



Skills Magazine

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Foreword



■ Europe’s hydrogen ambitions depend on people. Scientific advances, industrial investment and infrastructure deployment can deliver lasting value only if Europe develops the knowledge and skills to turn innovation into practice. Building this capacity is essential to industrial competitiveness, quality employment and a more resilient and sustainable European energy system.

For Hydrogen Europe Research, skills are one of four complementary pillars, alongside fundamental and applied research, research and technology infrastructures, and European policies supporting the sustainable development of the hydrogen sector. These pillars reinforce one another. Research generates new knowledge; infrastructures enable experimentation, validation and practical learning; policy provides direction and the conditions for deployment; and skilled people connect these efforts across institutions, industries and borders.

Our Autumn 2026 thematic publication places this connection at its centre. It brings together the white paper “Towards European-wide Recognition of Hydrogen-Related Qualifications and Training” and contributions from our members showcasing educational programmes, training resources and learning initiatives. Together, they connect a shared European policy discussion with the experience of organisations developing and delivering hydrogen education and training.

The white paper addresses a practical challenge: how can learning achievements become more understandable, trusted and transferable across Europe? As hydrogen technologies develop, learners need clear routes into employment and professional progression. Employers need reliable evidence of competence. Education and training

providers need ways to connect their programmes and recognise relevant learning acquired elsewhere, including through professional experience.

Our perspective is that progress should build on existing European instruments and national qualification systems, supported by stronger cooperation between research, education, industry and public authorities. Transparent learning outcomes, credible assessment and quality assurance can help establish this trust. Digital credentials can make achievements easier to communicate and verify, while recognition depends on clear arrangements between the organisations responsible.

Recognition must also be connected to the capacity to develop skills. Research organisations and universities have a particular contribution to make: bringing emerging knowledge into teaching, supporting trainers, and opening laboratories and technology infrastructures to practical learning. Cooperation with vocational education providers and industry can help translate these assets into accessible pathways for new entrants and experienced workers alike.

The member contributions accompanying this white paper illustrate the breadth of this effort, from academic education and collaborative projects to practical training and peer learning, including cooperation beyond Europe. They offer experience on which our community can build, share approaches and develop further partnerships.

As President of Hydrogen Europe Research, I see this publication as an invitation to turn that collective experience into sustained action. By connecting skills development with research, infrastructures and policy, we can strengthen Europe's ability to develop, manufacture and deploy hydrogen technologies—and ensure that the people enabling this transition can learn, contribute and progress throughout their careers.



Dr Luigi Crema
President, Hydrogen Europe Research



WHITE PAPER »



Executive Summary



- Europe does not need a new recognition architecture for hydrogen skills; it needs a sector-specific way to use the tools it already has. The European Qualifications Framework (EQF), linked National Qualifications Frameworks (NQFs), quality assurance arrangements, micro-credentials, Europass, and European Digital Credentials for Learning already provide a basis that can be used to make hydrogen-related qualifications transparent, comparable, and portable.

The main gap is practical rather than conceptual. Hydrogen training provision is growing through higher education, VET, upskilling and re-skilling initiatives, but providers, employers and public authorities still lack shared approaches to the mutual recognition of learning achievements.

This draft proposes a pragmatic roadmap focused on voluntary coordination. It does not call for curriculum harmonisation or a new mandatory certification regime; instead, it recommends a common European recognition approach for hydrogen-related learning offers, starting with learning outcomes, NQF/EQF alignment, quality-assured micro-credentials and portable digital credentials, and pilot qualification (mastery) pathways supported by trusted sectoral actors.



Background and Rationale



- The scale-up of hydrogen technologies in Europe is creating considerable demand for workers across production, storage, transport, distribution, and end-use applications. This has already triggered various training and curriculum initiatives in the sector.

At the same time, the recognition landscape remains fragmented. Qualifications can already be compared through the EQF, which works as a translation tool across national systems and NQFs. Nevertheless, this does not automatically imply a recognition of formally equivalent training offers, as the EQF and NQFs describe levels of training and general learning outcomes, but do not specify learning content and do not take recourse to any sector-specific qualification needs or even internationally agreed job descriptions.

This matters because hydrogen is not a single occupation. It cuts across a variety of professions, including, but not limited to, technicians, operators, safety specialists, engineers, educators, and managers. Whilst formal education uses the European Credit Transfer System (ECTS) as a system of standardised measuring of student learning effort, based on a common understanding of university degree quality, such a system does not exist for vocational training. Furthermore, recognition of vocational training must work across vocational education and training (VET), continuing professional development (CPD), as well as short-course learning for up- and re-skilling. This requires the establishment of a standardised measure of trainee effort and joint recognition of qualification profiles aligned with the EQF/NQFs (Green Skills for Hydrogen, 2024).

In practice, learners need certificates that assert their qualification, documented by the education and training they have received. This is key especially in worker mobility, both within national and international job markets. The non-university hydrogen training market, though, lacks equivalent clarity to the ECTS system, including transferability and trusted qualification levels (European Commission, 2026).

Purpose and Scope

This white paper is a discussion and positioning document for European stakeholders active in hydrogen skills, including VET providers, industry, research institutions, and public authorities, but just as well universities, colleges, and VET institutions within national formal education structures. Its purpose is to identify a feasible route towards wider recognition of hydrogen-related qualifications and training in Europe, with the main emphasis on VET, upskilling and reskilling.

In this paper, recognition refers to several distinct processes: acceptance of learning outcomes towards further education or a qualification; validation of competencies acquired through non-formal and informal learning, including work experience; acceptance by employers for recruitment or professional progression; and, where applicable, recognition for access to regulated professions or activities. These processes involve different decision-makers and requirements. Each proposed recognition arrangement should therefore specify what is being recognised, by whom and for which purpose.

The paper distinguishes between two different layers of value in hydrogen learning offers: On the one hand low-barrier badges for visibility and motivation that can be added to a Europass CV, and on the other hand, recognised micro-credentials and mastery pathways for documented short-form learning, and full qualifications where quality and effort standards, credible issuers and accreditation routes, and industry-backed endorsement are required.

Why Recognition Matters

European-wide recognition can support three practical goals for the hydrogen economy.



Labour mobility: Employees and job seekers must be able to document and prove their qualification in the national and European job markets, especially in an emerging market where expertise is scarce.



Skills matching: Employers need understandable, trusted documentation of level, scope, and quality of hydrogen-related training and qualifications.



Faster scaling: Comparable and portable credentials improve the overall quality of training, make training offers comparable, and help industry and education providers to align industry expectations with educational offers.

A typical example is a technician trained in hydrogen technologies in one country who applies for a role or further training in another. Clear documentation of learning outcomes, practical assessment, issuer status quality assurance helps the receiving employer or institution assess the technician's competences. Where the qualification has an officially assigned NQF level referenced to the EQF, this provides an additional basis for comparison. The employer may accept this evidence for recruitment, while an education or awarding institution may recognise it towards a programme or qualification under its own applicable rules. Neither outcome automatically grants access to regulated activities or replaces task-specific authorisations and site-specific safety training.



Existing European Tools



Higher Education

The Bologna Process and European Credit Transfer and Accumulation System (ECTS) are mature instruments allowing transfer and recognition of university credits and degrees across Europe. They also offer useful design reference for hydrogen qualifications beyond academia. They show the value of clear workload definitions, common quality expectations, and transfer arrangements linked to defined curricula rather than isolated training units.

At the same time, ECTS should not be copied mechanically into VET and continuing training. Its strength lies not only in credit volume but in the institutional ecosystem around programme approval, learner registration, assessment, and final award that are far less structured and harmonized in the vocational training world.

Joint and cross-border degree structures are supported through the broader European Higher Education Area, and hydrogen-specific examples such as the Erasmus Mundus Joint Master in Hydrogen Systems and Enabling Technologies (HySET) and the EUREC Master programme (European Master in Renewable Energy), a consortium of 8 universities awarding a joint degree, amongst others, demonstrate that advanced education can already operate in an international, recognised format (Eindhoven University of Technology, n.d.). Nevertheless, there is an absence of an overarching framework for an integrated research and vocational training infrastructure and a need to bring together established leaders from academia, VET providers, and industry to target an internationally competitive skills workforce.

EQF and NQFs

The EQF is the central European reference point that enables comparison of qualifications through eight levels based on learning outcomes, expressed in terms of knowledge, skills, and responsibility/autonomy.

Its practical value for hydrogen lies in its relationship to NQFs. Qualifications are compared and gauged nationally through NQFs, and these national levels are then referenced to the EQF so that qualification levels are comparable across countries (Europass, n.d.).

This means hydrogen recognition cannot bypass national systems. A realistic approach is to support hydrogen-related programmes, modules, and awards in being described in learning outcome language and, where relevant, accredited or otherwise formally recognised within national arrangements that connect to the NQF and therefore the EQF.

For many hydrogen training offers, the most realistic short-term target may not be full formal qualification status, but credible alignment with NQF/EQF logic, using transparent descriptions and quality-assured documentation that can later support recognition routes. Awareness and use of EQF/NQF-based referencing vary on the member state and often remains limited, especially in emerging sectors like hydrogen.

VET, Lifelong Learning and Micro-credentials

For VET and lifelong learning, a flexible means of addressing targeted skills needs. The 2022 Council Recommendation on a European approach to micro-credentials supports their development, implementation, and recognition across institutions, businesses, sectors and borders (European Commission, 2022). Micro-credentials are increasingly used to address labour-market needs through targeted and flexible training, but the landscape remains diverse and still lacks clarity, coherence, and quality assurance, especially outside of formal education systems (European Centre for the Development of Vocational Training, n.d.). Whilst many universities can issue recognised and transferrable micro-credentials in form of ECTS credits, this is currently not possible through non-academic institutions.

For hydrogen, micro-credentials could be especially useful for focused competence areas such as hydrogen safety, electrolyser/fuel cell operation and maintenance, inspection procedures, or permitting-related knowledge, amongst others. Their value will depend on quality, transparent documentation of workload and content, learning outcomes, credible assessment, and a clear link to NQF/EQF formalisms.

A practical distinction between tokens earned by learners will be useful here (Steinberger-Wilckens, 2026):

Badges, informally attributed without the need and goal of wider recognition, can help make learning visible; their meaning depends on the issuer, supporting evidence and assessment requirements.

Micro-credentials can document assessed learning in a more structured way, but need a recognition framework to include transparent information and appropriate quality assurance; and

Larger, stackable Mastery Pathways support broader recognised qualifications where governance, assessment, and endorsement are clearly regulated across a wider area of industry.

Europass and Digital Credentials

Recognition is not only about framework alignment; it is also about portability and trust in day-to-day use. The Europass ecosystem and European Digital Credentials for Learning allow organisations to issue verifiable digital credentials, including diplomas, training certificates and micro-credentials, in a common European format.

The European Learning Model strengthens this by providing an interoperability model for learning opportunities, qualifications, accreditation, and credentials in Europe, and it is already used in the European Digital Credentials infrastructure and related tools (European Commission, DG for Employment, Social Affairs and Inclusion, n.d.).

The 2020 Council Recommendation on vocational education and training replaced the 2009 ECVET Recommendation and discontinued ECVET credit points as a European credit system, while retaining key ECVET principles concerning learning outcomes, units of learning, flexibility and mobility (The Council of the European Union, 2020). These principles and tools have also continued to be used in practice: for example, the Green Skills for Hydrogen project has applied ECVET-related approaches in developing and delivering modular hydrogen training, including the use of ECVET points for some training courses. For a hydrogen training ecosystem, this creates a practical route from a course or qualification to a credential that can be shared with third parties across Europe. It also supports the creation of structured learning biographies that are more useful for recruitment and cross-border recognition.

Current Hydrogen Skills Landscape

The hydrogen skills ecosystem is already expanding through European projects and institutional initiatives. H2Excellence, for example, is building Centres of Vocational Excellence, lifelong learning offers, transnational curricula and training programmes in fuel cells and green hydrogen, while also including teacher upskilling as a core strand (H2Excellence).

As part of its effort to strengthen skills development in the hydrogen sector, the GreenSkills4H2 project promoted the use of short, targeted learning units that can complement existing educational pathways. These courses are designed to provide flexible upskilling opportunities where current qualification systems may fall short. However, the initiative itself does not introduce a dedicated system for formally recognising credentials, aside from identifying relevant training programmes that could qualify as such. To support this approach, the project relied on ECVET (Green Skills For Hydrogen, 2024).

