GOING GLOBAL

An update on Hydrogen Valleys and their role in the new hydrogen economy

Clean Hydrogen Partnership

MISSION INNOVATION

Roland Berger

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Hydrogen is a key cornerstone of the green transformation of the global economy, and a major lever to diversify energy supplies and accelerate the clean energy transition. With its RePowerEU Plan, the European Commission topped top-up Horizon Europe investments to double the number of Hydrogen Valleys by 2025 and is committed to achieve 10 million tons of domestic renewable hydrogen production and 10 million tons of renewable hydrogen imports by 2030.

We are proud to see that all these efforts will allow us to further enhance and expand the Mission Innovation Hydrogen Valley Platform.

Rosalinde van der Vlies
Vice-Chair of the Mission Innovation Steering Committee
Director of the Clean Planet Directorate in DG Research and Innovation – European Commission

Hydrogen will be essential to replace natural gas, coal and oil in hard-to-decarbonise sectors in industry, mobility and energy. Hydrogen Valleys will become an important cornerstone in producing, importing, transporting, and using clean hydrogen in Europe. I expect other geographies to follow similar strategies (hydrogen hubs, clusters, ecosystems, etc.), as local agglomerations of various hydrogen users, shared infrastructure and joint supply sources are essential to scale the industry and take the "New Hydrogen Economy" to the next level. In light of this, I am very pleased that this report further promotes the Hydrogen Valley concept by providing more insights to project developers, industry, and policy makers alike.

Bart Biebuyck
Executive Director, Clean Hydrogen Joint Undertaking

Contents

1 The emerging hydrogen market today: Ever more momentum

Hydrogen is universally considered as an important element in global climate action efforts. Over the last years, it has become a main talking point around the global energy transition away from fossil fuels towards decarbonisation of industrial processes, mobility, and energy sectors. It is an essential lever to meet the goals of the Paris Agreement of limiting global warming to well below 2°C compared to pre-industrial levels.

Key industrial sectors like fertiliser or steel production need decarbonised hydrogen as clean feedstock. Heavy-duty mobility users in trucking, shipping or aviation need clean hydrogen as a fuel where battery electrification is no option (whether in its pure form or as an e-fuel). Lastly, global power and heat sectors will require hydrogen as a means of energy storage and as fuel for clean dispatchable assets.

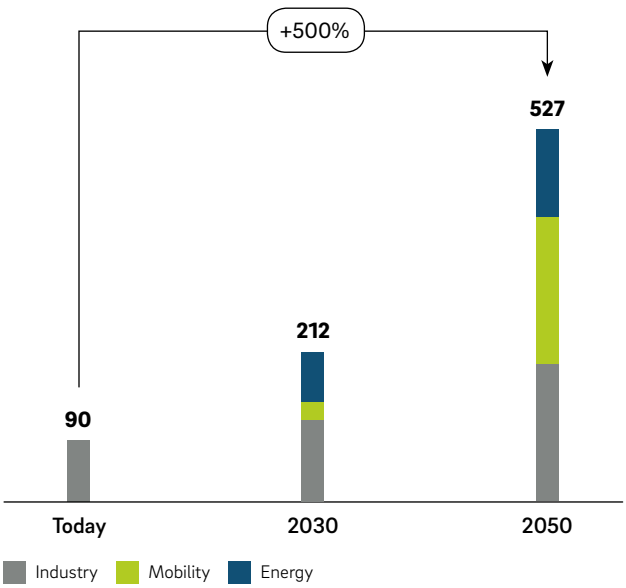
As a result, clean hydrogen consumption must significantly increase to meet global decarbonisation objectives – not only in the long-term but already in this decade. → A

However, hydrogen today is predominantly produced from fossil fuels (natural gas, coal). Less than 2% of global hydrogen volumes today are produced from "clean" production technologies. In order to get to "net zero", especially green hydrogen supply – produced from renewable energy sources – will have to meet most of the growing demand. For that, an enormous build-out of electrolysers and corresponding renewable electricity production will be required. → B

In light of rising ambitions in global climate action as well as efforts to increase energy security, the political momentum for hydrogen ambitions continues to grow. Governments around the world push hydrogen as a decarbonisation enabler. More than 25 national hydrogen strategies have been published to date. Europe is very much a frontrunner, with the European Commission increasing political targets for hydrogen and introducing policies and regulation to support market development: After the EU Green Deal and the "Fit-for-55" package, the "REPower EU" plan aims for a speed-up and scale-up of renewable energy build-out and production and usage of clean hydrogen, amongst other objectives, calling for doubling the number of Hydrogen Valleys in Europe.

Other continents are increasing their policy initiatives as well: The United States has increased its focus on the clean hydrogen sector starting with the introduction of the Infrastructure Investment and Jobs Act (IIJA) in 2021, continuing with the Inflation Reduction Act, and is further investing in research, development, and demonstration activities, such as the DOE Hydrogen Program

A: Hydrogen consumption in the IEA's Net Zero Emission Scenario [Mt]



