# PROJECT $H_2$SHIFT: Supporting innovation in hydrogen production through open innovation

**Highly specialised facilities and providers of technical and non-technical business support services provide a comprehensive portfolio of resources for hydrogen start-ups and companies**

**THE EUROPEAN UNION'S (EU)** strategic vision for a climate-neutral economy by 2050, as outlined in the Communication 'A hydrogen strategy for a climate-neutral Europe' (COM/2020/301), places clean hydrogen production at the core of its decarbonisation agenda. The strategy sets ambitious targets: by 2030, the EU aims to produce 10 million tonnes (Mt) and import an additional 10 Mt of renewable hydrogen, supported by the deployment of 40 GW of electrolyser capacity – 20 GW within the EU and 20 GW in neighbouring regions.

Further developments in the political framework have resulted in a fully-fledged legislative framework for the production, consumption, infrastructure development and market rules for a future hydrogen production market, as well as binding quotas for renewable hydrogen consumption in industry and transport.[1] Investment mechanisms, e.g. through the Innovation Fund under the umbrella of the Hydrogen Bank, have been implemented to reduce the cost gap between renewable and fossil hydrogen in the EU, and support the renewable hydrogen market formation with de-risking of the European hydrogen projects.

To catalyse this transition, the European Commission established an intermediate target of 6 GW of installed electrolyser capacity by 2024, primarily leveraging mature technologies such as alkaline electrolysis (AEL) and proton exchange membrane electrolysis (PEMEL). However, progress towards this milestone appears to have been insufficient,[2] underscoring the urgent need for intensified efforts to scale up hydrogen production capacity and diversify technological pathways.

Achieving the 2030 targets requires not only the expansion of existing technologies but also the acceleration of innovation in emerging and lower technology readiness level (TRL) solutions. These include:

- Less mature electrolysis technologies, such as solid oxide electrolysis cells (SOEC), proton conductive ceramic electrolysis (PCCEL), and anion exchange membrane electrolysis (AEMEL).
- Low TRL hydrogen production routes, including direct solar water splitting (photoelectrochemical and thermochemical processes) and offshore wind-powered electrolysis.
- Alternative feedstocks – such as biogas, biomethane, and bioethanol – to complement water electrolysis and enhance system flexibility.

The Clean Hydrogen Joint Undertaking's Strategic Research and Innovation Agenda (SRIA) identifies key challenges in clean hydrogen production – notably the need to reduce the levelized cost of hydrogen (LCOH) to below €3/kg. This requires a dual approach: improving the performance and cost-efficiency of commercial technologies (AEL, PEMEL) while fostering the development and integration of next-generation, high-efficiency systems.

## The $H_2$SHIFT project

The Horizon Europe $H_2$SHIFT project – Services for Hydrogen Innovation Facilitation and Testing, project ID 101137953, co-ordinated by Snam – is designed to accelerate the development, validation, and market readiness of innovative hydrogen production technologies, in alignment with the European Union's hydrogen strategy and the Clean Hydrogen Joint Undertaking's Strategic Research and Innovation Agenda (SRIA). The project's overarching ambition is to establish a European-wide Open Innovation Test Bed (OITB) that enables the emergence of next-generation hydrogen production pathways that are efficient, cost-effective, and scalable.

## The technological focus and the services on offer

$H_2$SHIFT investigates, tests, assesses, and upscales


emerging hydrogen production technologies, offering comprehensive 360° support services for startups and SMEs – including prototyping, upscaling, circularity, sustainability, and business development – to help advance technologies from TRL3 to TRL8.

The focus of the project is on the following emerging technology areas:

- Alternative electrolysis, including high temperature and anion exchange membrane (AEM) electrolysis.
- Hydrogen production from bio-based feedstocks (biogas/biomethane and bioethanol).
- Direct solar hydrogen production through thermochemical water splitting and photo-electro-catalysis.
- Hydrogen production from offshore wind energy.

