five EU countries within the Alpine region has yielded significant insights into the integration of green hydrogen in the mobility sector. The following section presents the key findings specific to each country.

SLOVENIA:

Slovenia exhibits the least developed hydrogen infrastructure. The existing plants (4 in total, as recorded by the partner) are either remnants of older pilot projects or are still in the planning stages, lacking full operational capacity at present. Furthermore, the hydrogen refuelling capacity and the number of cars served by these plants are either unspecified or exceedingly low (36kg). It is noteworthy that none of the stations are located on the TEN-T network, with the nearest station situated 12.3 km away and the furthest 73.7 km away. Another significant observation is that these stations rely on on-site production, with only one station having plans for connection to hydrogen production plants via pipelines.

Moreover, three hydrogen production plants have been identified in Slovenia. Among them, one plant currently produces black/brown hydrogen primarily for industrial activities but intends to transition to green hydrogen production and supply it to the mobility sector. Considering Slovenia's national target of having 974 Fuel Cell Electric Vehicles (FCEVs) on the roads by 2025, and 5559 FCEVs by 2030, which entails a nearly sixfold increase in the demand for green hydrogen, it becomes evident that Slovenia has substantial infrastructure gaps to address.

AUSTRIA:

The Alpine regions of Austria count 22 HRS (8 existing and 14 planned), 11 of which are located in Tyrol (2 existing and 9 still in planning stage or under construction). However, the collected data on hydrogen storage capacity at these stations remains incomplete, with the highest storage capacity recorded at 100 kg. Regarding their geographical location, data have been provided for 4 of the identified stations, and these are situated outside the TEN-T network, albeit within a short distance ranging from 3 to 33 km. Notably, Hydrogen Gas

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Trailers appear to be the preferred mode of transport for interconnecting the HRS with the production units, while 5 out of the 22 identified HRS have or will have on-site production. Among the planned HRS, two stations have been designated to support hydrogen trains, namely the Zillertalbahn, with one station supplying hydrogen through the pipeline network and the other utilizing Hydrogen Gas Trailers for refueling.

Furthermore, a total of 17 HRS have been recorded in the area (2 existing and 15 planned). 4 of these plants are located in Tyrol and 6 in Carinthia. The electrolyser capacities of these plants range from 86 kg to 2250 kg per day. The development of the hydrogen economy in Alpine Austria appears to be well-established, with numerous infrastructure projects already in the planning or construction stages. However, the absence of specific national targets hinders a comprehensive and concise assessment of the existing gaps in the region.

GERMANY:

A total of 13 hydrogen refueling stations (HRS) have been identified in Alpine Germany, specifically in the regions of Stuttgart, Karlsruhe, Freiburg, and Tübingen. Except for Tübingen, which has only one station, all other regions have three or more stations. Unfortunately, no data on HRS in Bavaria was provided. However, **additional desk research** revealed the existence of 18 stations and an additional six stations under construction in all regions of Bavaria. This brings the total number of HRS to 37, the highest concentration among Alpine regions in European countries.

Within the Freiburg region, there are four registered hydrogen production units, two of which are already operational and two in the planning phase. The production unit located in the Albbruck region will have a notable capacity of 8000 kg. Unfortunately, there is no available information on the transportation and distribution arrangements between the production units and the HRS.

Based on the provided data, it seems that Germany is at the forefront of hydrogen propulsion, encompassing various types of heavy and long-distance transportation, including heavy-duty trucks, cars, buses, and trains. Considering the ambitious targets and the current state of the infrastructure, the infrastructure gap in the German Alps appears manageable, and bridging it seems easily achievable.

FRANCE:

France trails behind Germany in terms of hydrogen infrastructure, with a total of 25 identified HRS spread across the four Alpine regions. However, France presents a novelty by envisioning two stations specifically designed to refuel fuel cell vessels in Provences-Alpes-Côte d'Azur. In most cases, HRS in Alpine France rely entirely on on-site hydrogen production. In terms of hydrogen production, 25 hydrogen production units have been

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identified in the 4 investigated regions (2 already in operation, 20 in the planning stage and 3 whose phase remains unclear). The existing units have a relatively low production capacity, reaching up to 40 kg. However, the planned units are expected to have a significantly higher production capacity, ranging in the tens of thousands of kilograms, with the Meyreuil unit in Provences-Alpes-Côte d'Azur capable of producing up to 4 tonnes of hydrogen. France's hydrogen strategy is expected to be updated within 2023. The first version of its hydrogen strategy, released in 2020, targeted 6,5 GW by of electrolysis capacity by 2030. At the time of its publication, this was the largest initial pledge from a member state, well above the 2 GW target by Germany. Data collected by partners during their survey raises concerns regarding France's capacity to achieve these ambitious targets, especially considering that most of the hydrogen infrastructure in the Alpine regions is still in the planning stage. Nevertheless, the anticipated increase in hydrogen supply throughout France is also bound to accelerate the expansion of HRS in the years to come.