In higher education, HySET demonstrates that hydrogen-specific advanced education can be organised as a collaborative two-year, 120 ECTS joint Master programme with a strong international dimension (HySET). Doctoral training in hydrogen, through Marie Cuire or independently at universities contributes to training highly qualified and certified experts who often act as trainers/teachers with teaching that frequently goes beyond academia. However, this could be built upon through more structured collaboration between higher education, VET and industry.

Across the wider landscape, providers are creating degrees, modules, short courses, continued professional development (CPD) offers, badges and emerging micro-credentials for different target groups. This shows momentum, but it also makes skills comparisons difficult unless a shared recognition logic is used from the start. Additionally, many member states are still in an early stage, where training and certification activities are carried out through pilot projects, EU-funded initiatives, and sector-specific programmes. As a result, there is no common and widely recognised logic to compare or validate these qualifications across the labour market. Employers often find it difficult to understand what these certificates mean and how they relate to job requirements.

Key Design Principles for Hydrogen Credentials

A hydrogen recognition approach should rely on a small number of design principles that can be applied consistently across providers and countries.



Learning outcomes first: Each educational offer transparently documents the learner knowledge, understanding, and capabilities, having successfully completed a course; these details need to align with NQF and EQF.



Transparent workload: The expected learner effort needs to be documented in hours of direct trainer-learner engagement and overall workload.



Credible assessment: Assessment needs to follow a transparent, credible, and reliable procedure on gauging learning success, including, but not limited to, written and oral exams, project presentations, skills demonstrations, or portfolio folders.



Clear issuer identity: The credential issuing body needs to be named together with contact details and, where relevant, accreditation or quality-assurance status and procedures.



Digital verifiability: Credentials need to be digitally signed or otherwise machine-verifiable, ideally in formats that are compatible with Europass and related infrastructures.



Stackability where useful: Short learning units should ideally, where possible, be part of a broader Mastery Pathway that can lead to further recognised qualification.



Defined validity and review cycle: Each credential should state its issue date, content version and relevant standards;

For safety-critical activities, any validity period, refresher training or reassessment requirement should be specified according to the applicable regulatory, occupational and risk-based requirements. Providers should establish regular content reviews to reflect technological and regulatory developments. Credentials documenting learning achievements should be clearly distinguished from any authorisation required to perform a specific task or work at a particular site.



Credit, Workload and Stackability

One lesson from European higher education is that transfer works best when workload, curriculum logic, and final award conditions are clear and transparent. ECTS credits represent the workload of a full academic year through a 60-credit annual framework, which calibrates the expected workload and amount of content, and help to structure progression and transfer within the European Higher Education Area (EHEA).

For hydrogen training outside universities, the exact credit convention must be well defined, implementing the same principle as with ECTS: an educational unit awarded micro-credentials must represent a clearly defined amount of learner effort. It may or may not, though, sit within a clearly defined Mastery Pathway that would allow learners to collect certificates on a clear route towards a broader recognised outcome.

This is why stackability matters. A good hydrogen micro-credential system should allow short modules to stand alone, but also allow a selection of modules to be built toward larger milestones, whether for an formal institutional certificate, a provider-backed programme, or a nationally recognised qualification, where available.

Quality Assurance

Quality assurance is essential if hydrogen micro-credentials are to be trusted by employers, public authorities and learners. At minimum, quality assurance should cover transparency of learning outcomes, validated, secure and practical assessment procedures, recognised issuing institutions or equivalent provider credibility, quality of content and its delivery, and documented and verified trainer competencies.

Recognition also depends on alignment with national qualification frameworks and, where relevant, the possibility of credit transfer or progression into broader programmes. Without this, micro-credentials risk remaining informative signals rather than recognised steppingstones.

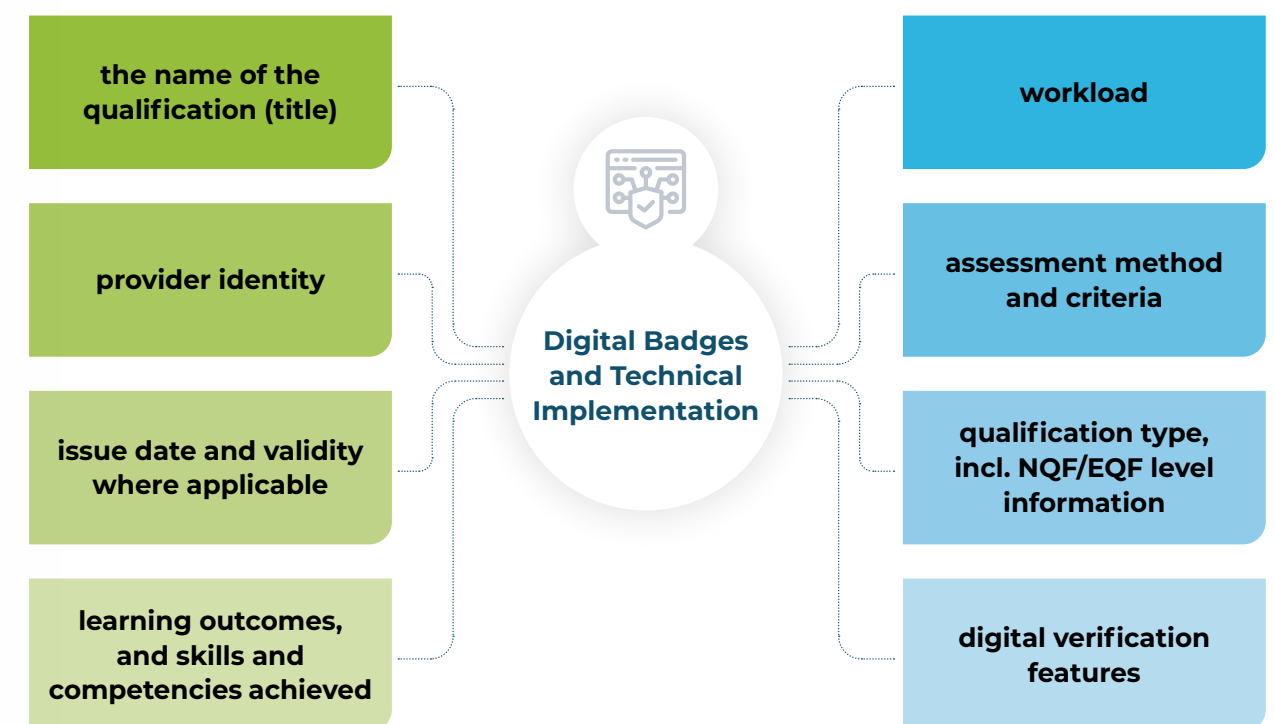
Sector-specific frameworks can constitute a first step in the direction of a generally accepted European framework. In some national contexts, technology or industry competence frameworks already translate EQF logic into occupationally relevant skill structures, which can help hydrogen providers connect technical safety, operational competence, and continuing training needs more directly to recognition pathways.

Digital Badges and Technical Implementation

Digitally verifiable credentials are a practical building block for hydrogen recognition. Open badges and related digital credentials allow learning outcomes to be presented visually while embedding structured metadata on the issuer, assessment, date, skills description, and verification route.

This matters because recognition increasingly happens in digital settings: recruitment platforms, HR systems, online portfolios, and interoperable public infrastructures. A hydrogen training ecosystem that still relies mainly on static documents will be less portable and less trusted than one using secure, machine-readable credentials.

In operational terms, each hydrogen badge, digital credential, or micro-credential needs to include at least



Furthermore, verified credentials could be centrally stored and allow learners to make them accessible to employers, educational institutions etc. if needed and on request.



Key Barriers



- There are certain barriers that currently impede the widespread introduction of recognition of qualifications in the hydrogen space.

Barrier Fragmented Description of Learning Outcome

1 Many hydrogen-related programmes are not described in standard learning outcomes language, so that learners and employers struggle to compare depth, scope, educational level, and competencies achieved.

Barrier Connection to NQF/EQF and National Accreditation

2 A major practical barrier is that hydrogen training offers often do not connect to national and European qualification or accreditation structures. In practice, recognition depends on whether a provider or programme can fit into national rules of accreditation, attribution of qualifications, and quality assurance, which will differ across Member States even when linked to the common EQF logic.

If hydrogen-related training can be anchored in national systems and assigned NQF levels, cross-border transparency is possible as those levels can be read through the EQF.

Barrier Quality Assurance for Short-Form Training

3 Short courses and micro-credentials can respond quickly to skills gaps, but their credibility depends on assessment, provider quality, transparent documentation, and trusted credential arrangements. The diversity of micro-credentials across contexts makes coherence and quality assurance a central issue.

Barrier Weak Portability of Credentials

4 Even where good training exists, credentials are not always easy to verify, compare or share. Interoperable digital credentials and common metadata can reduce these barriers by making the issuer, learning outcomes, assessment and quality assurance arrangements transparent. They facilitate recognition decisions but do not themselves confer academic or professional recognition, which remains subject to the applicable institutional and national arrangements.

Barrier Recognition of Trainer Competence

5 Train-the-trainers programmes are a critical but sometimes overlooked issue. If trainers themselves are not systematically upskilled in hydrogen technologies, safety, pedagogy, and assessment methods, the credibility and consistency of hydrogen qualifications will remain inhomogeneous.

This matters for recognition because trusted qualifications depend on trusted delivery. A hydrogen training ecosystem needs recognised trainer competency profiles and upskilling pathways, not only learner-facing awards.

Barrier Weak Progression Pathways

6 Most short learning offers are designed as isolated outputs rather than as part of a broader Mastery Pathway. Without clear rules on how micro-credentials and recognised qualifications cannot be accumulated by learners as proof of activity towards progressing along a recognised Mastery Pathway route.

Barrier Fragmented coordination

7 Hydrogen-related training and recognition initiatives are often distributed across universities, VET providers, or EU-funded projects, with limited coordination at national and European level. This fragmentation further slows the development of shared standards and recognition pathways.

Project-based mutual recognition can be useful, but if it remains within a limited group of partners or employers, its wider labour-market value remains weak. For hydrogen, the challenge is therefore to move from project-level acceptance to a broader recognition base that employers and institutions across Europe can understand and trust.

Barrier Weak integration with recruitment and HR systems

8 Credentials and qualifications need to be consistently integrated into job markets, recruitment platforms, HR systems, and employer selection processes. Many employers are not familiar with EQF, learning-outcomes-based descriptions, or micro-credentials. This reduces the practical value of these tools in recruitment and limits their use outside education and training systems.

