

Hydrogen Valleys: a catalyst for advancing the global hydrogen value chain

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Abstract

The global shift towards decarbonisation and sustainable energy systems has sparked a growing interest in the development of a hydrogen-based economy. This paper explores the concept of 'hydrogen (H₂) valleys' as focal points for the accelerated production, distribution and utilisation of H₂. It presents technical and economic analyses of the development of H₂ valleys, highlighting the wide range of international initiatives and support mechanisms provided by countries around the world to promote the adoption of H₂ technologies. This study analyses and elaborates data available from [1] and other technical reports in the literature for 5 geographical areas/countries, representative of the policy approaches adopted to support H₂ valleys (hubs or clusters). Financing mechanisms, role of public and private sectors and general characteristics of H₂ valleys are described in the Table 1, which reports the main results of the analysis.

Table 1: Main results of the analysis on hydrogen valleys development worldwide

Area/country	N. H ₂ valleys (large-scale)	Fundings (Public and/or Private)	Policies and initiatives	Peculiarities	Refs
Europe	62 (24)	Public and private	- Repower EU - H2020 Horizon - A hydrogen strategy for a climate-neutral Europe	Industry-focused, mobility and industry internal use. Collaboration between different H ₂ valleys	[2,3]
Australia	4 (2)	Public and private	- Australia's National Hydrogen Strategy - Other regional fundings	Industry, energy and mobility internal uses and export potentials.	[4]
USA	4	Public and private	- U.S. National Clean Hydrogen Strategy and Roadmap	Industry-focused. Production and internal transport (trucks and pipelines).	[5]
Chile	2 (2)	Private	- National Green Hydrogen Strategy	Production from renewables and export potentials.	[6]
China	3	Public	- China Fuel Cell Subsidy Policy - Medium and Long-Term Planning for the Development of Hydrogen Energy Industry	Focus on mobility (cars, buses, trucks, forklift) and energy.	[7]
Middle East	3 (2)	Public and private	- Net Zero Emissions in 2050 and Green Hydrogen Strategy (Oman) - National Plan to Integrate Hydrogen into Energy Landscape (Israel)	Development of large-scale H ₂ production plants and export potentials	[8,9]

European countries are leader in the development of H₂ valley (hosting 75% of global H₂ valleys) with 26 large-scale H₂ valleys (i.e. entailing a production of more than 10 t_{H₂}/d) under development. Large-scale H₂ valleys can help reduce H₂ production costs, develop a large



infrastructure network and increase the scale of implemented technologies. Funding support from private and public sectors, generally operates by EU countries, goes beyond simply building infrastructure; it entails a long-term commitment to H₂ production and/or supply, breaking the chicken-and-egg dilemma that often hinders the construction of large-scale plants. One of the strengths of European policies lies in their promotion of cooperation among different H₂ valleys and the possibility of exchange between countries within the EU. Currently, 8 cross-border H₂ valleys are under development, ensuring enhanced energy and legislative interconnection among nations and improved resource sharing [1–3]. One example of transnational hydrogen valley is the North Adriatic Hydrogen Valley (NAHV) which compasses the territories of Friuli Venezia Giulia region (Italy), Slovenia and Croatia.

A different approach is adopted by Middle East countries, which hold promising potential as green H₂ exporters due to their abundant renewable energy resources. In these cases, H₂ production is almost entirely devoted to export overseas by shipping. The analysis emphasises that ports could play a key role in facilitating the development of infrastructure for both mobility (e.g. port vehicles and ships), energy-intensive industries and creating potential opportunity for green energy export/import. A global H₂ production is expected to be 42% by 2050 in port areas [10].

While in Europe, Australia, USA and Middle East a combination of public and private fundings, in China, the three H₂ clusters are totally financed by the government. It is worth noticing that H₂ utilization is focused on mobility applications, as evidenced by industry and energy planning for H₂ [7].

The combination of public-private fundings could lead to a greater diffusion of expertise and an accelerated and competitive development of technologies, as expected for EU hydrogen initiatives.

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