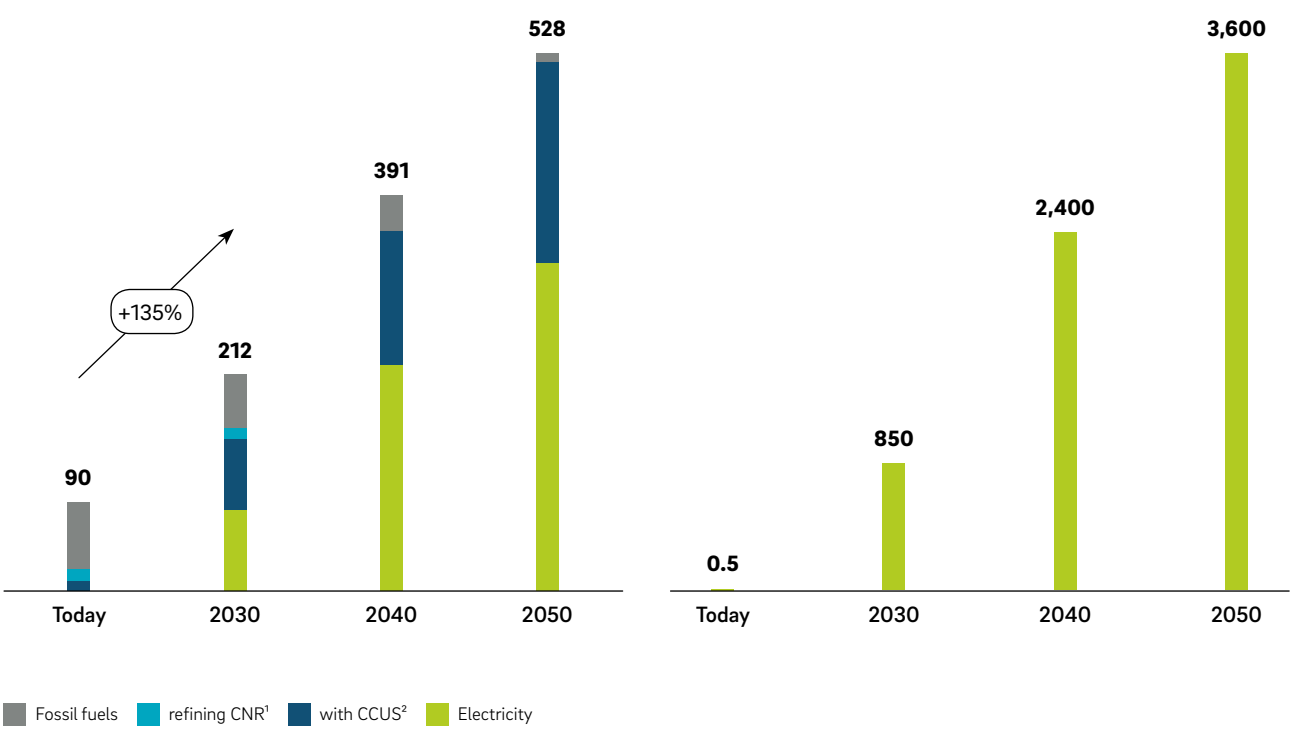
Source: IEA, Roland Berger

Plan, the DOE Energy Earthshot Initiative and the IIJA Hydrogen Investments and Incentives. This year, a new section was added to the Energy Policy Act to support the development of at least four regional clean hydrogen hubs as part of the Bipartisan Infrastructure Law.

In Australia, where almost 100 hydrogen production projects have been announced so far, the national hydrogen strategy focuses on the creation of new hydrogen hubs, i.e., comprising clusters of large-scale demand located at ports and cities with production. Based on its vast renewable energy potential, Australia aims to become a leading global player in the hydrogen sphere by the end of the decade.

In Africa, the South African government has made hydrogen a national priority as an alternative energy source. With first pilot projects based on the Hydrogen

B: Hydrogen supply and resulting electrolyser capacity needs in the IEA's Net Zero Emission Scenario



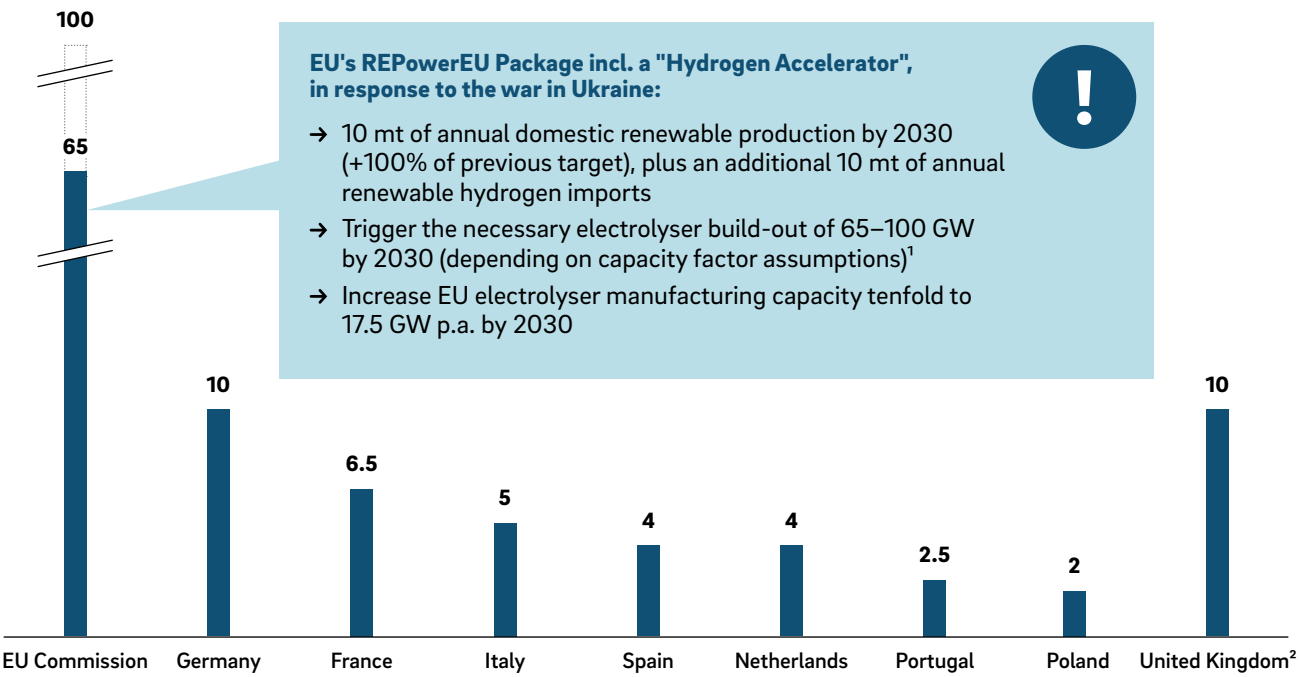
Source: IEA, Roland Berger

1) Catalytic Naphtha Reformer 2) Carbon Capture (Utilisation) and Storage

Valley concept underway already, South Africa's Hydrogen Strategy states the target to ultimately become a major producer and exporter of clean hydrogen.

Thanks to these government targets and corresponding public support schemes, the global project landscape for new clean hydrogen projects is more dynamic than ever, with more and bigger announcements of new projects around the world. While Europe is currently the most vibrant market in terms of number and capacity of communicated projects, the project pipeline is growing rapidly in all regions. The global hydrogen project count with dedicated own production now exceeds 1,300 projects – of which more than 400 plan to be operational by 2030 with a total electrolysis capacity of more than 250 GW. → C

C: National electrolyser capacity targets for 2030 in major European economies [GW]



Source: European Commission, national governments, Roland Berger

1) The range reflects varying assumptions on capacity utilisation factors and efficiencies underlying the EU green hydrogen production targets.
2) Including installed capacity for production of low-carbon hydrogen

2 Hydrogen Valleys: Next-level market development

As the "New Hydrogen Economy" is still nascent, many projects (or agglomerations of multiple projects) seek to form first regionally integrated hydrogen ecosystems, so-called hydrogen hubs, hydrogen clusters or "Hydrogen Valleys".

Moving beyond mere demonstration activities, Hydrogen Valleys are the next-level pioneers of the market and ultimately the steppingstone towards the full scaling of the New Hydrogen Economy (and the industrialisation of key technologies). → D Due to their integrated approach, Hydrogen Valleys pave the way for the setup of regional 'mini hydrogen economies' by combining or pooling hydrogen supply and demand to increase scale, maximise asset utilisation and bring down costs. These captive projects are typically centred around long-term commercial agreements (supply, off-take, transportation, etc.) to de-risk and synchronise investments and avoid stranded assets.