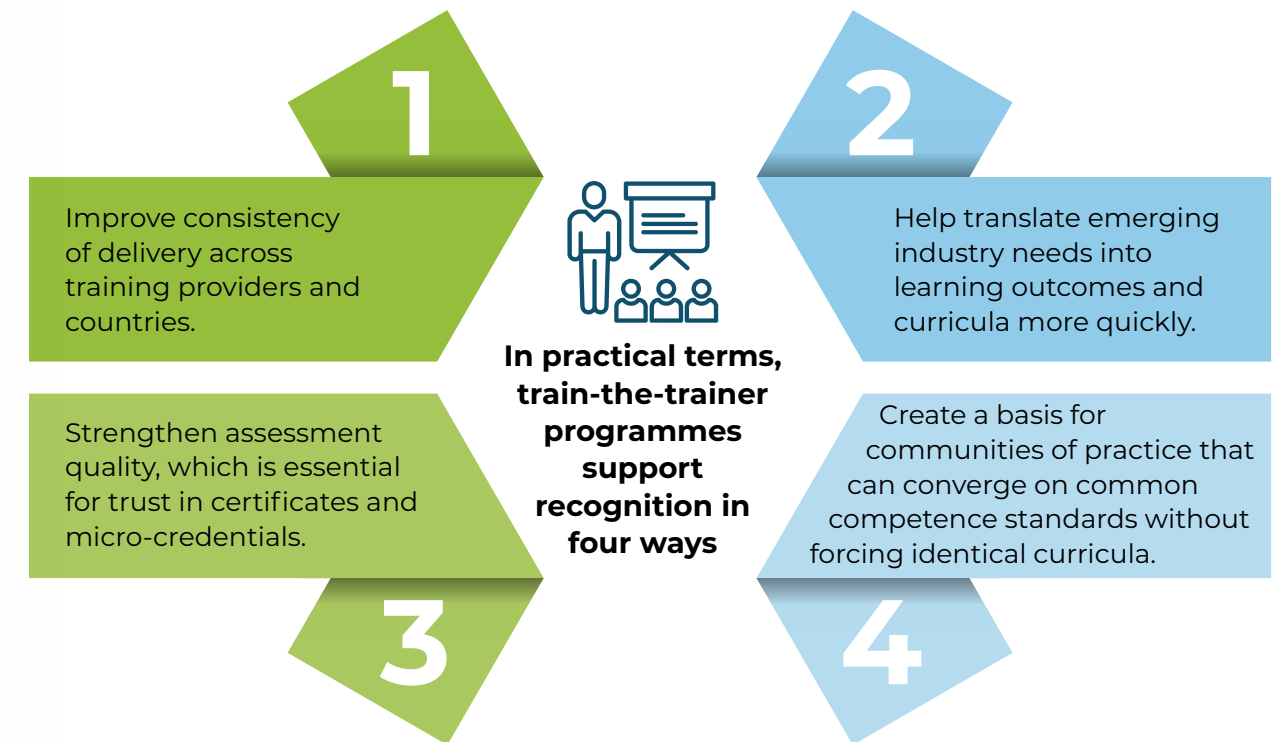
Barrier Lack of a framework for integrating academia and VET with industry qualification standards

9 Need for a framework outlining a more permanent understanding of how university and vocational education and training connect and how they serve industry qualification needs and standards to ensure continuously updated training content and career pathway development.

Furthermore, hydrogen-related keywords need to be introduced into national and European job profile standards to make vacancy offers searchable for key terms that matter to the hydrogen industry.

The Role of Train-the-Trainer programmes

Train-the-trainer education should be treated as part of the infrastructure for course recognition, not as a side activity. Many projects like Green SKHy, Green Skills for Hydrogen, or H2Excellence explicitly include a teacher upskilling training programme, which reflects a broader reality: new industrial sectors cannot scale quality learning without capable trainers who understand both the technical content and how to assess competence (H2Excellence, 2026).



A hydrogen train-the-trainers programme should therefore cover technical content, safety-critical competencies, pedagogy (including e-teaching skills), assessment literacy, and familiarity with recognition tools such as learning outcomes, EQF/NQF alignment, and digital credentials.

What is Happening Now in Europe

At EU level, the policy direction is moving toward stronger portability and transparency of skills certificates. The European Commission's Union of Skills highlights a Skills Portability Initiative to enhance portability of skills and qualifications across the EU, alongside work on a European degree, a new European VET diploma, and stronger support for Centres of Vocational Excellence (European Centre for the Development of Vocational Training, 2025).

This is relevant for hydrogen because it creates a favourable policy window. A hydrogen-sector approach that aligns with European initiatives, policies, and infrastructure targeting skills portability, digital credentials, micro-credentials, and VET excellence is more likely to gain traction than a standalone sectoral system.

At the same time, ongoing Cedefop work on micro-credentials shows that Europe is still actively defining how short-form, employment-relevant learning should connect to labour-market recognition, especially outside formal systems (European Centre for the Development of Vocational Training, 2025).



A Roadmap and its key stakeholders



Phase 1: Build a Common Recognition Vocabulary

The first step is to agree on a hydrogen-specific recognition language that all participating projects and providers can use.

This should include:

Common principles for describing hydrogen-related learning outcomes, assessment criteria and learner workload, consistent with existing European instruments and the 2022 Council Recommendation on micro-credentials;

Indicative mapping of typical hydrogen learning offers to EQF levels, without replacing national authority decisions;

A shared template for describing target group, workload, assessment, safety relevance, and type of delivery; and

A common terminology for describing knowledge, skills, competencies, and responsibility/autonomy in hydrogen occupations.

Phase 2: Review of Potential Alliance Partners and Relevant National Stakeholders

The second step is to work country by country with competent authorities, awarding bodies, accreditation agencies, and providers to identify how hydrogen-related training can be recognised within existing national arrangements.

This may include formal qualifications, accredited modules, continuing training offers (CPD), or micro-credentials recognised by providers, industry sectors, or public authorities, depending on the national context.

The practical output will be a mapping exercise across Member States showing which hydrogen training offers are already accredited, which can be referenced to NQF levels, which can be linked to employer or sector recognition, and which remain outside formal structures but could still adopt European quality and transparency principles.

For each pilot pathway, participating organisations should agree on the intended recognition outcome and identify the competent decision-makers. The arrangements should specify the evidence required, assessment criteria, procedures for validating prior learning, and conditions for accepting learning outcomes towards a broader qualification. Employer endorsement should be distinguished from formal recognition by an awarding institution or competent authority. Pilots should document actual recognition decisions, including any additional training required, to demonstrate how credentials support progression and mobility in practice.

Phase 3: Alliance Building and Agreement on a Hydrogen Credential Data Profile

The third step is to bring together training providers, awarding/standardisation bodies, industry representatives and relevant national authorities to agree what every hydrogen badge, micro-credential, or certificate should contain as a minimum data set. The emphasis should be on enabling collaboration of credible standardization bodies to ensure a critical mass that can push towards subsequent phases.

This should build on the European Learning Model and the standard elements established by the 2022 Council Recommendation on micro-credentials, using ESCO terminology where appropriate. It should specify how existing data fields are applied to hydrogen-related learning outcomes, assessment and occupational contexts, adding sector-specific information only where necessary. The aim is to support interoperability and consistent interpretation across providers and countries.

Phase 4: Develop Quality Principles for Hydrogen Micro-credentials

Hydrogen stakeholders need to define a voluntary quality framework for short-form learning offers that align with the European approach to micro-credentials.

The framework should cover links to NQF/EQF levels, minimum information requirements, assessment expectations, trainer competencies, content review cycles, stackability, and digital issuance criteria.

Phase 5: Make Credentials Portable by Default

Providers then need to move toward issuing hydrogen-related credentials in a verifiable digital format compatible with Europass and the European Digital Credentials infrastructure.e.

This would not solve recognition as such, but make credentials easier to trust, verify, and use across borders. For employers, this is the difference between receiving an arbitrary certificate and receiving a machine-verifiable record with standard metadata and traceability.

Phase 6: Establish a European Train-the-Trainers Strand

A dedicated train-the-trainers programme needs to be part of the roadmap from the start. This could include a hydrogen trainer competencies profile, a shared trainer upskilling programme, peer-learning offers across projects, and guidance on assessment of safety-critical competencies..

Phase 7: Pilot Qualification Pathways

Rather than trying to solve the whole system at once, a few pilot areas such as hydrogen safety, operation and maintenance, permitting, and technician upskilling could be selected for pilot recognition. These pilots could test how micro-credentials and recognised qualifications work in practice across several countries and are stackable towards pathway-based qualifications.

A useful pilot design could include low-barrier badges for awareness, assessed micro-credentials for professional learners, and larger pathway completion certificates for those following a coherent curriculum.

Phase 8: Build Recognition Through Endorsement

Because a single EU-wide formal recognition route does not yet exist for hydrogen training outside formal education, stakeholder endorsement will be an important transitional mechanism. A practical approach would be to secure endorsement or co-branding from credible institutions, trusted sectoral bodies (e.g. Hydrogen Europe, France Hydrogène, etc.), competent industry organisations, and major employers for clearly defined qualification pathways.

Different endorsement models are possible, from simple endorsement of micro-credentials, to co-branded final assessment, to deeper adoption of a full Mastery Pathway by external bodies. The stronger the external involvement, the greater the likely labour-market trust, but also the greater the coordination effort.



Roles of Key Stakeholders

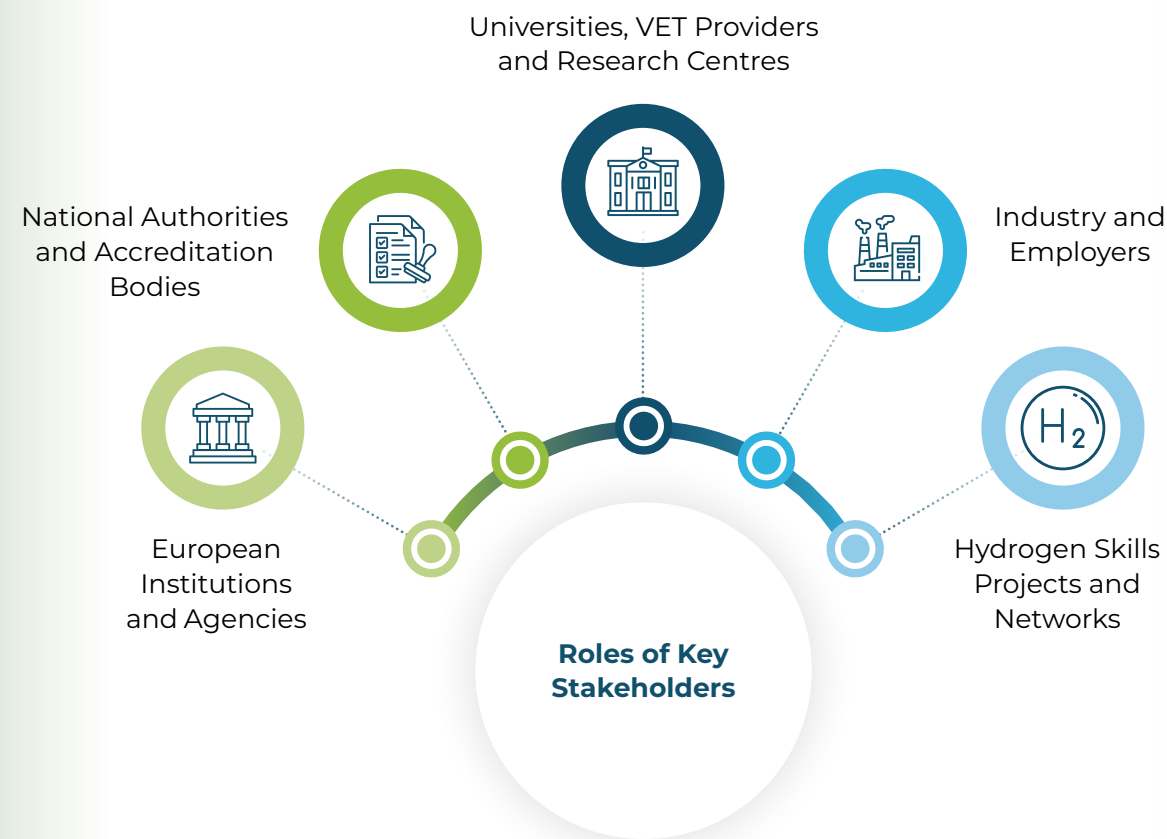


European Institutions and Agencies

European institutions and agencies can provide the enabling framework through policy, transparency tools and guidance on qualifications, credentials and mobility. The relevant direction of travel is already visible in the EQF, the micro-credentials recommendation, Europass digital credentials, and the Union of Skills agenda.

National Authorities and Accreditation Bodies

National authorities remain central because recognition of qualification, accreditation of courses, and award of degrees are largely organised nationally. Their role is to determine how hydrogen-related learning can be integrated into existing national systems and quality assurance arrangements. National authorities/ accreditation bodies will be crucial to take part in the country-by-country mapping exercise proposed in Phase 2, which cannot be completed without them.



Universities, VET Providers and Research Centres

Providers are the actors that can operationalise recognition. They write learning outcomes, design assessments, issue credentials, engage employers, and build the evidence base for what works in hydrogen education and training.

They are also the actors best placed to define coherent pathways rather than isolated modules. In practice this means describing hydrogen offers in learning-outcomes language with declared workload, assessment method and indicative EQF level using the common template proposed in Phase 1, issuing credentials in a verifiable digital format compatible with Europass rather than as static documents, and designing new offers as components of a stackable pathway, stating up front which stand alone and which accumulate.

Industry and Employers

Employers help define which competencies matter in practice and whether credentials carry labour-market value. Their involvement is especially important for up- and re-skilling, emerging occupations, and short-form training where demand signals can change quickly.