Testing services for the above technology areas are offered by test lines located around Europe and managed by expert research and innovation specialists:

- Alternative electrolysis: **IREC**, the Catalonia Institute for Energy Research, has mobilised test stations from the watt- to the MW range for the characterisation of high temperature electrolysis, with facilities also for characterising pilot plants in real environments using real power profiles from installed renewable energy capacity. The Hydrogen Centre at the **University of South Wales** features AEM electrolysis testing lines, including a 1-10kW prototype line and a technology upscaling line, including a 100kW showcase Anion Exchange Membrane electrolyser unit. As well as conducting full performance testing and improvement, the Centre offers advice to manufacturers on innovative application of safety and control approaches.
- Bio-based hydrocarbon: **Tecnicas Reunidas**, a global engineering company based in Spain, offers a state-of-the-art facility that includes a syngas upgrade and purification unit, to obtain pure H2 (mobility grade) from ethanol reforming, with complete system testing in operational conditions. **Snam**, Europe's leading natural gas infrastructure operator based in Italy, makes available a cutting-edge facility for the conversion of biogas/biomethane to bio-hydrogen through steam methane reforming (SMR) and methane decomposition (plasmalysis/pyrolysis).
- Direct solar: **Politecnico di Torino**, also based in Italy, has a pluriennal expertise in the development, characterisation and testing of electrochemical and thermochemical processes and technologies for energy conversion, with special focus on projects related to hydrogen processes.
- Offshore wind: **Youwind** specialises in evaluation of engineering feasibility and financial viability of offshore wind farms. Its test line will evaluate the business case for hydrogen production and storage in offshore wind parks. A wind gallery owned by **Politecnico di Torino** within **Envipark** facilities is also available for scale testing.

The hardware testing services are complemented by software-based development support, i.e. modelling and simulation. Partner **Resolvent** specialises in multiphysics numerical modelling that can be used for conceptual modelling (all relevant physics), numerical testing of new product concepts/designs, sensitivity analysis, optimisation, upscaling, etc.

Finally, support is provided on acceleration, business development, and technoeconomic, safety and life cycle analysis by the projects' expert through the test line managed by **CDI**, who provides strategic advice and support to companies on innovation-related projects to tackle complex future challenges.

## Demonstrating the OITB model

The project is validating the service offering through a number of showcases involving project partners **Politecnico di Milano** (electrified biogas/biomethane steam reforming unit based on a patented reactor configuration), **H2B2** (advanced solid oxide electrolyser stack), **Viver Clean Tech** (compact methanol reforming), and external companies **Protium** and **HeatH**. Showcases are an opportunity to test the suite of the services on offer, enabling the creation of a case study that can serve as a reference for startups and SMEs looking to leverage these services.

**Politecnico di Milano** (POLIMI) electrified steam methane reformer (e-SMR) is designed for the production of low-carbon hydrogen from biogas and biomethane, putting into advanced concepts of electrification and system intensification for hydrogen production. This technology is a compact, high-efficiency reactor developed by the Energy Department's Group LCCP at POLIMI and composed of resistive heating elements embedded in porous copper-based materials, packed with highly active catalytic pellets.

**Snam** will support POLIMI in evaluating both the lab-scale and pilot-scale prototypes of the e-SMR. First, an upscaled prototype will be realised through a collaboration between POLIMI and Snam, followed by laboratory testing to validate its thermal performance and hydrogen production effciency. The test line will allow the e-SMR reactor to be operated continuously, during which energy input, and thermal stability will be closely monitored. A gas chromatograph will be used to assess output gases, while internal sensors (thermocouples) will measure actual versus predicted temperature profiles – helping to refine POLIMI's in-house mathematical model.

Alongside the technical validation, **CDI** will manage the partners' contribution for:

- A techno-economic analysis to calculate the levelised cost of hydrogen (LCOH).
- A regulatory compliance check to determine feasibility for market deployment.
- An optional life cycle assessment to quantify the environmental footprint of bio-hydrogen from e-SMR.

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**H2B2** is developing a high-temperature electrolysis stack designed to produce low-carbon hydrogen more efficiently. A key innovation in this stack is the integration of 3D printing technology in the manufacturing process. Using stereolithography (SLA), H2B2, in collaboration with the IREC, has developed corrugated electrolyte membranes, thus enhancing hydrogen output and mechanical stability while maintaining a compact stack design. This breakthrough optimises performance, simplifies component integration, and improves the system's overall efficiency and cost-effectiveness.

The available capabilities within $H_2$SHIFT have been combined to provide H2B2 with valuable data to address the following phases of technology development:

- **IREC** will conduct the technical evaluation of the SOEC stack. Electrochemical testing, including current-voltage characterisation and long-term durability tests at 850–900°C, will provide critical data on efficiency and performance. The findings will help fine-tune the design of the stack and validate its operation under realistic hydrogen production conditions.