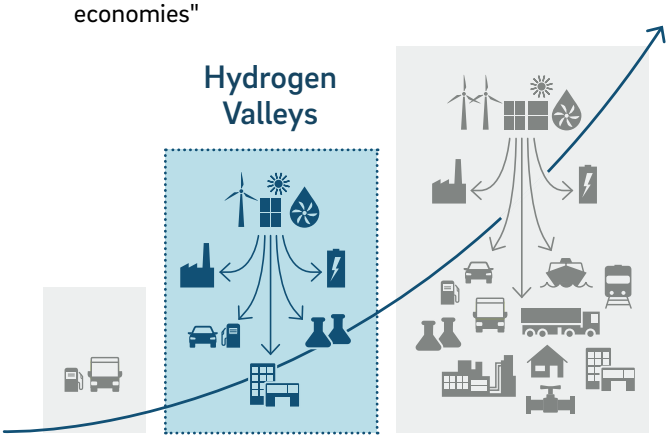
Hydrogen Valleys have become a global phenomenon, with new integrated projects emerging all around the world. While still predominantly present in the traditional hydrogen "lead markets" (Europe, Asia, North America), more and more projects are now shaping up on all continents. → E

Although Hydrogen Valley concepts are always adapted to cater to specific regional circumstances and the overall objectives of a project, there are common characteristics of what constitutes a Hydrogen Valley: → F

D: Hydrogen Valley project drivers

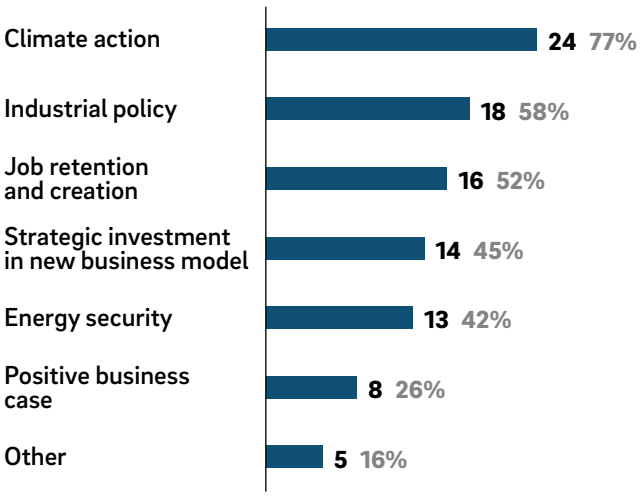
THE AMBITION

- → Next-generation market development
- → Integrated (and larger-scale) projects covering more and more of the value chain – "mini hydrogen economies"



THE UNDERLYING DRIVERS

Question: "What are the main drivers for your project?" (n=31)[1]



Source: Clean Hydrogen JU, Roland Berger

1) Multiple answers possible

E: Global Hydrogen Valley activities and example projects from the Mission Innovation Hydrogen Valley Platform

United Kingdom
- → HyNet North West
- → BIG HIT Orkney Islands

Netherlands
- → HEAVENN
- → Hydrogen Delta
- → Europe's Hydrogen Hub: H_2 Proposition Zuid-Holland/Rotterdam

Belgium
- → Flemish Hydrogen Ports Valley

Germany
- → H2Rivers
- → HyBayern
- → eFarm
- → Northern German Living Lab
- → Hyways for Future

Italy
- → Hydrogen Valley South Tyrol
- → H2iseO Hydrogen Valley

Denmark
- → HyBalance

Austria
- → WIVA P&G: Hydrogen Flagship Region

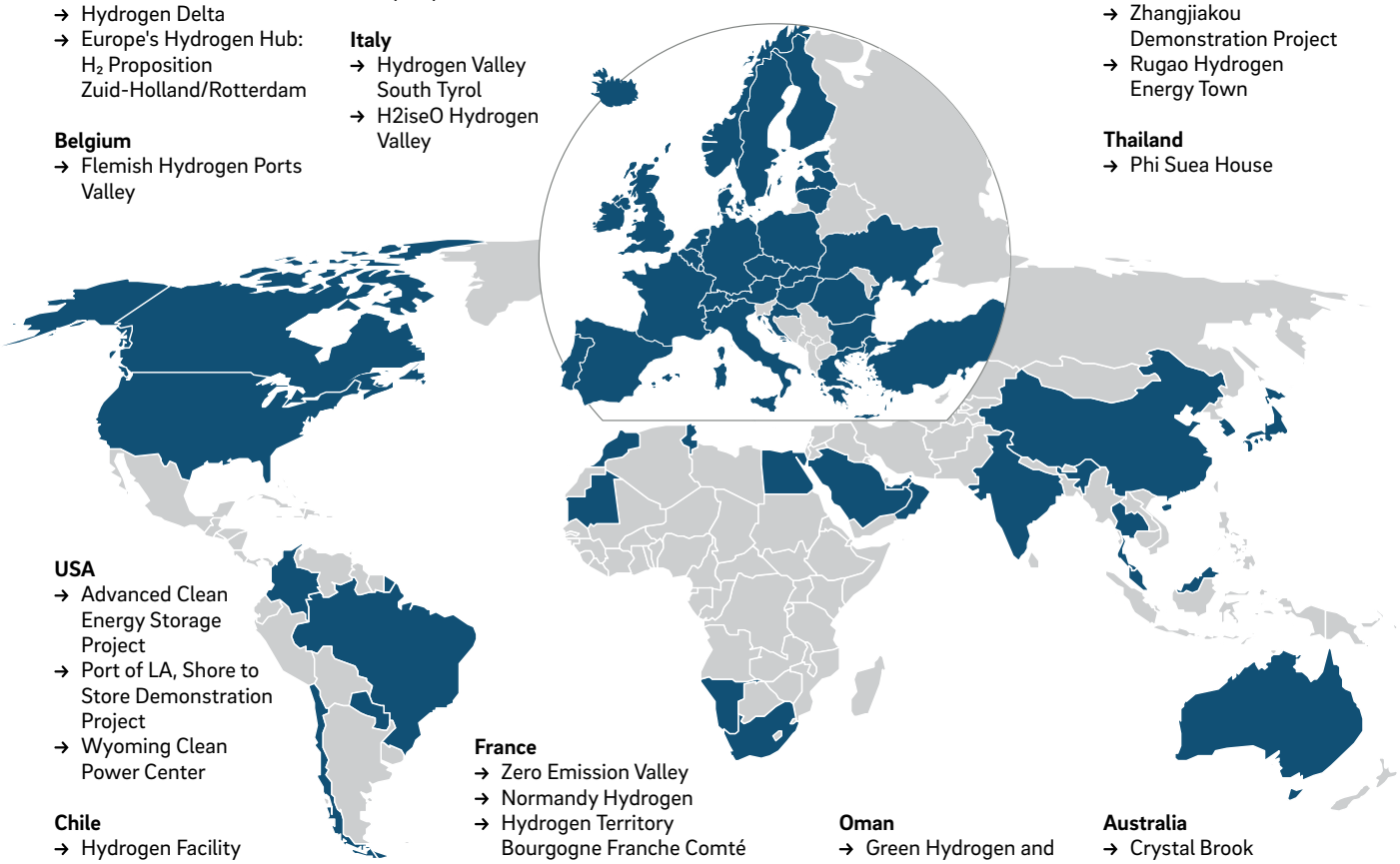
Portugal
- → Sines Industrial Hub

Spain
- → Green Hysland
- → Basque Hydrogen Corridor

Japan
- → FH2R Fukushima

China
- → Foshan Nanhai Xianhu Lake Hydrogen Valley Town
- → Zhangjiakou Demonstration Project
- → Rugao Hydrogen Energy Town