In the hydrogen field, employer and association endorsement may also be one of the most realistic near-term bridges between project-based training and wider recognition. This is especially relevant where no single formal recognition route yet exists across countries.

Overall, it is crucial that industry is fully involved and integrated in the process of developing recognised qualifications, to ensure that there is a practical use after inception.

Hydrogen Skills Projects and Networks

Projects and networks can act as testbeds. They can compare approaches, develop templates, pilot digital credentials, test pathway models and create voluntary convergence without waiting for formal regulatory reform.

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MEMBER STORIES »

- **EU PROJECTS**
- **ACADEMIA**
- **NATIONAL-REGIONAL INITIATIVES**
- **INTERNATIONAL PROJECTS**
- **PEER-TO-PEER**
- **PRACTICAL TRAINING**

Green SKHy: Practical Training in FCH Technologies

Funded by the Interreg North-West Europe programme, Green SKHy was created to help prepare the workforce needed for the growing hydrogen economy. The project brings together universities, training providers, companies and public organisations from several European countries to develop practical learning opportunities and support the recognition of hydrogen-related skills across borders.

At the heart of the initiative is an innovative idea: instead of expecting learners to travel to specialised laboratories, why not bring the laboratory to them?

To make this possible, the project developed a mobile hydrogen laboratory consisting of portable experimental equipment that can be transported in standard vehicles and used safely in classrooms or laboratory spaces. The equipment allows participants to explore hydrogen production, fuel cells, electrolyzers and hydrogen safety through hands-on experiments using only very small amounts of hydrogen. This approach makes practical education accessible, flexible and affordable while maintaining high safety standards.

The training programme is designed for a wide range of learners. Professionals looking to upskill, university students, vocational education learners, teachers and trainers all benefit from the courses. A blended learning approach combines online preparation with intensive practical sessions, allowing busy professionals to complete much of the theoretical content at their own pace before attending two days of laboratory-based training. This format has proven particularly attractive for participants who cannot easily leave their workplace for an entire week.

What makes the programme especially distinctive is its emphasis on learning by doing. Participants do not simply observe demonstrations, they assemble fuel cells, operate electrolyzers, perform hydrogen leak detection, interpret performance data and gain first-hand experience with the materials that make these technologies work. Few hydrogen training programmes currently offer this level of practical engagement, particularly in such a mobile and flexible format. Another unique feature is the strong collaboration between education and industry. The project combines academic expertise from the University of Groningen with practical experience from industrial partners such as Deutsche WindGuard, Future.Solutions and PLANET. This ensures that participants learn not only the scientific principles behind hydrogen technologies but also how they are applied in real-world settings. The mobile laboratory itself includes commercial fuel cell systems and demonstration equipment that reflect current industrial practice.

One of the project's greatest achievements has been demonstrating that practical hydrogen education can be delivered successfully outside traditional laboratory environments. Between autumn 2025 and summer 2026, eight pilot courses trained



HER members involved:
University of Groningen,
University of Lorraine

nearly 80 participants with diverse backgrounds, ranging from apprentices and university students to researchers and industry professionals. Particularly valuable were the “teach-the-teacher” courses, which equipped educators to pass their newly acquired knowledge on to future generations of learners, multiplying the project’s impact.

The project has also provided valuable lessons. Organisers discovered that creating an authentic laboratory atmosphere through simple measures such as wearing lab coats and safety glasses helped participants adopt the right safety mindset. At the same time, practical experience highlighted how educational activities must balance effective learning with the perceptions and safety procedures of different training environments. Continuous participant feedback has allowed the team to refine both the content and the delivery of every course.

Looking ahead, Green SKHy aims to expand both its curriculum and its network of practical training facilities. The mobile laboratory concept will continue to evolve, including dedicated trailers for hydrogen safety training and wider deployment through collaborations with initiatives such as HyAcademy and PermittHy. The ambition is to make high-quality practical hydrogen education available wherever it is needed, supporting professionals, educators and future workers across Europe while contributing to the recognition of hydrogen skills and qualifications.

By turning classrooms into laboratories and learners into active participants, Green SKHy is helping ensure that Europe’s hydrogen transition is supported by a workforce with the confidence, competence and practical experience to make clean hydrogen a reality.



*Experimental work in the Energy Building at the Zernike Campus of University of Groningen (RUG)
(Photograph: Andrea A. Cabrera).*

Interreg



Co-funded by
the European Union

North-West Europe

Green SKHy

Green Skills for Hydrogen

The project Green Skills for Hydrogen (GreenSkills4H2, No. 101056448) developed education and training pathways aligned with the evolving needs of the European hydrogen sector. Supported by the Erasmus+ Programme and co-funded by the European Union, the initiative brings together 32 partners across industry, academia, research and vocational education and training. Its activities reach a diverse audience from students, teachers and researchers to technicians, company personnel and public-sector professionals, while creating opportunities for workers to acquire new competencies and transition towards emerging hydrogen-related occupations.

A flexible model grounded in practice

GreenSkills4H2 combines a shared European framework with resources that can be adapted to different education systems, professional contexts and levels of prior experience. The consortium developed three modular curricula based on occupational profiles and clearly defined learning outcomes. Training providers may deliver each curriculum as a complete programme or select individual modules in response to local workforce needs.

The learning model integrates conceptual knowledge with practical application. Presentations and video lessons are supported by laboratory demonstrations, applied exercises and an interactive Hydrogen Game that make complex concepts accessible. A train-the-trainer programme strengthens approaches of educators to adult learning, facilitation and assessment. Guidance on work-based learning and the recognition of emerging qualifications further aligns training with occupational requirements and supports greater comparability of hydrogen skills across Europe.

Evidence of demand and adaptability

The pilot phase provided clear evidence of both the demand for hydrogen-related skills and the adaptability of the training model. GreenSkills4H2 delivered more than 60 training events and engaged over 2,000 participants. These activities ranged from introductory awareness sessions and summer schools to specialised technical courses centred on equipment, safety procedures and hands-on experience.

A central lesson: build for adaptation

A central lesson from the project is that a European training initiative must accommodate substantial differences in institutional capacity, specialist expertise and national education systems. Addressing this diversity required close coordination, clearly defined responsibilities and consistent reporting. The consortium also adapted the timing and format of its final conference to present mature results to a broader audience. The experience confirmed that flexibility is a prerequisite for effective international training.



HER members involved:

Aragon Hydrogen Foundation,
Karlsruher Institut für Technologie,
Technical University of Denmark, The Danish Institute of Fire and Security Technology,
POLITO, University of Galway,
Austrian Institute of Technology,
ICST, University of Perugia



Online training

Hydrogen: Key Concepts and Use in Green Technologies: Online course via Coursera, developed by the Technical University of Denmark.

Video Lectures: Get in-depth, expert insights from DTU researchers as they present their latest results and project experiences.

Lab Series: Go behind the scenes into a Laboratory to see the fabrication of critical components like electrolysis cells and fuel cells.

Train the Trainers video Series: Designed to facilitate the upskilling of VET trainers by equipping them with the knowledge, confidence, and tools to deliver training.



The Hydrogen Game

Enhance your hydrogen training sessions with this free, innovative, and open-source educational tool.

The Hydrogen game is designed to demystify the complex hydrogen and energy value chain, and is built on a simple, groundbreaking method called "icon pedagogy", making it the perfect resource for teachers and trainers.



Trainings in EU countries

This section highlights the successful implementation of pilot training courses, summer courses, masterclasses, delivered across European Union countries:

- Bulgaria
- Denmark
- France
- Greece
- Germany
- Ireland
- Italy
- The Netherlands
- Poland
- Romania

Resources available in the Green Skills for Hydrogen members area

From project results to lasting capacity

To ensure the continued use of its results beyond the funded period, GreenSkills4H2 consolidated its principal outputs into an open-access, implementation-ready training package. Education and training providers can select and adapt these resources to different learner profiles, industrial requirements, technological developments and regional labour-market needs.

Established through the project and currently supported by 64 signatory organisations, the European Hydrogen Skills Alliance provides a structured framework for continued cooperation among industry, education and training institutions, public authorities, research initiatives and other stakeholders. Beyond completion of the project, the Alliance is expected to promote knowledge exchange, wider uptake of the project results and the development of new collaborative initiatives.

GreenSkills4H2 therefore extends beyond the delivery of individual courses. Through shared curricula, validated resources, strengthened educator capacity and closer links between education and employment, it has established a solid foundation for sustained European cooperation. Its long-term strategy focuses on expanding the adoption and continuous improvement of these resources while consolidating the Alliance as a lasting platform for hydrogen skills development.



H2Excellence: Building Skills for Europe's Hydrogen Future

The H2Excellence project was created with a clear mission: to build an active community where education meets innovation in the fast-growing field of hydrogen. Whether you are a student eager to gain hands-on experience, a teacher looking to update your skills, or a company searching for skilled employees, H2Excellence offers something for you.

At its core, H2Excellence is more than just a training programme, it is a platform that brings together learners and experts from across Europe. The project delivers high-quality e-learning opportunities through the [H2Excellenceplatform.eu](https://h2excellenceplatform.eu), where users can access a wealth of resources, courses, and interactive modules. What sets this project apart is its inclusive approach: it welcomes people at different stages of their careers, from young students and apprentices to experienced trainers and industry leaders.

One of the project's hallmarks is its dedication to innovative teaching. Instead of relying solely on traditional lectures, the H2Excellence team has designed learning experiences that mirror real-life challenges. Learners can participate in hands-on activities, join virtual labs, and tackle project-based assignments that develop practical skills. This emphasis on experiential learning means that knowledge gained is not just theoretical, but directly relevant to the workplace.

H2Excellence connects Centres of Vocational Excellence (CoVEs) in Finland, Poland, Italy, France, Portugal and Spain and their satellite partners across Europe, fostering a community where ideas and best practices are shared. This network approach encourages international teamwork, giving learners the chance to work with peers and experts from different countries. Through mobility actions, students and trainers can study or teach abroad, broadening their horizons and building valuable professional relationships.

By working closely with businesses and research organisations, H2Excellence ensures that its courses remain aligned with the latest industry needs. This collaboration results in training that is not only up-to-date, but also directly linked to job opportunities. Significant effort has been dedicated within the project to the development and implementation of micro credentials, which are now effectively integrated throughout the H2Excellence platform. As a result of this work, an article titled "*Micro-credentials within the institutional and regulatory framework of the European Union: a systematic review of literature*" has been accepted for publication in the journal *Indagatio Didactica*, published by the University of Aveiro (Vieira, C. R., & Marta, J. M., *Indagatio Didactica*, 2026, 18(1), accepted for publication).

The project's digital tools make learning flexible and accessible. The [H2Excellenceplatform.eu](https://h2excellenceplatform.eu) is a central hub, offering resources that can be accessed anytime, anywhere. It supports a train-the-trainers programme, ensuring that educators are equipped with



HER members involved:
ENEA,
University of Perugia,
University of Mondragon,
CIEMAT

the latest knowledge and methods to pass on to their students. This cycle of continuous learning and teaching strengthens the overall quality of hydrogen education across Europe.

One of the biggest lessons has been the impact of collaboration. When educators, learners, and industry partners join forces, they can create learning experiences that are engaging and impactful. During the first semester of 2026, the project launched several course pilots, inviting both trainees and trainers to actively participate. Their feedback is now playing a crucial role in refining and improving the courses, ensuring they better meet the needs of all users. Achievements include the development of comprehensive e-learning modules, the successful rollout of mobility programmes, and the recognition of new types of qualifications that make it easier for learners to advance their careers.

Looking ahead, the ambition of H2Excellence is to expand its reach, inspire more people to join the hydrogen sector, and keep innovating in the way education is delivered. By continuing to embrace digital tools, hands-on learning, and international collaboration, the project aims to set new standards for excellence in hydrogen education—not just in Europe, but around the world.

In short, H2Excellence is more than a project—it is a movement that is building a skilled, connected, and forward-thinking community, ready to lead the way in the energy transition.

The H2Excellence platform (<https://h2excellenceplatform.eu/>) offers streamlined access to a comprehensive suite of resources.



Fuel Cells and Green Hydrogen Centers of Vocational Excellence towards affordable, secure, and sustainable energy for Europe (H2Excellence). Grant Number: ERASMUS-EDU-2022-PEX-COVE Project Number: 101104447 Project Period: 15.06.2023 – 14.06.2027.