ITALY:

The available data collected from the Alpine regions of Italy is limited to four regions, namely Piemonte, Lombardy, Bolzen Province and Valle d'Aosta. In total 24 HRS have been recorded by partners. Notably, Lombardy and Bolzen province are the sole regions where are two operational HRS for urban buses is reported.

The remaining 22 registered stations within these two mapped regions are currently in the planning stage. Moreover, it is worth noting that a connection of hydrogen production to the pipeline network is already in place.

The national Hydrogen strategy of Italy has a highly ambitious target for electrolyser capacity (5GW by 2030) while foreseeing the construction of only 40 HRS. The target for HRS seems thus relatively low, also considering the country's aspiration to have 4000 FCEVs circulating on the roads by 2030. Overall, it seems that it would be challenging for Italy to bridge existing gaps and achieve its ambitious targets, given the limited progress in HRS deployment and the significant disparity between the anticipated demand for FCEVs and the planned number of HRS.

4.2 Recommendations

Based on the above-mentioned findings the following recommendation have been developed.

1. Set precise quantitative targets for hydrogen

The survey on regional hydrogen strategies in the partner territories showed that while political commitment to promote the hydrogen economy and the will to adopt relevant measures are declared, concrete quantifiable targets are rather missing. Setting precise

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quantitative targets for hydrogen mobility at national and regional level is essential to formulate, implement and evaluate hydrogen strategies, and assist policy making at lower administrational levels (i.e., local public authorities).

2. ***Improve strategic infrastructure planning to ensure optimal distribution of HRS on the TEN-T network***

Survey findings indicate that existing hydrogen stations are not evenly distributed across the TEN-T Network. It is imperative to engage in strategic infrastructure planning to ensure improved distribution of new HRS along major transportation corridors and urban centers in the Alps, facilitating widespread access to hydrogen for both FCEVs and FCETs. In this context, employing planning tools (as the one developed in H2MA) can be highly beneficial for the responsible authorities and support the design of the territorial HRS networks.

3. ***Foster transalpine collaborative partnerships***

Hydrogen mobility in the Alps presents unique geographical challenges that should be addressed through transalpine cooperation. Survey results already showed that hydrogen development in the Alps is progressing at different speeds. Continuous transalpine, transnational cooperation through knowledge sharing, exchange of expertise and transboundary initiatives would allow territorial actors to overcome barriers in the proliferation of hydrogen infrastructure and lead to better coordination and more efficient infrastructure planning.

4. ***Develop harmonised policies and standards***

Building upon the previous recommendation, cooperation should also focus on the development of harmonized policies, regulations, and standards across borders. This would promote consistency, reduce barriers, and create a favorable environment for businesses (e.g., transalpine logistics). Moreover, the development of common standards, especially for safety would enhance social acceptance among stakeholders and would also enable the development of interoperability protocols that would pave the way for the construction of multi-stations serving cars, trucks, trains, and vessels.

5. ***Promote coordinated fleet conversions***

Regarding end-users of hydrogen mobility, particularly in long-haul heavy-duty freight, a significant advancement would involve the systematic conversion of fleets, including trucks and city buses. Several cities within the Alpine space have already begun integrating hydrogen city buses into their urban transportation systems, and this positive trend should

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be sustained. Simultaneously, there should be an emphasis on transitioning private truck fleets, specifically within the transport sector. This can be accomplished by incentivizing fleet replacement and establishing green criteria in public tenders for transport and mobility initiatives. Such measures would encourage the adoption of hydrogen-powered vehicles and promote the broader integration of hydrogen mobility across different sectors, contributing to a more sustainable transportation landscape.

6. Prioritise the development of a hydrogen pipeline network

Finally, emphasis should be given to the development of a pipeline network for hydrogen distribution (primarily through the repurposing of the natural gas pipelines), eliminating the need for frequent refuelling of HRS and reducing transportation costs. Such a step would allow the transportation of large quantities of hydrogen over long distances, ensuring a steady and consistent supply to HRS and end-users, even in regions where hydrogen production remains limited. Moreover, it would help address the challenge of limited storage options associated with hydrogen in regions with high demand. A transalpine pipeline network will provide scalability and further growth of hydrogen mobility, allowing Alpine regions to meet their ambitious targets.

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