Interreg Alpine Space

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Co-funded by the European Union

H2MA

H2MA - Green Hydrogen Mobility for Alpine Region Transportation

Training package on green H2 mobility planning
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CODOGNOTTO

H2MA project in pills

WHAT: H2MA project aims to coordinate and accelerate the transnational roll-out of green hydrogen infrastructure for transport and mobility in the Alpine region.

HOW: Through the joint development of cooperation mechanisms, strategies, tools, and resources.

WHO: 11 partners from all 5 Interreg Alpine Space EU countries (SI, IT, DE, FR, AT).

WHEN: from 11.2022 to 10.2025

WHY: to increase the capacities of territorial public authorities and stakeholders to overcome existing barriers and collaboratively plan and pilot test transalpine zero-emission H2 routes.

MAIN FOCUS: create **policy** and **strategies** in order to accelerate the deployment of H2 routes.

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Introduction

Mobility is an essential factor for the economic and social growth of the Alpine Space.
The transport sector contributes 5% to the European GDP and employs 10 million workers.
On the other hand, Greenhouse gas emissions have increased over the time → they account for as much as a **quarter** of the EU's total emissions.

For these reasons, the EC has set a strong regulation framework: **the Green Deal**→ 90% reductions of GHG emission by 2050.
Linked with that regulation the EC has adopted the **Sustainable and Smart Mobility Strategy**, that stated:

By 2030:
- At least 30 million zero-emission vehicles will be in circulation.
- 100 European cities will achieve climate neutrality.
- Doubling of High-speed rail traffic capacity.
- All scheduled collective journeys under 500 km should be carbon-neutral within the EU.
- Automated mobility will be widely adopted.
- Zero-emission ships will be market-ready.

By 2035:
- Large-scale zero-emission aircraft will be market-ready.

Furthermore by 2050:
- Nearly all new cars, vans, buses, and heavy vehicles will be zero-emission.
- Rail freight traffic will double.
- High-speed rail traffic will triple.

Premise

Since the EC has set such ambitious targets, **Green Hydrogen** can be seen as a major solution for the future of mobility.

An advantage of hydrogen is its versatility across different propulsion technologies. It can be used to generate electrical power (via fuel cell technology) or directly used as fuel for internal combustion engines. Furthermore, its transport is not as complex, and it can benefit of existing natural gas distribution networks.

The challenge of production cost and the substantial amount of energy required for electrolysis remains topics to be addressed, with a strong needs in finding innovative solutions to increase performances and investment costs.

…Many other challenges still need to be addressed and solved…

The Context

Given the role of primary importance of Local Public Authorities and Policy Makers, the H2MA project aims to support such actors in their Strategic planning process.

To this end, amplifying the macro-regional impact of currently siloed initiatives and starting from the experience gained from the Sustainable Urban Mobility plans for people transport and goods, the tool has been developed considering the needs of the end user and the ELTIS Guidelines, used for mobility planning.

The H2MA planning tool - Scope

H2MA Planning Tool is a computer tool to support decision-makers involved in design of local strategy for hydrogen mobility development, to contribute to the creation of Hydrogen Routes within the Alpine Space Region.