Thailand
- → Phi Suea House



USA
- → Advanced Clean Energy Storage Project
- → Port of LA, Shore to Store Demonstration Project
- → Wyoming Clean Power Center

Chile
- → Hydrogen Facility Initiative

France
- → Zero Emission Valley
- → Normandy Hydrogen
- → Hydrogen Territory Bourgogne Franche Comté
- → Centrale Electrique de l'Ouest Guyanais

Oman
- → Green Hydrogen and Chemicals Oman

Australia
- → Crystal Brook Hydrogen Superhub
- → Eyre Peninsula Gateway

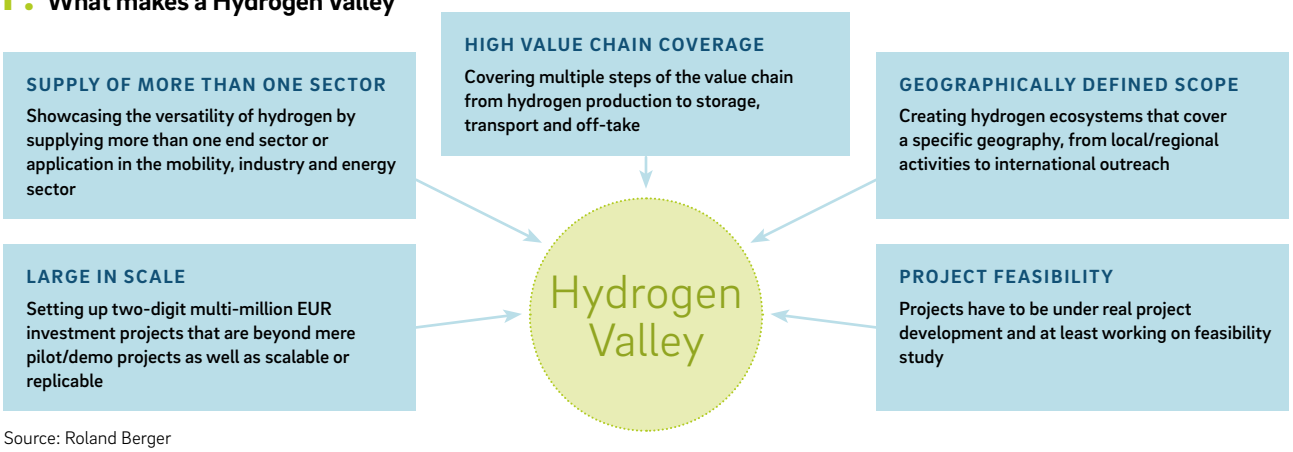
Countries with ongoing Hydrogen Valley activities

Source: Clean Hydrogen JU, Roland Berger

→ **Large in scale:** the project scope goes beyond mere demonstration activities and entails at least a two-digit multi-million EUR investment. It typically also includes several sub-projects that make up the larger Valley "portfolio".
→ **A clearly defined geographic scope:** Hydrogen Valleys are hydrogen ecosystems that cover a specific geography. Their footprint can range from a local or regional focus (e.g., a major port and its hinterland) to a specific national or international region (e.g., a transport corridor along a major waterway).
→ **A broad value chain coverage:** along their geographic scope, Hydrogen Valleys cover multiple steps in the hydrogen value chain, ranging from hydrogen production (and often even dedicated renewables production) to the subsequent storage of hydrogen and distribution to off-takers via various methods of transport.
→ **Supply to various end sectors:** Hydrogen Valleys usually showcase the versatility of hydrogen by supplying ideally several sectors in their geography such as mobility, industry and energy end uses. Thus, Hydrogen Valleys are ecosystems or clusters where various final applications share a common hydrogen supply infrastructure.
→ **Project feasibility:** Projects have to be under real development and at least working on a feasibility study.

However, across different nations around the globe and the evolving hydrogen economies in them, different terms and definitions have developed. These include primarily Hydrogen Hubs (United States of America, Australia), Hydrogen Clusters (China, Australia, parts of Europe) and Hydrogen Ecosystems (parts of Europe). While the outlined characteristics of a Hydrogen Valley not necessarily apply to all projects labelled under these definitions, they most often have at least one of the following attributes in common:
→ Co-locating hydrogen producers, users, and exporters in one area
→ Connecting of businesses, universities and research programs, innovators, local and state government agencies, as well as communities to support hydrogen project development
→ Closing the hydrogen value chain from production, distribution, storage to end-usage in one area

F: What makes a Hydrogen Valley

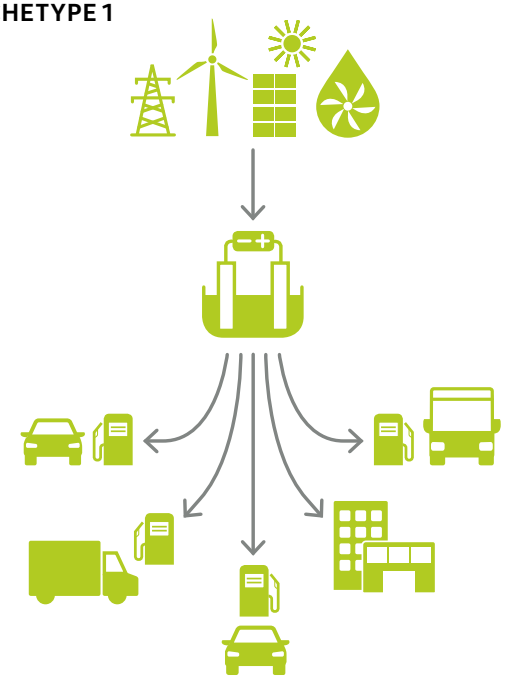


Source: Roland Berger

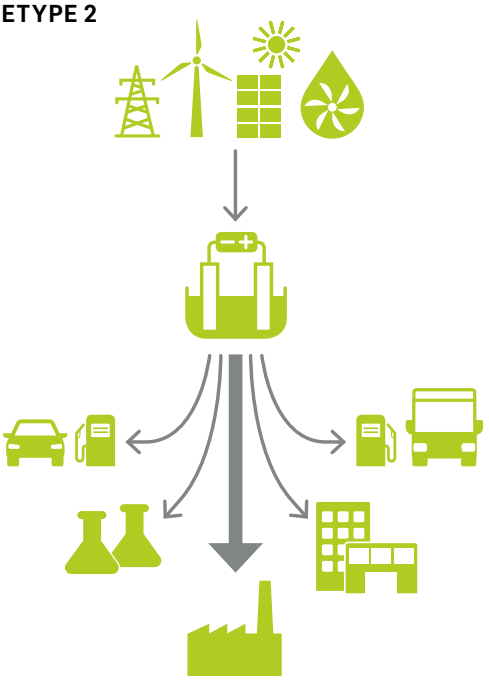
3 What projects look like: Hydrogen Valley archetypes