Hy2Market

Hy2Market is a European Union-funded project that brings together 42 partners from regions across Europe. Supported by the Interregional Innovation Investments programme (I3), the project connects regions with strong hydrogen production potential to regions where demand is developing. Its activities cover the hydrogen value chain, from production and transport to industrial and mobility applications.

Alongside investments in technology and infrastructure, the partners recognised a central question: Is Europe's workforce prepared to plan, build and operate the emerging hydrogen economy safely and effectively?

To better understand the skills needed in the emerging hydrogen sector, the Hy2Market team examined the practical requirements of companies and professionals.

Existing training programmes in the Netherlands, Austria and Greece were mapped and compared. At the same time, 38 Hy2Market partner organisations were surveyed about the knowledge required for 14 different roles. These ranged from engineers, operational staff and safety specialists to project managers, finance professionals, purchasing departments and senior management.

The beneficiaries are therefore not limited to one profession or education level. They include students preparing for future careers, engineers and technicians entering hydrogen-related roles, employees who need additional training, managers responsible for investment decisions and professionals transferring from established energy and industrial sectors.

The study showed that there is no single set of "hydrogen skills" that applies to everyone. Mechanical and chemical engineers need detailed technical, material and process knowledge. Operational staff require practical experience, equipment-specific knowledge and a strong understanding of safety. Even employees without a technical role need enough basic knowledge to assess contracts, projects and strategic decisions.

Formal education provides an important foundation. However, the findings show that many of the skills required in hydrogen projects are developed through practical experience. On-the-job learning was repeatedly among the most highly valued learning methods in the survey and, for several roles, emerged as a particularly important source of competence. Learning on the job, mentoring, cooperation between departments and exchanges with experienced colleagues are therefore just as important as lectures and online courses.

This does not mean that external training is unnecessary. Specialist courses and workshops are essential in areas that are changing quickly, such as hydrogen safety, regulations, technical standards and new system designs. At the same time, access to these programmes can be a challenge. Hy2Market partners identified the cost of existing courses as a barrier, particularly where specialised training is mainly offered



HER members

involved:

Wiva P&G,
Aragon Hydrogen
Foundation,
Austrian Institute of
Technology, ERIG

by private providers. The most effective approach is a combination of theory, guided practice and workplace experience.

The Training Guidelines therefore recommend role-specific learning pathways rather than one large training programme for all employees. A company could begin by identifying the most important tasks for each role, such as carrying out safety checks, operating equipment or responding to an incident. These tasks can then be converted into short training modules that combine basic theory, guided practice and a simple assessment.

Mentoring is another central element. New employees should be able to observe experienced colleagues, perform tasks under supervision and gradually take responsibility. A simple competence record can document when a task has been observed, assisted and finally completed independently. More structured approaches to mentoring, task rotation and workplace learning could help companies turn the informal learning that already takes place in hydrogen projects into systematic skills development.

Experiences from the Hy2Market regions demonstrate why this practical approach matters.

In Western Macedonia in Greece, for example, the transition away from lignite-based energy created both new opportunities and significant skills gaps. Many workers already had strong experience in the energy sector but had little previous exposure to hydrogen technologies. Cooperation between regional organisations, universities and training centres helped connect this existing expertise with the requirements of future hydrogen projects.

The most important lesson from Hy2Market is that Europe does not simply need more hydrogen courses. It needs training that is practical, accessible and closely linked to real roles and tasks.

Additionally, the project identified gaps in advanced technical training, safety, system maintenance and practical implementation. Training opportunities are also fragmented across regions and are not always connected to the needs of companies.

The Training Guidelines and the accompanying white paper translate these findings into practical recommendations. Companies are encouraged to include workforce planning from the beginning of every hydrogen project, identify which skills can be developed internally and determine where external recruitment or specialist training will be required.

Europe's hydrogen transition will ultimately move only as quickly as its people can learn, adapt and work together. The Hy2Market findings show that workforce development is an important element in preparing Europe for a safe and effective hydrogen transition.

Hy₂Market

The European Hydrogen Academy - HyAcademy.eu

The European Hydrogen Academy (short: HyAcademy.eu) acts as a platform for students, teachers, and the general public, giving access to training offers across Europe. Whether students looking for the best placed university courses that cover hydrogen technologies, teachers identifying schools and colleagues active in hydrogen teaching, or teachers and lecturers looking for material useful in teaching, or the general public looking for general information, users will find resources and materials on the HyAcademy web site.

The European Hydrogen Academy has five key outcomes it is working towards. Status and achievements by Aug. 2026 have been to

- build and sustain a network of over 85 universities (Network 100+) that offer recognised qualifications, specialisations, and degrees in hydrogen technologies,
- build and sustain a network of over 510 schools (Network 500+) that integrate hydrogen topics into their science teaching, including technical schools and colleges with more specific technical training,
- create a network of 5 hands-on, physical training laboratories that allow 3rd parties to access their facilities,
- build a portal that links the hydrogen-related educational programmes available, currently listing over 180 qualification offers ranging from university courses and degrees to vocational and CPD courses;
- provide access to free training materials to lecturers and teachers in order to enable educational staff to deliver the vast body of educational measures necessary, including novel (online) teaching methodologies for universities, colleges, and schools and an online library of 10 university textbooks, school work sheets, and children's books to be freely accessed and used by teachers and lecturers.

In 2024/25 HyAcademy developed the outlines of the Net-Zero Hydrogen Academy (NZH2A) that is currently being established by the European Commission's Directorate General 'Employment'. HyAcademy will be working closely with the NZH2A operators in order to support their mission of training in vocational hydrogen qualifications.

The web site www.hyacademy.eu offers access to the two searchable databases of formal education offers (universities and schools) and CPD courses (mainly offered by universities) and the e-library of educational material. Users have to register and use a password to dig below the top layer information, simply for the sake of creating a level of measurable engagement, and count 'real' access to information as opposed to the many US American web bots that persistently scrape the web site for information. An increasing number of additional features the site offers includes a map of network members, a news section that also feeds the 3 newsletters (university, school, and industry networks), placement and PhD offers, and pages dedicated to specific project results, such as the open access publications.



HER members involved:

University of Birmingham, DVGW, University of Groningen, Aragon Hydrogen Foundation, UNIMORE, Trakia University, POLITO, UCT Prague, Ulster University

The textbook series includes titles on

- Fuel Cell Technology,
- Electrolyser Technologies and Systems,
- Fuel Cell Electric Vehicles,
- Unconventional Hydrogen Production Technologies,
- Hydrogen and Hydrogen-based Fuels,
- Hydrogen storage and infrastructure,
- Hydrogen Safety for Responders,
- Electrochemistry and thermodynamics for fuel cells and electrolysis,
- Solid Oxide Cells, and
- Economics of hydrogen.

We have completed the two textbooks on hydrogen safety and a children's book on hydrogen ('Katy and the Hydrogen Pigeon') that are currently being processed by the publishing houses of Groningen and Prague universities. They are due to be publicly available in Autumn 2026.

Driven by industry interest in getting involved in the educational activities, for instance by offering specific training materials, contributing to the textbooks, co-branding of material, etc. an third network, the Industry Network has been established that currently has 20 members. The network gives access to offering placements, accessing student talent, accessing schools, and options to place small research projects as final research projects of Masters degree students.

Initially the Academy had aimed at building a 'following' on social media. This concept proved to have to be overhauled in the past two years as user habits have changed and impact is today rather measured in 'impressions'. With over 100 000 views and interactions per year the web site, the social media posts, and newsletters have now managed to gain access to a large body of audience engaging with hydrogen and educational content.

The project started 01 Jan. 2024 and will end in June 2028. In order to sustain all activities beyond this point, a not-for-profit business is being established in 2026 that will currently act as the 'commercial arm' of the project and ultimately take over all business. This allows us to reliably and sustainably interact with educational, network, and industry partners and continue all services once public funding ends. This is a key aim for the project as we do not believe in activities that can only survive with subsidies.

The project gratefully acknowledges the co-funding from the Clean Hydrogen Partnership and its members, by UK Research and Innovation (UKRI), and by the Swiss Confederation Secretariat for Education, Research and Innovation (SERI).



PermittHy - Supporting hydrogen project implementation in Europe by training all staff involved in the permitting process

The EU Net-Zero Industry Act foresees that permitting procedures for Net-Zero technologies should not take longer than 18 months. However, a widespread uncertainty with local public institutions, as to which regulatory framework applies and how projects are to be classified, assessed, and monitored meets a high number of hydrogen projects progressing to realisation in Europe.

The PermittHy project contributes to improving the situation by offering all those involved in hydrogen project permitting processes

- a best practices handbook of hydrogen permitting in Europe, and
- training courses in hydrogen technology, safety, and regulation(s).

The trainings address everyone involved in permitting, from members of public institutions responsible for permitting, including licensing and safety analysis of projects, up to the engineering staff preparing the applications for projects. This will ensure that everyone around the table in the permitting procedure has the same understanding and uses the same jargon in order to display, discuss, and assess projects.

PermittHy operates on the basis of a three-tier and hybrid format of training that is aligned with the National and European Qualification Frameworks (NQF's/EQF). The project offers courses for

- | | | |
|---|--|--|
| • basic understanding of hydrogen technology and its regulations (online only), leading to a participation certificate; | • expert understanding of hydrogen technology, regulations, and the permitting process (hybrid online and in-person), leading to a recognised qualification as 'expert'; and | • advanced understanding of hydrogen technology, regulations, and the permitting process (hybrid online and in-person), leading to a recognised qualification as 'decision maker'. |
|---|--|--|

Alongside these three modules we offer practical training sessions. The two 'expert' and 'decision maker' modules will lead to qualifications we are negotiating to be recognised by a number of key institutions (such as the DVGW in Germany, the National Association of Gas and Water Industry) in order to provide industry-endorsed qualifications. We are thus working towards a key goal of vocational training in Europe, a system of micro-credentials, and/or recognised job profiles and training schemes that will allow industry- and EU-wide worker mobility.

The courses will be delivered in 18 official EU languages for 29 EU and associated countries. PermittHy aims at training up to 9,500 course participants, online and hybrid, including regular staff and vocational trainers (Train-the-Trainer). This will ensure that a wide selection of participant backgrounds is included and future training of staff can be ensured by providing for a sufficient number of expert trainers.



HER members involved:

University of Birmingham, INEGI, Ulster University, ERIG, DVGW, INIG-PIB

The project presents a number of unique and 'first' features:

- a handbook of Best Practice in hydrogen project permitting;
- online and hybrid courses offering an introduction to hydrogen technology up to safety assessment and regulatory frameworks in the Member States, based on the Handbook;
- practical hydrogen training sessions in selected locations;
- use of e-laboratory tools and practice in building hazard scenarios;
- coverage of a broad range of EU official languages;
- work with IPCEI and Hydrogen Valley projects in order to facilitate their pathways towards functioning hydrogen eco-systems;
- establishment of a qualification profile that is to be recognised by several key European institutions, thus paving the way for more generally accepted vocational qualifications in hydrogen technology.

The project started on 10 Jan. 2026, has established its curriculum and is currently building the Best Practice Handbook of Hydrogen Permitting after having analysed the permitting processes and frameworks in most EU Member States. The questionnaire used to collect information from public services, companies, and regions remains available and can be accessed via the web site www.permittHy.eu.

We invite stakeholders, industry representatives, permitting bodies, public servants, engineering staff etc. to fill in the forms and give us hints as to the content of the courses, pain points and bottlenecks in the permitting processes, examples of best practice, and general information on what is missing in training and administrative schemes.

The feedback collected up to now confirms the concept of the course syllabus that offers a broad range of learning from basics of hydrogen technology up to details of the national permitting processes and especially the applicable regulations, codes, and standards (RCS). As expected, there are a number of stakeholders that are sufficiently experienced to not require a basic hydrogen training. Nevertheless, many more do wish to have a basic introduction before entering into the key areas of safety, permitting, and RCS. This is the specific situation that is best targeted by online content which can be accessed as needed by participants, skipping parts that are already known to then focus on the parts that are new to the trainee.

By the end of 2026 the English language 'Mother Course' is due to be complete so that it can be translated into further languages. Courses will start to be rolled out from early in 2027.

The project gratefully acknowledges the co-funding of the Clean Hydrogen Partnership and its members under contract 101251722.