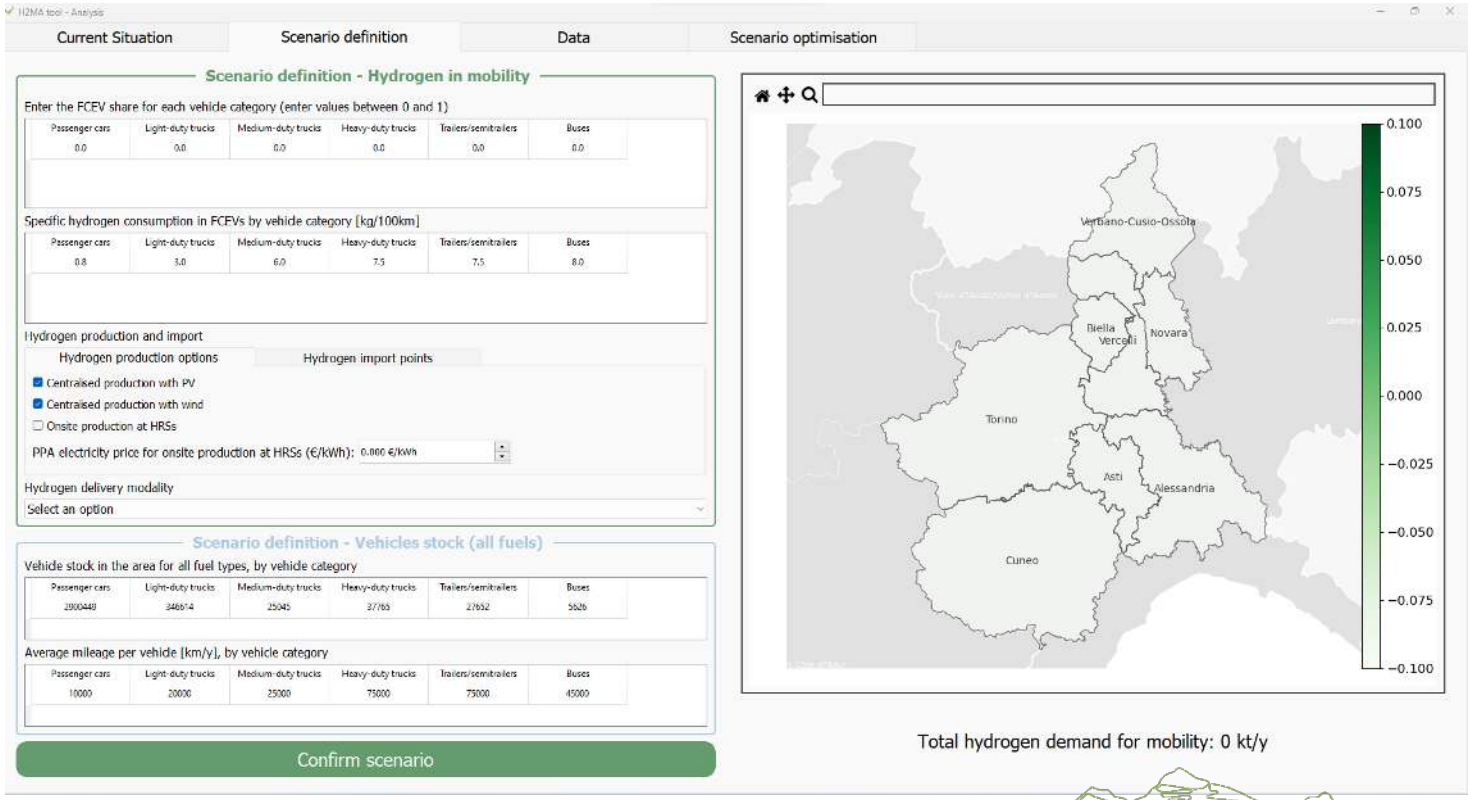
Scope: enable the identification of the optimal H2 infrastructure for mobility.

- It provides a numerical tool for the visualisation and computation of data regarding the hydrogen infrastructure in the regions of the Alpine space.
- It allow data and information to be uploaded and returned in graphical form through a development of a multilayer geographic portal based on the utilization of a GIS (Geographic Information System).
- It suggest sites having good potential for green hydrogen production and the construction of Hydrogen Refuelling Stations (HRS).