The global landscape of Hydrogen Valleys is as diverse as the evolving hydrogen market and industry. Yet, given the common challenges that project developers, users and political sponsors typically face, structurally similar recipes for designing projects start to emerge. The vast majority of these hydrogen projects can be categorised into three archetypes:

ARCHETYPE 1



ARCHETYPE 2

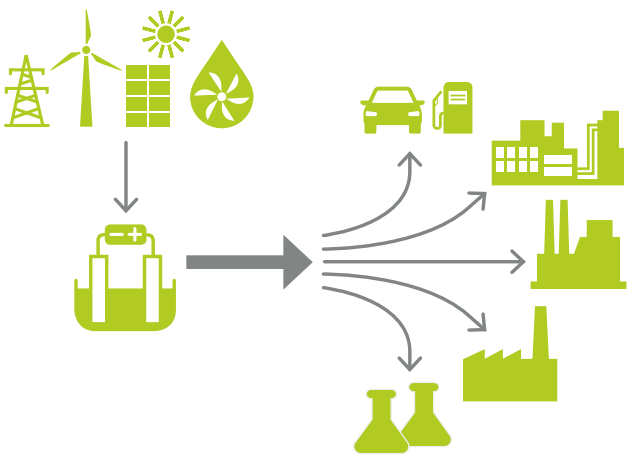


→ Smaller-scale local mobility-centred Hydrogen Valleys (typically 1–10+ MW of local electrolyser capacity): These projects typically combine the decarbonisation efforts of various regional mobility fleets (hydrogen fuel cell trucks, buses, trains, etc.). The Valley then matches the combined demand with the built out of jointly used hydrogen refuelling stations and centralised clean hydrogen production. Such mobility Valleys have the longest legacy of all archetypes (especially in Europe). They have historically enjoyed substantial public support but are now moving to more and more commercial business models. Project examples include the Zero Emission Valley Auvergne-Rhône-Alpes (FR), the Hydrogen Valley South Tyrol (IT), and the Hydrospider project (CH).

→ Medium-scale Hydrogen Valleys focusing on industrial decarbonisation (typically 10-300+ MW of local electrolyser capacity): These Valleys are based on a local or regional hydrogen production source (usually clean hydrogen) directly at the site of one or more large industrial consumers serving as “anchor load”, such as refineries or fertiliser production plants (i.e., converters from grey to clean hydrogen). Around this anchor load,

mobility off-takers and their hydrogen assets are added (fleets, hydrogen refuelling stations, storage and distribution), benefitting from lower hydrogen supply cost. The key to success for such projects is a seamless integration of the hydrogen production in the established (petrochemical) production processes on the anchor off-taker(s). They are mostly led by the anchor off-takers themselves, which might involve energy companies as partners. This type of Hydrogen Valley continues to grow in numbers and production sizes, with the first projects with capacities of up to 20 MW already operational in the EU and the US. Project examples include Hydrogen Holland 1 (NL), Basque Hydrogen Corridor (ES), and HyNet North-West England (UK).

ARCHETYPE 3



→ **Large-scale and ultimately export-oriented Hydrogen Valleys (typically 250-1,000+ MW of local electrolyser capacity):** This type of Valley is characterised by focusing on low-cost production of clean hydrogen for local off-take, but ultimately mainly regional and international export to connect supply and demand centers on a global scale. The projects are typically co-located with dedicated additional renewables capacities (e.g., pure PV, PV combined with on-shore wind, or pure off-shore wind). Such "gigaprojects" are mostly led by energy majors or sovereign developers. First projects are approach Final Investment Decisions, especially in the Middle East and Australia. Key projects include Project NEOM (KSA), AquaVentus (DE), H2 Magallanes (CL), and Pilbara Hydrogen Hub (AU).

Hydrogen Valleys are typically structured as closed ecosystems along the entire value chain, increasingly underpinned by longer-term commercial agreements. The most relevant archetypical project outline (i.e., renewable hydrogen valleys) covers renewable energy supply, hydrogen production, distribution and off-take. Along the way, key long-term contractual agreements define the Valley's commercial structure in the absence of mature and liquid clean hydrogen markets. Thereby, they enable the commercial de-risking of investments, ensure concerted action and thus avoid stranded assets. These contracts, often essentially on a take-or-pay basis, include Power Purchase Agreements (PPAs), Hydrogen Purchase Agreements (HPAs), and Hydrogen Transportation Agreements (HTAs). In addition to successful commercial de-risking via long-term contracts, a variety of success factors has emerged for clean hydrogen projects. They include for example the accessibility of low-cost renewable energy sources with high full-load hours, the proximity to large anchor off-takers (industry, mobility, energy), the involvement of experienced technology and EPC partners for timely delivery of equipment, and last but not least comprehensive government and stakeholder support – both financial and non-financial. While some of these success factors generally apply to large energy infrastructure projects, others are very specific to Hydrogen Valleys.

4 Outlook: The Mission Innovation Hydrogen Valley Platform

Today, Hydrogen Valleys already play an integral part in building further momentum in the global hydrogen market. While a significant number of Hydrogen Valleys are already progressing in the project lifecycle, more and more new projects are emerging anew, often building on the knowledge and experience of existing projects. This increasing number of Valleys is expected to go together with a development of larger scales in terms of hydrogen production capacities, involved stakeholders and regional coverage as well as demonstrations of newly emerging end uses for clean hydrogen. At the same time, with enhanced commercial maturity and increasing competitiveness, a new level of project development barriers for Hydrogen Valleys is anticipated – for which new best practices to overcome need to be analysed and derived.

The Clean Hydrogen Joint Undertaking, Mission Innovation, and the European Commission are committed to continuing their hydrogen-related efforts, such as the long-standing support of Hydrogen Valley projects. The established Hydrogen Valley platform (www.h2v.eu) is a key action step in Mission Innovation's goal to reach the milestone of 100 Hydrogen Valleys by 2030. In that regard, all three entities aim to take the platform to the next level – in terms of Valleys it features, content it shows, value it adds to its key audiences and adjacent activities it enables to promote Hydrogen Valleys around the world. To achieve this objective, four key actions are currently under development:

1. **Efforts to further increase the platform's attractiveness** through enhanced visibility and visualisation of the platform structure and layout as well as of its contents. This goes hand in hand with a more intuitive and user-friendly design of the platform, including smartphone compatibility.

2. **Recognition of progress and success stories of established Hydrogen Valleys**, including sharing of best practices for successful project development that can provide valuable guidance for Hydrogen Valley peers as well as future projects.

3. **Identification of new relevant project development barriers** that Hydrogen Valley projects have experienced along the way and the resulting success factors on how to overcome them.

4. **Enhance of international collaboration** (i) between Hydrogen Valleys, (ii) between Mission Innovation Member Countries and their policy makers, and (iii) between project developers and external stakeholders (i.e., investors, partners, suppliers, off-takers, ...) by implementing additional member's areas to the platform and thus enhancing collaboration and project development through knowledge sharing and partner matchmaking.