Introduction to the International Summer School on Hydrogen and Fuel Cells and the Executive Master of Business Administration (EMBA) in Twin Green and Digital Transition

The journey towards a climate-neutral future begins with international collaboration and high-level education. A prime example is the 18th International Summer School on Polymer Electrolyte Fuel Cells and Hydrogen (<https://www.tugraz.at/go/fcsummerschool>), held in 2026 at Yokohama National University in Japan. This intensive one-week course, organized in partnership with Graz University of Technology (TU Graz), brings together internationally renowned experts to deliver lectures on fundamental and advanced topics in fuel cell research. The program is designed for a diverse group of students and company employees, offering a rich blend of theoretical knowledge and practical exposure. Beyond the classroom, participants engage in company visits and workshops, including a specialised intercultural workshop and various common activities designed to foster a global 'Community of Practice'. Students have the opportunity to present posters, participate in hands-on sessions, and earn 3 ECTS credits through a written exam, all while diving deep into the latest hydrogen R&D topics.



Summer school participants celebrating the successful completion of the week-long course.

Besides the Summer School, our flagship initiative is the Executive Master of Business Administration (EMBA) in Twin Green and Digital Transition at TU Graz. This program is specifically designed for leaders, executives, and public sector experts who must navigate the 'double disruption' of digitalisation and climate change.

A key component of this certificate is the Microcredential 'Energy and Green Production,' which provides specialised training in new industrial processes, biorefinery, and the production of green hydrogen.

What sets this program apart is its 'Project-Based Learning' approach. We do not just teach theory; we invite participants to act as 'Project Owners' of real challenges from their own companies. For example, a learner might develop a techno-economic assessment for a large-scale electrolysis plant as their transfer project. Our approach is further characterised by:

- **Digital Innovation:** The program uses the 'Blended Learning' concept, combining high-quality digital materials (e.g. the MOOC 'Green Hydrogen on the Rise': <https://imoox.at/course/greenH2>) with intensive face-to-face sessions and lab visits.

- **International Reach:** Through initiatives like the International Summer School, we connect local talent with global expertise in countries like Japan, Italy, and France.
- **Industry Partnerships:** We collaborate within the framework of a national funded with a consortium of 15 industrial pioneers to ensure the curriculum meets market needs.
- **Innovative Hybrid Collaboration:** We are currently establishing a long-term cooperation with the Hochschule Emden/Leer (HSEL) in Northern Germany. This partnership implements a 'Double-Site Teaching' model where lectures at TU Graz are live-streamed to a dedicated lecture hall in Emden, supported by local specialised tutors.
- **Strategic Regional Synergies:** This cooperation bridges two leading energy regions: the Green Tech Valley in Styria and the Hydrogen hub in Ostfriesland/ Niedersachsen, home to major projects like Germany's largest electrolyser.

One of our proudest achievements is successfully addressing the gender gap in a traditionally male-dominated field. By actively targeting female researchers and leaders, we have achieved a 33% female participation rate among our lecturers, i.e. many modules are led by prominent female scientists. Our biggest lesson has been that technical knowledge alone is not enough for the hydrogen transition; leaders need the strategic ability to make decisions under uncertainty. To address this, we developed specialised management modules that use scenario stress tests and roundtables to train decision-making skills.

At the project level, our next major milestone is the implementation of the 'Pro-H2' qualification network. This project has been submitted for national funding (starting in October 2027) focuses specifically on the industrial scale-up and safety of hydrogen technologies. It will bridge the gap between pilot plants and industrial implementation through 8 new modules and 184 hours of training. Furthermore, our modular portfolio continues to expand with three new specialised Microcredentials within the framework of the so-called TU Graz Microcredential Masterclass currently in planning:

1. Applied Energy Storage:

Focusing on the practical integration of storage solutions into industrial systems.

2. Advanced Studies of Polymer Electrolyte Fuel Cells:

A technical deep-dive building on the success of our Summer School format.

3. Applied Hydrogen Technology:

Dedicated to the specific engineering and safety challenges of hydrogen production and scaling.

Perspectively, we are working with our partners in Germany, Emden to develop a shared Diploma of Advanced Studies (DAS) in Green Hydrogen and, eventually, a Joint Master's degree to institutionalise our international academic excellence.



Hydrogen Online Course - Key concepts and use in green technologies

Technical University of Denmark

One key finding regarding lifelong learning is that to succeed with reaching and educating enough people for the green transition, we need to develop a diverse portfolio of educational tools. Asynchronous online courses - meaning, courses you can take any time anywhere independently of a teacher or tutor - is one of the formats that are interesting.

We developed this course exactly to meet this need by covering a large range of topics related to hydrogen, such as fundamentals, theory, technology maturity, industrial players, application examples, etc. Learners can receive a certification for having completed the course, including exercises and quizzes. It is not a university diploma, but a recognition of the efforts made. While the course is not a university course, it was created to correspond to 2.5 ECTS points, thus being harmonised with this internationally recognised system and indicating the expected workload.

We selected a course about hydrogen as this is among the hottest topics within green energy systems and the green transition. On the other hand, hydrogen has been around for more than a century and is thus not at all a new molecule; it has been basis for many everyday products we meet in our lives. When we started with the planning of the course about hydrogen, we realised that there are numerous sources on the internet claiming to provide knowledge – and many do. Our perception was that probably not the lack of information about hydrogen, but the lack of structured and reliable (a kind of “approved”) knowledge was the challenge for anybody wanting to start a serious course. By involving our colleagues who have been deeply involved in hydrogen related research and development, we attempted to provide this qualified, science-based knowledge.



Title image of the course Hydrogen - Key concepts and use in green technologies developed by DTU Energy

From our course:

“Are you interested in hydrogen? Perhaps considering a carrier within hydrogen? Then you may need to learn or brush up key concepts, potentials and challenges regarding hydrogen.

This course was made for you.

The course is targeted people with a technical background and interest. You may be an undergraduate student, a graduate student, or an experienced employee in related industries.

In this course researchers from the Technical University of Denmark present you with fundamentals, research-based knowledge, and applications of hydrogen.

You are introduced to the key concepts related to green hydrogen: electrolysis, fuel cells, electrochemistry and modelling. You will learn about the development of green hydrogen systems through use cases and examples, and by reading central reports monitoring the development of the green hydrogen in EU and globally. Finally, you get a rare look into the laboratories of our department where technologies for the green transition are researched and developed.

The course is organised using a variety of tools such as videos, lectures, self-study, exercises and quizzes.”

The approach is to give a broad interest group access to hydrogen related knowledge by following a specific curriculum. We apply a variety of tools, i.e., we do not just record lectures. We combine selected lectures given by different teachers with tasks such as calculation exercises on relevant practical examples. We encourage reflection by referring to important reports from literature and we reflect the state-of-the-art, i.e. providing examples of industries. In addition, we include laboratory videos showing how hydrogen technologies work, more specifically, how fuel cells and electrolysis cells are made, how they are stacked together etc. This is a unique combination of tools. The activities are also thought to inspire further diving into those topics that the learners are most interested in or that are most relevant to their professional or general interest.

Releasing the course has been highly motivating. Before releasing the course, we were in doubt whether anyone would be interested enough to take the course. But we experience learners from Europe, Africa and Eurasia who are proudly sharing that they took the course. And some of them got inspired to continue with a regular education in this or related areas. After one year, we had attracted more than 2000 learners; that was more than we had expected. It also showed that we were on the right way in providing a course beyond country borders.

Our original intent was to supply a free course in a very relevant topic for the green transition. In the meantime, a fee was requested by coursera, the platform we are using, which is against our will and is negotiated at university level. Our goal is to establish an alternative platform to continue to provide the course for free to all interested learners around the globe.

CNH2 - Centro Nacional del Hidrógeno

In 2007, green hydrogen was just a concept in Europe, not to mention in Spain. In that context, *Centro Nacional del Hidrógeno* (CNH2) was born in Spain to start researching about hydrogen and fuel cells technologies. Beyond hydrogen technologies there are cross-cutting areas to enable their uptake, among them training and public awareness.

Sharing knowledge and building skills has always been a key priority of CNH2, as a public centre (funded equally by the regional and national governments). The centre coordinated and participated in several initiatives around hydrogen skills development. The target groups are the general public (students, citizens, etc.) and technical staff.

The project “*Senda del Hidrógeno*” focuses on hydrogen dissemination to young children. Through different activities, hydrogen concepts are presented in a simple language, making connections to their daily lives with the help of interactive games and demonstrative toys:

- racing cars powered by hydrogen to prove transport applications.
- a doll’s house to exhibit the domestic use of hydrogen.
- puzzles (crossword, word search, etc.) and online mini-games (<https://sendah2.cnh2.es/>) to consolidate the concepts learnt during the talks.
- infographics and videos which complement and reinforce the information given.
- experiments to show water electrolysis and the functioning of a fuel cell, either with educative prototypes or with everyday household materials (pencils, plastic bottles, 6-volt lantern battery, etc.).

When it comes to higher education, CNH2 has also different partnerships to ensure the promotion of hydrogen technologies in the academic curricula of universities and vocational training centres. This includes:

- master classes in Master’s Degrees, mainly those related with renewable energies and engineering. In this sense, the regular program is complemented with one or more specific sessions devoted to hydrogen. The scope of the talk (a general overview or a more specific focus) is accorded previously with the coordinators.
- training programs and final-year projects supervision, in which students from Bachelor’s Degrees, Masters Degrees or vocational training delve into CNH2 research lines and acquire practical skills.
- participation in employment fairs.

These activities make students aware about hydrogen-related career paths and help them to get hands-on experience in the sector. Not only scientific profiles are considered: training in the fields of social sciences (human resources, economics, communication) is also encouraged.

Apart from this, CNH2 coordinates different courses and training programs for technical professionals, which can be designed on an ad hoc basis, depending on the specific needs of the organisation requesting them. A 80-hour course on hydrogen technologies (*Curso Tecnologías de Hidrógeno*, <https://www.cnh2.es/curso-tecnologias-de-hidrogeno/>) is offered twice a year, covering the basic principles of hydrogen technologies and the hydrogen sector. It is held online, with a virtual campus that enables discussion forums, additional materials and communication with the tutors. At the end, participants receive a certificate indicating the hours completed and the contents of the course.

Additionally, the centre engages in numerous skills related collaborations with international organisations, universities, and entities, including Uruguay, Costa Rica, Panama, Colombia and Chile. In January 2026, 20 Chilean university professors were trained by CNH2 in Puertollano. The eight-day programme was part of the Team Europe Initiative (TEI) for the development of renewable hydrogen in Chile, promoted by the Chilean Agency for International Cooperation (AGCID) and the Chilean Ministry of Energy. The agenda contained theoretical training on green hydrogen and its role in the energy transition; hydrogen production technologies (alkaline, PEM and SOEC electrolysis); hydrogen storage, transport and conversion using fuel cells; green hydrogen derivatives such as ammonia and e-fuels; and applications in industry, ports and mobility. This was complemented with practical demonstrations in CNH2 laboratories, visits to demonstrative facilities and hydrogen-related companies, and a meeting with international experts on green hydrogen research and development.

What really sets all these activities apart is the people behind them. The involved staff works with hydrogen every single day. So, when they talk to students, visitors or professionals, they are not repeating something they read in a book, they are sharing first-hand experience from the lab and lessons learnt from real projects. This perspective gives CNH2 training greater depth.

Moreover, the provided courses feature a strong practical component, something few organisations can offer. This approach adds significant value, bringing together experience, innovation, infrastructure and skills transfer in one place.



H2Raum: Shaping the Hydrogen Transition in the Ruhr Region Together

Cards are spread out across the table, with glasses and notepads beside them. Around the table, people are talking, laughing, and carefully thinking about their next move. It looks like a relaxed evening among colleagues and friends. But at these poker tables, the real question is a very different one: How can the hydrogen economy in the Ruhr region move forward in practical terms?

Encounters like this are at the heart of H2Raum. The initiative brings together companies, research institutions and other regional stakeholders to develop solutions to the challenges of building a hydrogen economy.

H2Raum was initiated by Westphalian University of Applied Sciences and the Fraunhofer Research Institution for Energy Infrastructures and Geothermal Systems IEG. It is funded by the German Federal Ministry of Research, Technology and Space (BMFTR) as part of the "T!Raum – Transfer Spaces for the Future of Regions" programme.