The H2MA planning tool - Aims

The H2MA tool is devised to:

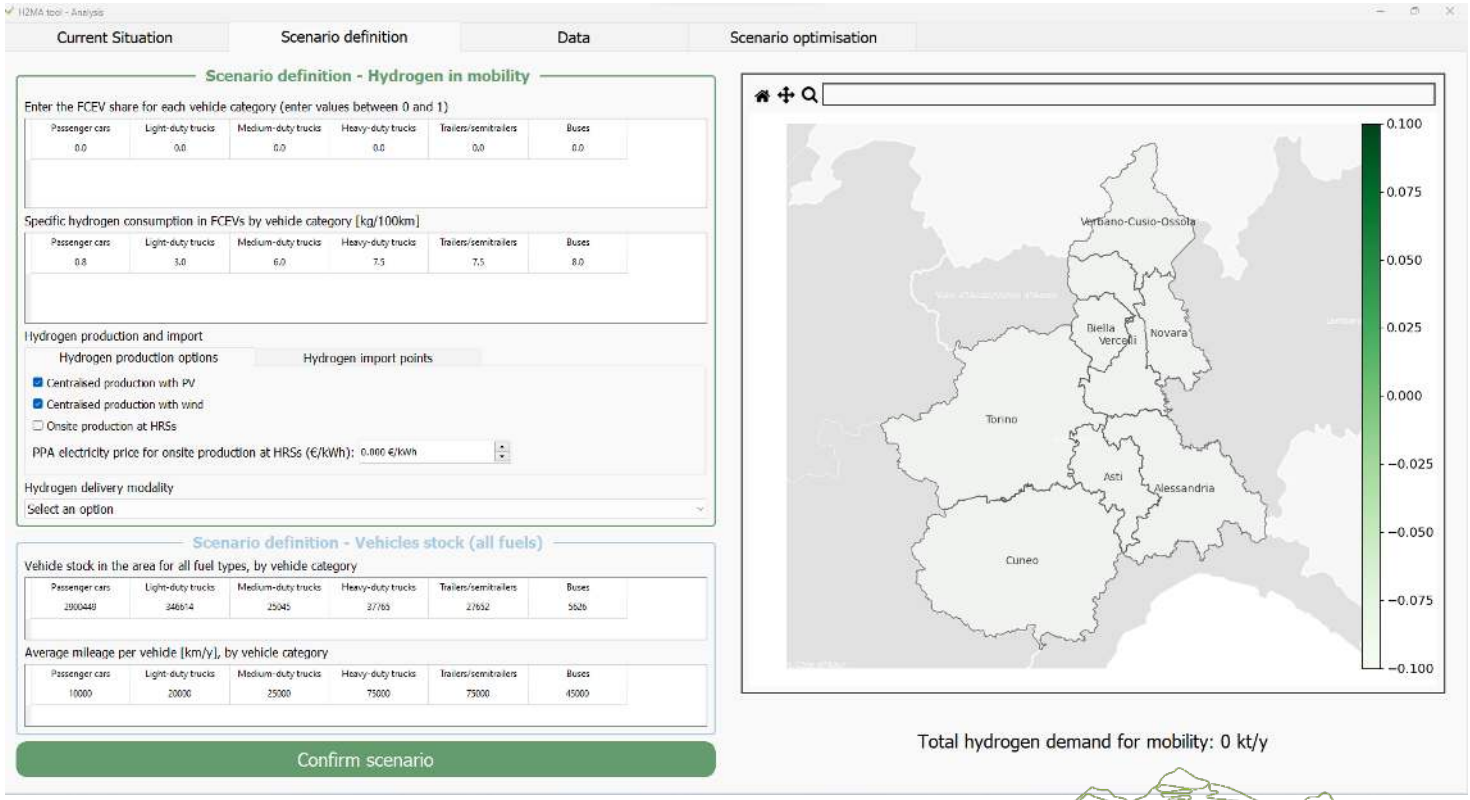
- ❑ Enable the visualization of available information regarding existing and planned facilities (hydrogen refuelling stations and green hydrogen production sites).
- ❑ Compute cost-optimal configurations for a scenario defined by the user – the definition is performed by selecting parameters such as the share of hydrogen vehicles, techno-economic data of the technologies, possible constraints on distances and max capacities, etc.
- ❑ Enable the visualization of the configuration obtained by the calculations.



The H2MA planning tool – Policy targets

The toolkit also make it possible to define **policy targets** such as:

- the reduction in the number of endothermic-powered vehicles
- the type of hydrogen production
- the spatial distribution of H2 demand in given areas
- To complete the definition of the scenario the toolkit will provide guidance on the parameterization of investment and production costs.