Besides these changes and additions, several other improvements of the platform are underway. As a result, Mission Innovation and the Clean Hydrogen Joint Undertaking aim to re-launch the new **H2.0 Valley Platform in the first quarter of 2023.**

5 Join the platform!

The relaunched Hydrogen Valleys Platform intends to feature new, recently emerged Hydrogen Valley projects from around the world. As such, the project consortium has continued to contact potential project additions to evaluate their compatibility with the Hydrogen Valley definition and the platform's goals.

We encourage and invite all other projects at project development stage from around the world to reach out to join the platform. We firmly believe that by participating in the further development of the Hydrogen Valleys Platform, project developers will play a significant role in promoting the emergence of other hydrogen projects, and thereby facilitating the global clean energy transition as such. Above that, these projects will join an exclusive group of other leading hydrogen projects who can actively collaborate and exchange best practices.

If you are interested, please get in touch regarding your Hydrogen Valley via https://h2v.eu/join-us or send an email to H2V@clean-hydrogen.europa.eu!

In a next step, our team will evaluate the fit of the project regarding the Hydrogen Valley definition, which includes a comprehensive survey on project fundamentals, technologies deployed, project development overall, financial aspects as well as hurdles and key success factors. Afterwards, the project will be featured on the platform and joins the circle of successful peers from around the world. Furthermore, all Hydrogen Valleys on the platform will receive an H2.0 Valley Certificate. They are thus recognised and certified by Mission Innovation and the Clean Hydrogen Joint Undertaking as a global Hydrogen Valley flagship.

We are very much looking forward to hearing from you!

Annex Examples of Hydrogen Valleys from around the world

eFarm

LEAD DEVELOPER

GP Joule

PROJECT PARTNERS

- 20 regional shareholders
- 13 additional partners

PROJECT SUPPORTERS

- Federal Ministry for Digital and Transport (BMDV)
- District of North Frisia

LOCATION

Reußenköge

PROJECT DESCRIPTION

The project eFarm is the biggest green hydrogen mobility project in Germany to date. The project is realised by GP JOULE and addresses the complete value chain of green hydrogen on the mobility path from production over logistics to distribution via HRS.

H_2 PRODUCTION VOLUME

219 tons/year

TOTAL INVESTMENT VOLUME

16 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2017 Start — 2022 Finalisation

PROJECT STATUS

Operations

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis

H_2 end uses (target off-takers)
- Mobility (cars, buses, trucks)
- Energy

H_2 transport / distribution
- Trucking

H2Rivers

LEAD DEVELOPER

Metropolregion Rhein-Neckar

PROJECT PARTNERS

- Municipalities in the Rhine-Neckar Metropolitan Region
- Transport network of the Rhine-Neckar Metropolitan Region
- Chemical, mobility, research and development companies

PROJECT SUPPORTERS

Federal Ministry for Digital and Transport (BMDV)

LOCATION

Rhine-Neckar Metropolitan Region

PROJECT DESCRIPTION

Establishment of hydrogen generation and distribution with a focus on mobility applications. Sub-projects form the cornerstone for the transformation of the Rhine-Neckar metropolitan region towards CO_2 neutrality.

H_2 PRODUCTION VOLUME

380 tons/year

TOTAL INVESTMENT VOLUME

50 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2019 Start — 2023 Finalisation

PROJECT STATUS

Post-FID (financing, tendering, etc.)

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis

H_2 end uses (target off-takers)
- Mobility (cars, buses, service vehicles)

H_2 storage / conversion
- Cylinder

H_2 transport / distribution
- Trucking

Hyways for Future

LEAD DEVELOPER

EWE

PROJECT PARTNERS

- swb
- H2-MOBILITY
- BMÖ
- Weser-Ems-Bus
- Bremerhaven Bus
- VWG
- AWB
- OLEC

PROJECT SUPPORTERS

Federal Ministry for Digital and Transport (BMDV)

LOCATION

Bremen, Bremerhaven, Cuxhaven, Oldenburg, Wilhelmshaven

PROJECT DESCRIPTION

Hydrogen model region in the Northwest of Germany that focuses on the transport and industrial sectors.

H_2 PRODUCTION VOLUME

1,095 tons/year

TOTAL INVESTMENT VOLUME

90 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2020 Start — 2024 Finalisation

PROJECT STATUS

Operations

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis

H_2 end uses (target off-takers)
- Industry (steel)
- Mobility (cars, buses, trucks, and others)

H_2 storage / conversion
- Cylinder

H_2 transport / distribution
- Trucking

Norddeutsches Reallabor – Northern German Living Lab

LEAD DEVELOPER

CC4E/HAW Hamburg

PROJECT PARTNERS

An alliance of 50 partners from business, science and politics

PROJECT SUPPORTERS

- Federal Ministry for Economic Affairs and Climate Protection (BMWK)
- Federal Ministry for Digital and Transport (BMDV)

LOCATION

Hamburg

PROJECT DESCRIPTION

The Northern German Living Lab is an innovative joint project that aims to demonstrate new ways of achieving climate neutrality. It includes three projects with eight electrolysers for industrial and mobility use of clean hydrogen. The aim of the NRL is to test the transformation path for an integrated energy system that will succeed in reducing CO_2 emissions in the North of Germany by 75 percent by 2035.

H_2 PRODUCTION VOLUME

4,800 tons/year

TOTAL INVESTMENT VOLUME

400 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2018 Start — 2026 Finalisation

PROJECT STATUS

Construction

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis
- Alkaline electrolysis

H_2 end uses (target off-takers)
- Industry (chemicals, refineries, and others)
- Mobility (cars, buses, trucks, and others)

H_2 storage / conversion
- Cylinder
- Cavern

H_2 transport / distribution
- Trucking
- Pipeline

HEAVENN

LEAD DEVELOPER

New Energy Coalition

PROJECT PARTNERS

Gasunie, Nobian, Engie, Getec, Groningen Seaports, Nederlandse Aardolie Maatschappij, QBuzz, TotalEnergies, Energie Beheer Nederland, Lenten Scheepvaart BV, Green Planet, Municipalities of Groningen, Hoogeveen and Emmen, HyEnergy TransStore, Shell, H2Tec, Enercy, Rijksuniversiteit Groningen

PROJECT SUPPORTERS

Province of Groningen, Province of Drenthe, The Netherlands Ministry of Economic Affairs and Climate, The Netherlands Ministry of Infrastructure and Water Management

LOCATION

- Province of Groningen
- Province of Drenthe

PROJECT DESCRIPTION

HEAVENN is a large-scale demo project addressing the requirements of the call, by bringing together core elements: production, distribution, storage and local end-use of hydrogen into a fully-integrated and functioning Hydrogen Valley.

H_2 PRODUCTION VOLUME

36,500 tons/year

TOTAL INVESTMENT VOLUME

2,800 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2019 Start — 2026 Finalisation

PROJECT STATUS

Post-FID (financing, tendering, etc.)

