

Building a European Research Area for clean hydrogen

EXECUTIVE SUMMARY: THE ROLE OF EU RESEARCH
AND INNOVATION INVESTMENTS IN DELIVERING
ON THE EU'S HYDROGEN STRATEGY

Pozzi Mucelli Stefano

Head of European RDI Support

Rebecca Damotte

Advisor, European RDI Support

Contents

| | |
|---|---|
| INTRODUCTION | 3 |
| EU HYDROGEN R&I ACHIEVEMENTS | 4 |
| CHALLENGES AND OPPORTUNITIES FOR R&I INVESTMENTS | 4 |
| FUTURE EU R&I ACTIVITIES TO ACCELERATE THE HYDROGEN ECONOMY | 5 |
| CONCLUSIONS | 6 |

The European Commission has recently published a [Staff Working Document](#) on the role of European research and innovation investments to deliver on its hydrogen strategy. This document serves as an executive summary for Luxembourg stakeholders.

INTRODUCTION

The Competitiveness Council Conclusions on the new European Research Area of December 2020¹ highlighted the need for a “green” and “digital” twin transition and a resilient recovery as the core directions for translating the “New European Research area (ERA)” into concrete policy and funding actions. The Council called on the Commission and interested Member States to carry out an agenda process for a green hydrogen R&I ERA pilot action in 2021.

Achieving a climate-neutral EU economy by 2050 calls for the EU to ensure a complete switch from fossil fuels to clean (renewable) energy for all energy uses and an extensive decarbonisation of highly emitting industrial sectors, such as steel and chemical industries (most notably refinery and fertilizer plants) as well as the transport sector. It is widely recognised that this would require the production, distribution, storage and use of clean hydrogen at scale.

To this end, the Commission adopted Communications on the EU Strategy for Energy System Integration² and the Hydrogen strategy³ for a climate-neutral Europe, aimed at putting the EU in a leading position for achieving a real deployment of the hydrogen economy. These initiatives set as their ambition to install at least 40 GW of hydrogen electrolysers in the EU by 2030 and to scale up the clean (renewable) hydrogen production in the EU to 10 million tonnes by the same deadline. This would set the EU on track to deploy renewable hydrogen at large scale in the whole economy including in hard-to-decarbonise sectors towards 2050.

The EU Research and Innovation Framework Programmes invested more than €1 billion over the period 2008-2021 into developing hydrogen technologies through two successive Fuel Cells and Hydrogen Joint Undertakings. These partnerships leveraged an additional €1 billion for hydrogen technology investment from the private sector. Several Member States, including Luxembourg⁴, have adopted national hydrogen strategies with an ambitious research and innovation component.

Despite the heterogeneity among the Member States, Europe is in pole position to be the world leader in clean hydrogen technologies. Such leadership can only be maintained through increased research and innovation (R&I) efforts at both the EU and the national level, with a strong component of international cooperation.

¹Council conclusions on the New European Research Area 13567/20
<https://data.consilium.europa.eu/doc/document/ST-13567-2020-INIT/en/pdf>

² https://energy.ec.europa.eu/topics/energy-system-integration_en

³ https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

⁴ <https://gouvernement.lu/dam-assets/documents/actualites/2021/09-septembre/27-turmes-hydrogene/Strategie-hydrogene-LU-executive-summary.pdf>

EU HYDROGEN R&I ACHIEVEMENTS

The successive Fuel Cells and Hydrogen Joint Undertakings (FCH JU) under the 7th Framework Programme and Horizon 2020 played an important role in structuring and mobilising an otherwise fragmented landscape of different sectors and industries. During this time and under this programme, the European hydrogen market has considerably scaled up, creating EU technology leaders in the areas of electrolysers, hydrogen refuelling stations (HRS) and fuel cell buses.

Today there are 21 “hydrogen valleys” in the European Union⁵ showcasing the hydrogen economy locally by bringing together all the elements of hydrogen production, storage, distribution and end-use in a single space. The FCH JU have supported the development of hydrogen valleys through investments of €35 million and through Project Development Assistance (PDA), which aims at promoting the participation of regions in their projects and activities. For the next steps, the intention is to focus especially on regions that are less developed in the field of hydrogen, in particular in newer Member States.

The Luxembourg research and innovation ecosystem is also active in this field, both at low technology readiness level (TRL) and closer to real world deployment. On the more speculative research side, the Luxembourg Institute of Science and Technology (LIST) hosts the CleanH2⁶ ERC Consolidator Grant, a prestigious individual grant awarded to excellent researchers, aimed at developing new thin films for the clean production of hydrogen. Another initiative with low TRL is Paul Wurth’s participation in the 112CO2⁷ project, which proposes a new chemical reactor capable of using methane for the production of carbon dioxide-free hydrogen in a cost-effective way. At higher TRL, Paul Wurth participates in the GrInHy2.0⁸ and MultiPLHY⁹ projects, which are demonstrating industrial production of green hydrogen.

CHALLENGES AND OPPORTUNITIES FOR R&I INVESTMENTS

Today, many hydrogen technologies/applications are ready for market deployment but remain comparatively more expensive than competitor technologies. Substantial R&I efforts are still needed to improve the efficiency, cost, durability and manufacturability of technologies for hydrogen production, distribution and end-use and optimise their market-readiness and scaling up. Scientific advancement will be required to secure cost reductions and efficiency improvements in the production and use of applications at higher TRLs. Further R&I activities covering large-scale demonstration projects are vital in proving the feasibility of and potential for using large-scale electrolysers, and large-scale clean hydrogen end-use applications. Additional R&I efforts should be also placed on new technologies to produce renewable to continue supporting EU leadership.