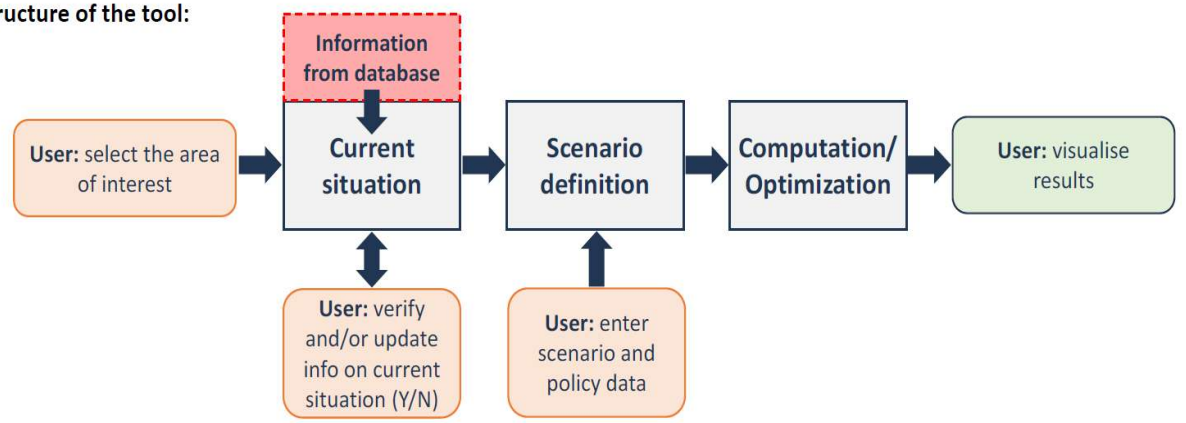


The H2MA planning tool – how does it works?

Workflow: (with respect to the phases of SUMP)

1. **Selection of the area of interest to be analysed**→ The required data are pre-loaded from the database of the tool. For extra Alpine regions data are provided by the user.
2. **Analysis of the current situation**→ extracts data from the database, reconstructing the current situation presenting the graphic visualisation on a map.
New data can be added manually by the user.
3. **Scenario definition**→ Input of scenario data, input of policy data, the tool allows the user to visualise and modify the default cost data.
4. **Optimisation of the H2infrastructure for mobility**→ execution which gives back graphic visualisation of the results (map or table).

Structure of the tool:



The H2MA planning tool – What data and how to collect them?

1. Within the H2MA consortium an **expert group** has been set to identify the key parameters to include in the tool (input data).

2. From a methodological point of view <u>every partner was responsible for the collection of data</u> for its region. The data has been collected is **shapefile formato (.shp)**.

3. Information regarding the current situation will be **pre-loaded** in the tool for the regions that will provide the required data.

Parameter	Description	Format	Notes	Included by expert group
Topology of the analysed area	Borders of the analysed area (NUTS-2) and structure of subareas (NUTS-3)	.shp		
Road network	Network of roads along which HRSs can be installed	.shp	TEN-T or higher ramification?	
Candidate network for H_2 delivery via truck	Network of roads along which H_2 truck can travel to deliver H_2 from production points to HRSs	.shp		
Candidate network for H_2 delivery via pipeline	Network along which H_2 pipelines can be installed to connect production points with HRSs	.shp	Possible alternatives: (1) natural gas grid; (2) railway network; ...	
Existing/planned HRSs	Location and capacity	.shp/.xls		✓
Existing/planned H_2 production sites	Location and capacity	.shp/.xls		✓
Existing conventional refuelling stations on TEN-T corridors	Location of existing conventional refuelling stations on TEN-T corridors	.shp/.xls		✓
Vehicle stock	Number of vehicles in the analysed area, by category	.xls		
Annual mileage	Average annual mileage by vehicle category	.xls		
Macroeconomic and demographic data	Population, GDP per capita, vehicle ownership, ... at NUTS-3 level	.xls		
RES generation profiles	Hourly-resolved RES generation profiles for the analysed area at a NUTS-3 level	.csv		
Features of RES power generation systems	Investment and O&M costs	*The tool will have default values that can be modified by the user*		✓
Features of electrolysis systems	Investment cost and performance indicators (electric efficiency, ...)	*The tool will have default values that can be modified by the user*		✓
Features of H_2 pipelines	Investment cost and sizing constraints	*The tool will have default values that can be modified by the user*		✓
Features of compressed H_2 trucks (tube trailers)	Investment cost and capacity	*The tool will have default values that can be modified by the user*		✓
Features of HRSs	Investment cost by capacity range	*The tool will have default values that can be modified by the user*		✓