As a regional innovation and knowledge-transfer ecosystem, H2Raum connects companies, research institutions, and other partners across the Ruhr region. Rather than simply transferring knowledge from research into practice, H2Raum promotes an ongoing dialogue between science and industry. Companies contribute their practical challenges and experience, while research institutions work with them to develop solutions that are both technically feasible and economically viable.

Practical Solutions Through Collaborative Workshops

The approach becomes particularly visible in H2Raum's workshop projects. Here, new ideas are not simply discussed – they are developed, tested, and refined together.

In the project "H2Reallabor Castrop-Rauxel", for example, researchers, local authorities, energy providers, and companies are working together to explore how hydrogen technologies can be used in practice in an industrial city. Discussions with local companies help identify concrete needs. The results are also intended to provide guidance for other regions.

Other workshop projects like "H2SpeicherRuhr", "H2Rollout", "O2Hamm", "H2SME", "H2Innovate", or "H2hoch2"

focus on different building blocks of a future hydrogen economy and create additional value for the region.

Developing Skills for the Hydrogen Economy

Technological development is only one part of the transition. Developing the skills needed for a hydrogen economy is equally important.

The project "H2!Academy" develops practical training and continuing education programmes for employees and companies, helping them build the skills they need for the growing hydrogen economy. At the same time, the "H2Challenge" project connects students with companies to develop innovative ideas for hydrogen applications and involve future professionals at an early stage.



HER members involved:
Fraunhofer IEG,
WHS - Westphalian
University of
Applied Sciences

Innovation Comes from Exchange

Technology alone is not enough. A successful transformation also depends on people sharing ideas, knowledge, and experience.

That is why H2Raum deliberately creates opportunities for researchers and businesses to meet in an informal and accessible way. Events such as H2 Business Poker, the H2Hackathon, and the Hydrogen Quiz provide space for new ideas, professional discussions, and the development of long-term partnerships.

The first H2 Matchmaking event in May 2025 demonstrated just how valuable this kind of exchange can be. The discussions not only created new connections between companies and research institutions – they even led to a joint funding project. It is a good example of how networking can turn into concrete innovation.

Learning and Developing Solutions Together

The experience gained so far shows that the hydrogen economy is most likely to succeed when companies are involved at an early stage and their real-world challenges help shape the development of new solutions. These challenges are often about more than technology. Economic considerations, regulatory requirements, and the need for qualified employees can be just as important. This is where H2Raum has a particular strength. The initiative does not see knowledge transfer as a one-way process, but as a joint learning process.



Hannah Zeibig, H2Raum; Martin Habermehl, Westphalian University of Applied Sciences; Philipp Neuhaus, ProPuls GmbH; Tim Peil, H2Raum; and Robert Mill, ZINQ, from left to right, during a tour of the galvanizing plant

Both sides benefit: companies gain access to current research and support in navigating new technologies, while research institutions receive valuable insights and ideas from practical experience. This helps create solutions that respond to the actual needs of small and medium-sized enterprises. Existing knowledge-transfer formats are continuously developed, new partners are brought into the network, and additional areas of application are explored.

Further information about projects, events and opportunities to get involved can be found at www.h2raum.de and on LinkedIn.



Green Hydrogen Morocco Camp: Building Skills for Morocco's Green Hydrogen Future

L'Institut de Recherche en Énergie solaire et Énergies Nouvelles (IRESEN), Morocco

The Green Hydrogen Morocco Camp is an initiative designed to prepare a new generation of talent for the opportunities and challenges of the hydrogen sector.

The third edition of the Camp took place from 6 to 11 July 2026 at Mohammed VI Polytechnic University in Benguerir. It was organised by GIZ Morocco, as part of the Relance Verte project, in collaboration with the Research Institute for Solar Energy and New Energies (IRESEN) and the Laboratory of Inorganic Materials for Sustainable Energy Technologies (LIMSET) at Mohammed VI Polytechnic University.

Over six intensive days, the programme brought together students from universities across different regions of Morocco, alongside researchers, national and international experts, institutional representatives and industry partners. By connecting these different communities, the Camp created a space where knowledge could be shared, questions could be explored openly, and new professional connections could begin to take shape.

What makes the Green Hydrogen Morocco Camp distinctive is the way it combines scientific learning with direct exposure to real technologies and practical challenges. Rather than limiting the programme to classroom-based teaching, the Camp takes participants through a complete learning journey: from understanding the fundamentals of green hydrogen to applying that knowledge in a collaborative hackathon.

Throughout the week, participants explored the main components of the green hydrogen value chain. The programme covered renewable energy technologies, hydrogen production and electrolysis, as well as the conversion of green hydrogen into products such as green ammonia, methanol and synthetic fuels. It also addressed the infrastructure, storage, safety, sustainability and economic considerations that determine whether a project can move from concept to implementation.

Technical visits played an important role in bringing these subjects to life. Participants visited the Green Energy Park, the Green & Smart Building Park and other research facilities at Mohammed VI Polytechnic University. These visits allowed them to see how scientific research, technological testing and applied innovation are conducted in real-world environments. For many participants, this direct contact with research platforms helped transform complex technical concepts into something more tangible and accessible.

The week culminated in a hackathon, during which participants worked in multidisciplinary teams on challenges related to the green hydrogen value chain. They were encouraged to combine technical thinking with economic and industrial considerations and to develop solutions that were not only innovative, but also realistic. The teams then presented their concepts to a jury of experts.

This hands-on component was essential. It placed participants in situations that reflected the collaborative nature of real hydrogen projects, where engineers, researchers, economists, institutions and businesses must work together. The hackathon also helped participants strengthen skills that are sometimes difficult to develop through traditional training alone, including teamwork, problem-solving, communication and the ability to present a complex idea clearly.

The strength of the Camp also lies in the partnership behind it. GIZ Morocco brings the perspective of international cooperation and long-term capacity development. IRESEN contributes its experience in applied research, innovation and the development of Morocco's clean-energy ecosystem. LIMSET and Mohammed VI Polytechnic University provide scientific expertise and access to an advanced academic and technological environment. Together, the partners connect education, research, public institutions and industry around a shared objective: building the skills required to support the development of green hydrogen in Morocco.

The 2026 edition also demonstrated the importance of inclusion in shaping the sector's future. Women represented 60% of participants, reflecting the growing contribution of female talent to science, engineering and clean-energy innovation. Since its launch, the Green Hydrogen Morocco Camp has brought together more than 250 participants, speakers and experts from universities and institutions across Morocco.

One of the programme's main lessons is that effective skills development goes beyond transferring technical knowledge. Learners benefit most when they can understand the wider context, engage with practitioners, experience research environments and apply their knowledge to concrete problems. Creating these connections helps participants see not only how green hydrogen technologies work, but also where they themselves can contribute.

As Morocco continues to develop its green hydrogen ecosystem, the ambition is to keep strengthening the links between education, research, innovation and industry. By investing in people today, the Green Hydrogen Morocco Camp contributes to building the expertise, networks and confidence needed to support the country's energy transition in the years ahead.



University of Canterbury (UC), New Zealand

The innovative Process Engineering Design course, developed by Chemical and Process Engineer Professor Matt Watson, provides an experience designed to come close to professional engineering practice. The course is built around a major design project, developed in collaboration with New Zealand and international industry partners, which takes students through the stages of a real engineering design challenge.

“The academic and industry supervisors propose an open-ended framework of a problem, and then the students have to develop ways to figure it out,” explains Professor Watson.

In 2026, enrolment is close to an all-time high, with 13 groups of five students (class of 65) tackling unique projects grounded in past or future real-world design challenges.

While the course encompasses all areas of process engineering, UC Engineering's strong expertise in hydrogen technologies means many projects are in this field. Christchurch is also home to several clean hydrogen start-ups that strongly support practical, industry-focused student training and provide industry supervisors for the projects. In 2026, that network extends internationally, with industry partners from as far afield as Canada and Fiji.

The students of the course are supported by their academic and industry supervisors, but there is deliberately no prescribed route to developing an answer. They must work through the broad parameters of the problem, identify potential pathways and narrow these down to a specific process design largely on their own. Along the way, they analyse process safety and public perceptions of safety and undertake detailed economic analysis to determine whether their proposed project could be commercially viable. Their final report must give stakeholders something more than a technical design: a recommendation on whether or not to invest.

Another distinctive feature is the emphasis on cultural engagement. Students receive training in appropriate ways of working with Māori stakeholders and in culturally responsible practice. This encourages them to consider the wider cultural and societal consequences of engineering decisions alongside technical, economic and logistical factors.

The aim is to produce graduates who understand that a technically sound design is not necessarily a successful one if it fails to account for the people and communities affected by it.

One of the 2026 projects shows how these elements come together. A student team has been tasked with designing a hydrogen liquefaction plant and liquid hydrogen storage facility at Tāwhaki National Aerospace Centre. Tāwhaki is an Indigenous-led partnership between the New Zealand Government and mana whenua of Kaitorete, Wairewa Rūnanga and Te Taumutu Rūnanga.

The scenario envisages an aerospace company using liquid hydrogen and liquid oxygen as fuel and oxidant to launch up to 500 CubeSats a year. The students must determine the size and cost of the plant and utility requirements for the site. An additional supervisor from Christchurch-based liquid hydrogen technology company Fabrum provides another source of industry expertise on the project, with an academic supervisor from UC's CryoLab.



Solving the challenge requires much more than technical knowledge. Students need to consider economics, safety, logistics and stakeholder requirements while working effectively as a team, just as they would in professional practice.

Teamwork is therefore a fundamental part of the course. Professor Watson notes a strong correlation between good teamwork and final grades. Interestingly, Watson says the teams that encounter difficulties and successfully work through them are often among the most successful by the end of the course.

This real-world approach is already producing results. UC students won the top prize at the Institution of Chemical Engineers (IChemE) Australia and New Zealand Student Design Awards in both 2024 and 2025, demonstrating that work produced by the students can stand up on an international stage.

“We designed the course to have very few lectures and instead offer workshops on attributes that will help students in the real world—professional skills, teamwork, time management and cultural competency,” says Professor Watson.

That philosophy has proved so successful that engineering design programmes at other New Zealand universities are now modelled on the course.

And demand is unlikely to slow. UC's incoming first-year Engineering cohort exceeded 1,400 students in 2026, signalling a potential fourth-year Process Engineering Design class of at least 100 students by 2029.

For a hydrogen sector needing to build a skilled workforce alongside new technologies and infrastructure, this model is proving its worth in preparing the next generation of engineers. Giving students the opportunity to grapple with uncertainty, work with industry, navigate economic and cultural considerations, and learn how to solve complex problems together builds a strong future workforce.

The India-Netherlands Hydrogen Valley Fellowship

University of Groningen (UG)

The University of Groningen (UG) and India's Department of Science and Technology (DST) launched the India-Netherlands Hydrogen Valley Fellowship Programme. The Fellowship connects talented researchers from India with one of Europe's leading hydrogen regions: the Northern Netherlands. More than an academic exchange, it creates an international learning environment in which participants experience how research, industry, government and society work together to accelerate the hydrogen transition.

The Fellowship is open to PhD candidates, postdoctoral researchers and early-career faculty members from Indian institutions. During their stay at UG, fellows conduct joint research under the supervision of experts from both countries while becoming part of a vibrant hydrogen innovation ecosystem. This approach strengthens scientific excellence while fostering lasting partnerships between Indian and Dutch universities and research communities.

A distinctive feature of the Fellowship is its interdisciplinary character. Hydrogen is not only an engineering challenge: regulation, economics, public acceptance, infrastructure, business development, sustainability and policy are equally important to the development of viable hydrogen systems. Fellows therefore engage with expertise spanning engineering, natural sciences, economics, law, spatial planning, environmental sciences and public policy. This broad perspective reflects the reality that successful hydrogen systems require collaboration across disciplines.

Equally important is the Fellowship's connection with the Hydrogen Valley ecosystem. Rather than learning about hydrogen only through lectures or laboratory work, participants experience a region where hydrogen technologies are being developed, tested and implemented. Through interactions with researchers, industry partners and regional stakeholders, fellows gain first-hand insight into how innovation progresses from scientific discovery to practical application.