The availability of abundant and low cost renewable energy is very important to ensure the production of green hydrogen. Europe will continue to support both renewable energy and smart sector

⁵ <https://www.h2v.eu/>

⁶ <https://cordis.europa.eu/project/id/865985>

⁷ <https://cordis.europa.eu/project/id/952219>

⁸ <https://cordis.europa.eu/project/id/826350>

⁹ <https://cordis.europa.eu/project/id/875123>

integration, especially looking at market uptake and the development of breakthrough technologies for renewable energies.

The scope of hydrogen-related applications is increasing from its present focus on transport, fuel cells and electrolyzers. It is expanding to include the energy sector and industry and is focusing on specific transport applications (maritime, aviation, rail, heavy transport). With the constant emergence of new applications, the supply chain becomes more complex. The development of infrastructure for the distribution of hydrogen is slow. The development of the required suitable and safe infrastructure for hydrogen transport, storage and distribution will require R&I activities, for example to address the challenges of injecting hydrogen into the gas grid, demonstrating large-volume refuelling stations (> 1 tonne of hydrogen per day) and handling the transportation of liquid hydrogen, e.g. by trucks. The development of infrastructures needs significant investment and should therefore be planned in a sound manner across the whole system in order to avoid costly stranded assets and duplications.

Finally further R&I efforts are needed to address various issues of technologically crosscutting importance, such as:

- the circularity of hydrogen equipment;
- the environmental and socio-economic impact of hydrogen technology;
- the reduction of the use of and dependence on critical raw materials;
- safety issues along the whole value chain in order to build the confidence needed for widespread take-up in society;
- research on how to increase public awareness and acceptability; and
- the development of skills for industries at all stages of the hydrogen value chain.

FUTURE EU R&I ACTIVITIES TO ACCELERATE THE HYDROGEN ECONOMY

To address the challenges identified above, Cluster 5 “Climate, Energy and Mobility” of Horizon Europe, the new EU R&I Framework Programme, will invest €15 billion during the period 2021- 2027 in clean energy, mobility and climate sciences. This includes an €1 billion contribution to the **Clean Hydrogen Joint Undertaking**, leveraged with a €1 billion contribution from industry. This partnership will focus on renewable hydrogen production, but also on hydrogen transmission, distribution and storage, alongside transport and other end-use technologies.

The new partnership will have a large spectrum of activities. To mention only some, the partnership will for example invest in solutions for offshore wind energy directly producing clean hydrogen, and it will continue to support hydrogen valleys. It will work on connections between hydrogen valleys, thus establishing hydrogen corridors across the EU. Moreover, in order to continue increasing the uptake of project results by Member States and regions, ensuring effective cooperation between different stakeholders and pooling funding and financing resources across Europe, the Clean Hydrogen Joint Undertaking intends to provide technical assistance e.g. through procurements of services, or through the instrument of “Project Development Assistance for Cities and Regions”.

Enhancing R&I at all TRL is a pre-condition for increasing energy efficiency and reducing the cost of the entire hydrogen value chain. This will be done through a synergic approach involving a whole range of

existing instruments, e.g. **Horizon Europe** (notably the European Research Council, European Innovation Council, Horizon Europe clusters), the **European Institute for Technology and Innovation EIT** (notably its Knowledge and Innovation Community KIC InnoEnergy) and the **Innovation Fund**. This chain will also be linked with investment programmes inside of the EU as well as outside (in particular the **Catalyst Fund**¹⁰ and the **Mission Innovation**¹¹ leveraging capacity).

The **IPCEI** (Important Projects of Common European Interest) instrument, under consideration by Member States, would aim to support large-scale, cross-border hydrogen projects, in the common interest of the European Union. Investment projects from industry will benefit from the Hydrogen Alliance structure set up for clean hydrogen. The **Clean Hydrogen Alliance**¹² is developing a high-visibility pipeline of ‘bankable’ investment projects for the large-scale deployment of hydrogen in Europe and covering the whole hydrogen value chain. This will facilitate coordinated investments between private and public stakeholders across the EU, provide public support where appropriate and crowd in private investment.

CONCLUSIONS

The sustained EU support through the EU Research and Innovation Framework Programmes, including through the successive Joint Undertakings, has contributed to making the EU a world leader in hydrogen technologies. The steep increase in domestic electrolyser capacity and the success stories in fuel cell buses, hydrogen refuelling stations and hydrogen valleys, among other fields, bear witness to the strength of this targeted and coordinated EU approach.

Synergies between the Clean Hydrogen Joint Undertaking under Horizon Europe, the European Hydrogen Alliance and other relevant partnerships and programmes will create the innovation ecosystem to scale up hydrogen supply and demand.

The concerted action of the Commission and Member States in a ‘green hydrogen R&I ERA pilot’ will drive the implementation of a commonly agreed strategic research agenda and support open innovation, for example by the improvement of technology infrastructures such as test beds, data sharing and the development of education and skills.

All stakeholders are invited to embrace and actively support the ongoing and planned initiatives set out in the [European Commission’s Staff Working Document](#) to deliver on the European hydrogen strategy.

¹⁰ <https://www.breakthroughenergy.org/scaling-innovation/catalyst>

¹¹ <http://mission-innovation.net/>

¹² https://ec.europa.eu/growth/industry/strategy/industrial-alliances/european-clean-hydrogen-alliance_en