The H2MA planning tool – ALPHA/BETA VERSION

ALPHA/BETA VERSION:
Beta (current one) builds upon alpha version (Jan 15, 2024) for broader coverage, improved UI, and more configuration options.

•Key advancements from alpha version:

- Integration of all regions covered by H2MA partners, involving meticulous adjustments of partner-provided files.
- Enhanced visualization for a broader geographical perspective.
- Addition of 'onsite hydrogen production at HRS' option.
- Introduction of 'Save' function for result export.

•Visualization component allows users to explore existing and planned HRSs and hydrogen production sites in covered regions based on input data. Future versions will expand coverage as data collection progresses.

•Computational section focuses on scenario definition and optimization, conducting cost-optimal simulations to identify future infrastructure configurations. Regions are defined at NUTS-2 level, subareas at NUTS-3 level, except for Bavaria, where NUTS-1 and NUTS-3 levels are considered due to data availability.

The H2MA planning tool – further releases

The current Beta version of the H2MA planning tool is **under update** to have a functional tool that is always useful.

The next release will implement:

1. Large changes to the tool and algorithm
2. Multi-region addition: merging and adjustment of input data (from the data collected by partners) + development.
3. New version of the user manual.

The H2MA planning tool – “Step-by-step” user manual

- **Initialization:**
  - Extract files from .zip folder.
  - Launch the tool by opening "H2MAapp.exe" (double click).
  - Wait for the initial window to appear (up to 1 min depending on hardware).
  - Do not close the command prompt (black window) if it opens in the background.
- **Data Input:**
  - In the initial window, click "New" > Select area of analysis from the dropdown menu > Click "Start."
  - Wait for input data loading (up to 1 min, a temporary window will pop up).
  - Main window opens.
- **Navigation through Tabs:**
  - **"Current situation" tab:**
    - Alpine Space map: Visualize existing and planned hydrogen infrastructure.
    - Hydrogen refuelling stations: List with main attributes.
    - Hydrogen production sites: List with main attributes.
  - **"Scenario definition" tab:**
    - Enter desired FCEVs share by vehicle category.
    - Visualize/edit FCEV specific consumption values.
    - Select hydrogen production and import features.
    - Select hydrogen delivery modality.
    - Visualize/edit tables on overall vehicle stock.
    - Click "Confirm scenario" to update the map.
  - **"Data" tab:**
    - Visualize/edit techno-economic data.
  - **"Scenario optimisation" tab:**
    - Click "Initialize scenario" to start the optimization with progress bar.
    - Click "Start optimization" to begin; it may take some minutes.
    - Avoid interference during optimization; results visualized in sub-tabs.
    - Save results in different formats for different scenarios:
      - Installed hydrogen refuelling stations: shapefile (.shp).
      - Hydrogen production quantity by subarea: spreadsheet (.xlsx).
      - Installed hydrogen production sites: shapefile(.shp).
      - Hydrogen delivery network: shapefile (.shp).
      - Summary table (aggregated values by subarea): spreadsheet (.xlsx).
  - Different scenarios can be run sequentially, confirming and initializing each time input assumptions are varied.

Now it's time to show you what the tools is about…

N.B. open the app and show

Thank You for your attention!

Any questions?