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis
- Alkaline electrolysis
- Byproduct

H_2 end uses (target off-takers)
- Industry
- Mobility (cars, buses, trucks, ships)
- Energy (stationary fuel cells)

H_2 storage / conversion
- Cavern

H_2 transport / distribution
- Pipeline
- Trucking

Europe's Hydrogen Hub: H_2 Proposition Zuid-Holland/Rotterdam

LEAD DEVELOPER

Port of Rotterdam

PROJECT PARTNERS

Air Liquide, Air Products, AVR, BP, Deltalinqs, EBN, Eneco, Ennology, Equinor, Evides Waterbedrijf, ExxonMobil, Fieldlab Industrial Elektrification, Future Proof Shipping, Gasunie, Huntsman, Hydrogenious, Koedood Marine Group, Koole, LyondellBasell, Neste, Nobian, Nouryon, Plant One, Porthos, OCAP, Port of Rotterdam, Proton Ventures, Shell, Siemens, Stedin, Uniper, Vattenfall, Vopak, Zepp

PROJECT SUPPORTERS

- Province of Zuid-Holland
- The Municipality of Rotterdam

LOCATION

Rotterdam

PROJECT DESCRIPTION

Zuid-Holland has the industry, knowledge institutes and transportation capabilities to be the European Hydrogen Hub, and supply Europe's hydrogen demands. In triple helix collaboration, this region works towards international climate goals.

H_2 PRODUCTION VOLUME

1,160,700 tons/year

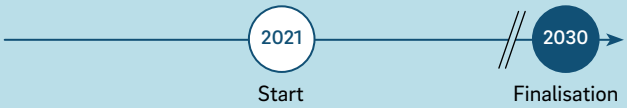
TOTAL INVESTMENT VOLUME

1,000 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE



PROJECT STATUS

Project concept

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis
- SMR with CC(U)S

H_2 end uses (target off-takers)
- Industry (chemicals, refineries)
- Mobility (cars, buses, ships)
- Energy (gas-fired power plants, gas grid injection)

H_2 storage / conversion
- Cylinder

H_2 transport / distribution
- Pipeline

Basque Hydrogen Corridor

LEAD DEVELOPER

Petronor (Repsol Group)

PROJECT PARTNERS

The project consortium consists of 78 entities, including research organisations, business associations, and private entities.

PROJECT SUPPORTERS

- Spanish Ministry of Industry, Trade and Tourism
- Basque Government
- Provincial Councils of Biscay, Gipuzkoa and Araba
- Bilbao City Town Hall

LOCATION

Bilbao

PROJECT DESCRIPTION

Large-scale project to develop a renewable hydrogen economy in the Basque Country and surrounding regions, proving hydrogen as enabler for the energy transition, with applications throughout the renewable hydrogen value chain, and boosting technological and industrial competitiveness.

H_2 PRODUCTION VOLUME

24,600 tons/year

TOTAL INVESTMENT VOLUME

3,000 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

PROJECT STATUS

The in total 38 projects are all between project conceptualization phase and start of constructions.

VALUE CHAIN COVERAGE

H_2 production route
- Alkaline electrolysis
- Solid oxide electrolysis

H_2 end uses (target off-takers)
- Industry (refineries, steel)
- Mobility (cars, buses, trucks, forklifts, ships)
- Energy (gas grid injection)

H_2 storage / conversion
- Cylinder
- Cavern

H_2 transport / distribution
- Pipeline
- Trucking

Green Hysland

LEAD DEVELOPER

Enagás

PROJECT PARTNERS

A balanced and multi-disciplinary consortium of 30 partners from industry (large and small), public bodies, research and academia and community organisations

PROJECT SUPPORTERS

- Regional Balearic Government
- IDAE
- Spanish Ministry of Industry, Trade and Tourism
- Spanish Ministry for the Ecological Transition and the Demographic Challenge

LOCATION

Mallorca

PROJECT DESCRIPTION

Green Hysland aims to create a replicable Hydrogen Territory in the Balearic Islands by converting solar energy generated in Mallorca into green H2 which will be used in multiple applications: mobility, heat and power and injection into the gas grid.

H_2 PRODUCTION VOLUME

300 tons/year

TOTAL INVESTMENT VOLUME

50 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2018 Start — 2025 Finalisation

PROJECT STATUS

Post-FID (financing, tendering, etc.)

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis

H_2 end uses (target off-takers)
- Mobility (cars, buses)
- Energy (stationary fuel cells, gas grid injection)

H_2 storage / conversion
- Cylinder

H_2 transport / distribution
- Pipeline
- Trucking

Hydrogen Valley South Tyrol

LEAD DEVELOPER

Institute for Innovative Technologies Bozen

PROJECT PARTNERS

Autostrada del Brennero SpA, Alperia AG, SASA AG, Südtiroler Transportstrukturen AG, Vinschger Energiekonsortium, Stadtwerke Bruneck, EURAC, Neogy GmbH, Stadtwerke Meran, SEAB AG

PROJECT SUPPORTERS

- Autonomous Province of South Tyrol
- Euregio
- MISE Ministry of Economic Development

LOCATION

Bozen

PROJECT DESCRIPTION

The Hydrogen Valley South Tyrol aims to decarbonise the mobility sector and to connect the region with the main Italian and European economic areas along the Brenner Corridor.

H_2 PRODUCTION VOLUME

90 tons/year

TOTAL INVESTMENT VOLUME

55 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2017 Start — 2026 Finalisation

PROJECT STATUS

Construction

VALUE CHAIN COVERAGE

H_2 production route
- Alkaline electrolysis

H_2 end uses (target off-takers)
- Mobility (cars, buses, trucks)

H_2 storage / conversion
- Cylinder

H_2 transport / distribution
- Trucking

Centrale Electrique de l'Ouest Guyanais

LEAD DEVELOPER

Hydrogène de France

PROJECT PARTNERS

- MERIDIAM
- SARA

PROJECT SUPPORTERS

Collectivité Territoriale de Guyane (CTG)

LOCATION

Saint Laurent du Maroni

PROJECT DESCRIPTION

Renewable project combining solar PV plant with large storage capacity based on hydrogen to produce stable and dispatchable power to the grid of French Guiana.

H_2 PRODUCTION VOLUME

730 tons/year

TOTAL INVESTMENT VOLUME

130 EUR m

FUNDING

Privately funded

PROJECT TIMELINE

2017 Start — 2024 Finalisation

PROJECT STATUS

Construction

VALUE CHAIN COVERAGE

H_2 production route
- Alkaline electrolysis

H_2 end uses (target off-takers)
- Energy (power generation, energy storage)

H_2 storage / conversion
- Cylinder

HyBalance

LEAD DEVELOPER

Air Liquide

PROJECT PARTNERS

- CHN
- Hydrogenics
- Centrica
- Hydrogen Valley
- Ludwig-Bölkow-Systemtechnik (LBST)

PROJECT SUPPORTERS

- Clean Hydrogen Joint Undertaking
- Danish EUDP Program

LOCATION

Hobro

PROJECT DESCRIPTION

HyBalance demonstrates the use of hydrogen in energy systems. The hydrogen is produced from water electrolysis, enabling the storage of renewable electricity from wind turbines. It balances the grid, and the hydrogen is used for transport and in industry.