- **Resolvent** will apply multiphysics simulation tools to assess the internal thermomechanical behaviour and optimise the design of the SOEC stack. The goal is to improve gas flow distribution and reduce internal stress through advanced modelling, ultimately contributing to a more robust and scalable hydrogen production solution.

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**Viver Cleantech's** methanol reformer will be used to demonstrate the integration of reforming and purification technologies in a flexible and robust testing environment, moving toward the production of high-purity hydrogen from methanol/water feedstocks.

The methanol reformer, developed by Viver Cleantech, will be connected to **Técnicas Reunidas's** (TR) advanced pressure swing adsorption (PSA) skid, designed to purify hydrogen by removing CO, $CO_2$, $H_2O$, $CH_4$ and other impurities. The site will be adapted to connect and integrate all necessary interfaces from the reformer: fuel supply, syngas outlet, venting, condensate management, and control system connections. Flexible blending panels allow simulation of various gas compositions for detailed performance testing, while the reformer and PSA are integrated to condition and recycle off-gas streams. TR's facilities offer a full-scale industrial platform, providing utilities, safety infrastructure, process control systems, and specialised engineering support for system integration.

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The **University of South Wales' Hydrogen Centre** is co-operating with **Protium** to explore the performance and commercial potential of a 100kW anion exchange membrane (AEM) electrolyser, installed and operated at the Centre's premises. This showcase is designed to validate the effectiveness of AEM technology in delivering clean, cost-efficient hydrogen production – supporting the $H_2$SHIFT mission to accelerate hydrogen innovation through real-world testing.

The Protium electrolyser is tested for:

- Operational performance: Evaluate hydrogen output, efficiency, load response, and startup/shutdown

behaviour. The system should meet production targets with stable performance under varying loads.

- Durability and longevity testing: Test continuous and cyclic operation, identify component wear, and estimate lifespan.
- Gas purity and safety testing: Ensure hydrogen meets purity standards, detect leaks, with no appreciable gas crossover.
- Efficiency and energy use testing: Measure energy and water use, Faradaic efficiency, and thermal control to assess performance.
- Economic and cost analysis: Estimate the unit cost of hydrogen produced, evaluate operating/maintenance costs.
- Safety and compliance testing: Verify emergency systems, check regulatory compliance, and minimise environmental impacts.

By testing the AEM electrolyser under dynamic, long-term, and safety-critical conditions, this showcase will generate valuable data to support scale-up and commercialisation of AEM technology.

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H₂SHIFT project has established a connection with Snam's HyAccelerator, a leading corporate accelerator for hydrogen and decarbonisation technologies, to support the first industrial deployment design (FID-d) of a startup or SME's hydrogen-related innovation. The selected beneficiary – the Swedish start-up **HeatH**, chosen among the applicants of the HyAccelerator 2025 edition, 'Net Zero Revolution', will receive support from **CDI** focusing on business development, mentoring, and go-to-market strategy.

Services include:
- Perimeter definition for a tailored use case.
- Monitoring of results and project milestones (PMO).
- Market trend analysis, benchmarking, and deep-dives.
- Development of a roadmap for industrial deployment.
- Strategic mentorship and ecosystem navigation.
- Communication and visibility support.

This showcase represents a strategic bridge between acceleration and real industrial validation. It offers an invaluable opportunity for a startup or SME to benefit from high-level expertise, market insight, and operational support while preparing their solution for scaling. Through this collaboration, H₂SHIFT not only validates its services but also empowers innovative hydrogen ventures to reach the next level of commercial and industrial readiness.

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## Access to the services

The showcases are demonstrating how H₂SHIFT can fully support developers in advancing their innovation. H₂SHIFT will soon open its service to other companies developing technologies in scope. Access to the H₂SHIFT services on offer will be available through a single entry point (SEP), managed by CDI. The SEP will evaluate the needs of the applicants to match them to the technical and non-technical support within the consortium, thus tailoring the offer to the needs of the developers. The SEP was launched in June 2025 in view of the upcoming open calls.

## Next steps

At the end of 2025, the project will launch the first of two open calls for start-ups and companies developing technologies in the project's focus areas. The calls will allow up to 12 candidates to access the H₂SHIFT services with subsidy by the project. With a webinar planned for the end of November and a roadshow covering Italy, France, and Spain, H₂SHIFT will reach potential candidates throughout Europe to disseminate the opportunity and the mechanisms of the calls.

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