H_2 PRODUCTION VOLUME

confidential

TOTAL INVESTMENT VOLUME

15 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2015 Start — 2020 Finalisation

PROJECT STATUS

Operations

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis

H_2 end uses (target off-takers)
- Industry
- Mobility

H_2 storage / conversion
- Cylinder

H_2 transport / distribution
- Pipeline
- Trucking

WIVA P&G: Hydrogen Flagship Region

LEAD DEVELOPER

WIVA P&G

PROJECT PARTNERS

WIVA P&G combines the experience of more than 30 completed and ongoing projects and will implement approx. 25 sub-projects within the energy model region.

PROJECT SUPPORTERS

- Climate & Energy Fund Austria
- Research Program "Energy Model Region"

LOCATION

Austria

PROJECT DESCRIPTION

The energy model region WIVA P&G pursues demonstrating the conversion of the Austrian economy to a largely CO_2-neutral structure with the production and use of renewable hydrogen as an important component.

H_2 PRODUCTION VOLUME

3,650 tons/year

TOTAL INVESTMENT VOLUME

80 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2018 Start — 2025 Finalisation

PROJECT STATUS

Construction

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis

H_2 end uses (target off-takers)
- Industry
- Mobility (buses, trucks, trains)
- Energy (stationary fuel cells, gas grid injection)

H_2 transport / distribution
- Trucking
- Ship

BIG HIT

LEAD DEVELOPER

Foundation for the Development of
New Hydrogen Technologies in Aragon

PROJECT PARTNERS

FHA, ITM, Orkney Council, Calvera, SDT, CES, EMEC, DTU, SymbioFC, SFHCA, Giacomini, Ministry of Transport and Infrastructure – Malta

PROJECT SUPPORTERS

- Clean Hydrogen Joint Undertaking
- Scottish Government
- UK Government

LOCATION

Orkney Islands

PROJECT DESCRIPTION

BIG HIT is a six-year demonstration project which aims to create an integrated low carbon and localised energy system establishing a replicable model of hydrogen production, storage, distribution and utilisation for low carbon heat, power and transport.

H_2 PRODUCTION VOLUME

confidential

TOTAL INVESTMENT VOLUME

14 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

PROJECT STATUS

Post-FID (financing, tendering, etc.)

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis

H_2 end uses (target off-takers)
- Mobility (cars)
- Energy (stationary fuel cells)

H_2 transport / distribution
- Ship

Shore to Store Demonstration Project

LEAD DEVELOPER

Port of Los Angeles

PROJECT PARTNERS

- California Air Resources Board
- South Coast Air Quality Management District
- Kenworth Trucks
- Toyota
- Shell
- Port of Hueneme
- UPS
- Southern Counties Express
- Total Transportation Services

PROJECT SUPPORTERS

California Air Resources Board

LOCATION

Los Angeles

PROJECT DESCRIPTION

This project provides a large-scale "shore-to-store" plan and a hydrogen fuel-cell-electric technology framework for freight facilities to structure operations for future goods movement.

H_2 PRODUCTION VOLUME

confidential

TOTAL INVESTMENT VOLUME

70 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

PROJECT STATUS

Post-FID (financing, tendering, etc.)

VALUE CHAIN COVERAGE

H_2 end uses (target off-takers)

- Mobility (trucks, HRS, service vehicles)

Eyre Peninsula Gateway

LEAD DEVELOPER

H2U

PROJECT PARTNERS

- Mitsubishi Heavy Industries
- Casale SA
- Hexagon AB
- SIAD Macchine Impianti
- NEL Hydrogen
- SMA

PROJECT SUPPORTERS

South Australian Government

LOCATION

Cultana/Port Bonython

PROJECT DESCRIPTION

The Eyre Peninsula Gateway project plans a production precinct near Cultana, an export precinct in the Port Bonython, and a product logistics and infrastructure corridor connecting the two precincts with the Cultana Substation, via existing easements for power, water and gas infrastructure. After the demonstrator stage, the project aims for 1.5 GW electrolysis capacity for 250,000 tons of annual hydrogen production by the end of 2027.

H_2 PRODUCTION VOLUME

15,000 tons/year

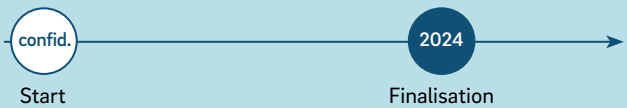
TOTAL INVESTMENT VOLUME

150 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE



PROJECT STATUS

Pre-FID (planning, engineering, de-risking, etc.)

VALUE CHAIN COVERAGE

H_2 production route
- Alkaline electrolysis

H_2 end uses (target off-takers)
- Industry (off-take sectors confidential)

H_2 storage / conversion
- Cylinder

H_2 transport / distribution
- Pipeline
- Trucking
- Ship

Crystal Brook Hydrogen Superhub

LEAD DEVELOPER

Neoen Australia

PROJECT PARTNERS

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PROJECT SUPPORTERS

South Australian Government

LOCATION

Crystal Brook

PROJECT DESCRIPTION

Large-scale hydrogen production from Neoen hybrid renewables project.

H_2 PRODUCTION VOLUME

9,000 tons/year

TOTAL INVESTMENT VOLUME

370 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2018 Start — 2024 Finalisation

PROJECT STATUS

Pre-FID (planning, engineering, de-risking, etc.)

VALUE CHAIN COVERAGE

H_2 production route
- PEM electrolysis

H_2 end uses (target off-takers)
- Industry (chemicals, refineries, steel, and others)
- Mobility (cars, buses, trucks, trains, forklifts, ships)
- Energy (gas-fired power plants, gas grid injection)

FH2R Fukushima

LEAD DEVELOPER

New Energy and Industrial Technology Development Organization

PROJECT PARTNERS

- Toshiba Energy Systems & Solutions
- Tohoku Electric Power
- Tohoku Electric Power Network
- Iwatani
- Asahi Kasei

PROJECT SUPPORTERS

- Ministry of Economy, Trade and Industry (METI) and other ministries
- New Energy and Industrial Technology Development Organization (NEDO)
- Fukushima Prefecture

LOCATION

Fukushima

PROJECT DESCRIPTION

Demonstration project based on the Fukushima Plan for a New Energy Society to lower the cost of hydrogen production based on solar PV as well as ensure reliability and flexibility of the large-scale hydrogen production system. The 10 MW electrolyser is powered by solar PV with 20 MW capacity in Namie Town, Fukushima.

H_2 PRODUCTION VOLUME

200 tons/year

TOTAL INVESTMENT VOLUME

200 EUR m

FUNDING

Publicly and privately funded

PROJECT TIMELINE

2020 Start — TBD Finalisation

PROJECT STATUS

Operations

VALUE CHAIN COVERAGE

H_2 production route
- Alkaline electrolysis

H_2 end uses (target off-takers)
- Mobility (cars, buses)
- Energy (stationary fuel cells)

H_2 storage / conversion
- Cylinder

H_2 transport / distribution
- Trucking

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