The response to the first Fellowship call demonstrated the growing interest in hydrogen education and research. Nearly 250 applications were received from a highly specialised group of hydrogen researchers from across India, reflecting both the country's strong scientific capacity and the enthusiasm of young researchers to contribute to the clean energy transition. Applicants represented leading institutions, including the Indian Institutes of Technology (IITs), National Institutes of Technology (NITs), and many other universities and research institutes. From this strong pool of applicants, 20 researchers will be selected to join the University of Groningen through the Fellowship Programme.

Beyond individual research projects, the Fellowship contributes to a broader strategic partnership between India and the Netherlands. It supports knowledge exchange within the framework of India's National Green Hydrogen Mission while strengthening



collaboration among universities, researchers and innovation ecosystems in both countries. By combining complementary expertise and creating long-term research networks, the programme helps prepare the next generation of hydrogen professionals to work effectively across borders and disciplines.

One of the programme's most important lessons is that developing hydrogen talent requires more than technical training. Future leaders need international experience, interdisciplinary understanding and close interaction with industry and policymakers. By connecting talented researchers with a functioning Hydrogen Valley, the Fellowship provides an environment in which scientific knowledge, practical experience and international collaboration reinforce one another.

Looking ahead, the ambition extends beyond supporting individual fellowships. The programme aims to establish a lasting international network of researchers, universities and industry partners that will continue to drive innovation long after each fellowship has ended. As hydrogen becomes an increasingly global sector, initiatives such as the India-Netherlands Hydrogen Valley Fellowship demonstrate how international cooperation can help build not only new technologies, but also the skilled, globally connected workforce needed to realise the hydrogen economy of tomorrow.

H2ENRY: Turning a Hydrogen Network into a Learning Network

Over 20 months, five Spanish technology centres: CIDAUT, AICIA, EnergyLab, ITE and Leitat, worked as a national network to strengthen renewable-hydrogen research, share knowledge and prepare people to move new solutions closer to industrial use. Coordinated by CIDAUT and supported through Spain's Cervera programme, the initiative connected complementary expertise in hydrogen production, purification, storage, transport and digital tools. That structure became H2ENRY's most distinctive learning asset. No single centre was expected to hold all the answers. Instead, each contributed a different part of the hydrogen value chain and became both teacher and learner. Researchers and technical staff learned directly from colleagues working on biological, photoelectrochemical and electrochemical hydrogen production, purification, storage and process integration. The first cross-training course, delivered by Leitat and EnergyLab on biological production systems, brought together 40 participants from the network. In addition, Leitat also organised and delivered a webinar on *Innovative Electrochemical Technologies for Green Hydrogen Production*.



HER members involved:
CIDAUT
Foundation, Leitat
Technological
Center, ITE
- Instituto
Tecnológico de la
Energía

H2ENRY then opened this shared classroom to the next generation. Its free International Spring School on Hydrogen Technologies, held in hybrid form from 7 to 11 April 2025, registered more than 100 participants. Each day was led by a different technology centre and focused on one practical theme: digital tools at ITE, purification membranes at Leitat, biological hydrogen production at EnergyLab, high-temperature electrolysis at AICIA and storage technologies at CIDAUT. Designed for university students, researchers and other emerging hydrogen professionals, the initiative combined expert presentations, technical visits and interactive activities. It was supported by the Universities of Valladolid, Vigo, Seville and Valencia, creating a direct connection between academic pathways and applied research.

For Leitat, H2ENRY fit naturally with an applied, collaborative approach to innovation. The centre contributed to sustainable materials and components, photoelectrochemical hydrogen production, biological processes that combine fermentation with electrochemistry, and polymeric membranes for hydrogen separation and purification. Leitat also explored scalable approaches such as screen-printed photoelectrodes, helping researchers see how a material developed in the laboratory can progress towards a practical system. This breadth enabled participants to connect materials science, electrochemistry, biological processes and industrial requirements rather than learning each subject in isolation.

The project's achievements were therefore both technical and social. H2ENRY improved electrolysis systems, explored alternative routes for producing renewable hydrogen, developed more sustainable components, advanced storage and purification solutions, and created a digital toolbox for simulation and process optimisation. Alongside these



The **H2ENRY** International Spring School connected students and researchers with specialists from five technology centres. Its hybrid programme attracted more than 100 registered participants. The webinar featuring LEITAT discussing about Hydrogen Separation by the Functional Materials & Processing Group

results, the network recruited 18 new professionals, including international and doctoral profiles. Its training ecosystem combined hydrogen production and integration with digitalisation, innovation management and technology-transfer skills helping participants understand not only how technologies work, but also how they can be improved and brought closer to industrial application.

Perhaps H2ENRY's most important lesson is that collaboration is itself a hydrogen skill. Working across centres and disciplines encourages researchers to develop a shared language, understand how decisions in one part of the value chain affect another and build professional relationships that last beyond an individual training session. Cross-training, the Spring School, technical visits and engagement with industry transformed the research network into a practical learning environment.

Although the funded project concluded in June 2025, its partners intend the network to remain active as a platform for collaborative innovation and knowledge transfer. The next ambition is to carry these shared capabilities into new research and industrial collaborations, translate results into useful services and specialised training, and continue giving emerging professionals opportunities to learn from real hydrogen challenges. H2ENRY's lasting achievement is therefore not only a portfolio of new technologies. It is a community better equipped to develop them together.



Hydrogen and Fuel Cell Community (CH2PC)

The Hydrogen and Fuel Cell Community (CH2PC) is a network of professors and researchers from different engineering schools within the Universidad Politécnica de Madrid (UPM) (<https://www.upm.es/Investigacion/innovacion/Comunidades/CH2PC>). By integrating expertise from various engineering specialisations, it can address the complete hydrogen value chain, from production to final applications. The main areas of research of the community are hydrogen production, storage, transport, and end uses of hydrogen; and low temperature fuel cells (PEMFC, DMFC).



HER members involved:
Universidad Politécnica de Madrid, POLITO

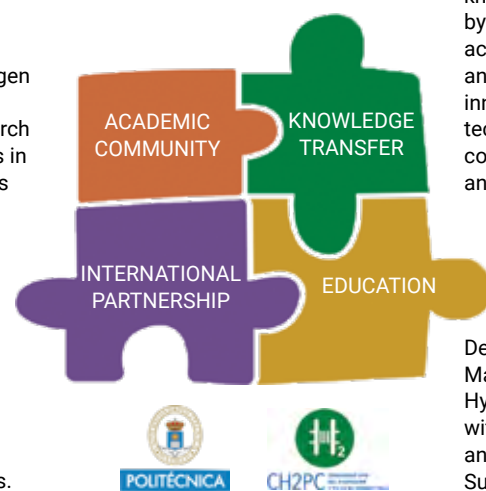
The CH2PC was established in 2022 with the aim to unify all UPM professors and researchers working on hydrogen-related topics. Its primary objective is to look for synergies among researchers from different fields, strengthen partnerships with external research groups and industry stakeholders and giving UPM research on hydrogen national and international relevance. This community enables the UPM to be represented in associations, facilitating participation as a unified institution, in both national and international research and innovation projects (Fig. 1).

So far, the CH2PC has more than 50 members for more than 12 different UPM research groups and has established collaboration with different industrial partners and other research partners like Oklahoma University in USA, POLITO in Italy or Iberian Centre for Research in Energy Storage in Spain and Portugal, among others. Furthermore, the CH2PC has created two advisor committees: one industrial and the other about research that aggregate 21 companies and 8 research centres, respectively. By bringing together a well-established group of experienced researchers, this community has facilitated the participation in national and international projects.

The greatest achievement of the CH2PC has been the creation of a collaborative environment that connects researchers who previously worked independently, enabling new research initiatives and joint national and international projects. Another major success has been the creation of a Fuel Cell and Alternative Fuels Laboratory at the Faculty of Naval Architecture and Marine Engineering (Fig. 2) of UPM. This

Fostering the relationship between UPM researchers in complete hydrogen value chain and improving research competitiveness in competitive calls

Encouraging national and international relations with universities, companies and research centres.



Strengthening knowledge transfer by connecting academia, industry and research through innovative facilities, technical committees, collaborative projects and networking events

Designing our own Master's Degree in Hydrogen and Fuel Cell with industrial partners and participating in UPM Summer International Summer School

Figure 1. The Hydrogen and Fuel Cell Community (CH2PC) objectives of Universidad Politécnica de Madrid (UPM)

facility will enable to test powertrains based on fuel cells under operating conditions representative of marine and aerial environments, among others, equipped with a Stewart Platform of 6 degrees of freedom and ± 1 g.

Additionally, the community has the aim to connect the hydrogen industry and academia research, through different meeting workshops and networking events. During these years, there were organised five conferences related to production, storage, use, safety and supply chain of hydrogen with more than 700 participants from academia and industry. Also, as a research institution, members of CH2PC have participated in international conferences to present the CH2PC experience and published relevant articles about the hydrogen value chain.



Figure 2. Laboratory of Fuel Cells and Alternative Fuels (UPM) at the Faculty of Naval Architecture and Marine Engineering

Beyond its networking activities, as a member of the UPM, CH2PC is engaged with education and knowledge transfer. The community has been working on the development of a master's degree in hydrogen and fuel cells, aimed at training the next generation of professionals. The programme has been designed in collaboration with industry experienced professional partners participating as lecturers. Furthermore, some members of CH2PC have collaborated during the last three years with subjects related to hydrogen in the UPM International Summer School, a programme where students from all Europe learn about latest trends in engineering and architecture.

Next steps of the CH2PC are, among others, to continue the collaboration among its UPM members working on hydrogen-related topics, seeking synergies and continuing to work together in national and international proposals and projects. Another important objective is to expand the capabilities of its research infrastructure. Finally, the CH2PC aims to intensify collaboration with industry, promoting knowledge transfer and the development of joint projects that bridge the gap between academic research and the sector's real-world needs.



A Lighthouse for H2 Training: ETHYC Charts EU's Hydrogen Talent Pipeline

"Ultimately, ETHYC's ambition is to contribute to a stronger training and education pathway that equips future hydrogen professionals with the interdisciplinary skills needed to support the clean energy transition."

With the Education and Training for Hydrogen Ecosystems (ETHYC) project, we bring together five leading universities to develop future-focused learning opportunities that support Europe's growing hydrogen economy. The 2-year ENLIGHT Thematic Network, led by the University of Galway, aims to guide European universities towards a joint multidisciplinary hydrogen curriculum. Rather than creating isolated courses, it aims to develop a Europe-wide network that connects education, research, industry, and society. Together, the University of Galway, University of the Basque Country, Ghent University, and the University of Groningen combine their different expertise in Hydrogen with strong international and cross-sector collaboration to create a coordinated European training ecosystem. For that, the project is mapping institutional strengths, connecting universities with industry, policymakers, NGOs, and civil society. This diverse ecosystem ensures the curriculum is co-developed with non-academic partners and aligned with real workforce needs.

Its challenge-based curriculum development approach is informed by the mapping of institutional expertise, regional strengths, and stakeholder feedback, ensuring that training remains relevant, adaptable, and future-oriented. And a key lesson already confirmed is that designing courses for future hydrogen professionals requires more than technical knowledge alone; it requires the ETHYC-level of integration between engineering, chemistry, business, law, policy, and wider societal considerations.

The primary beneficiaries of this phase of project are academics in the 5 ETHYC universities, local industries, and students and early-career researchers across ENLIGHT universities interested in hydrogen technologies and the clean energy transition. And ETHYC's biggest achievement so far has been the strong collaborative foundation established across the five partner countries, fostering cross-disciplinary and cross-sectoral connections and creating meaningful opportunities for knowledge exchange between universities and a wide range of regional stakeholders. The project emphasises hands-on learning through summer and winter schools, workshops, and collaborative activities that expose students to real-world hydrogen challenges. It also supports academic staff involved in hydrogen education by providing opportunities for collaboration and knowledge exchange. The results of these workshops will contribute to the broader mapping of hydrogen skills and education needs across the ENLIGHT network and will be shared at a later stage.



HER members involved:

University of Galway, University of the Basque Country, Ghent University, University of Groningen

So far, we have successfully organised a stakeholder engagement workshop for ETHYC partners (led by the Ghent University), a local and two regional workshops, and we are about to have our first ETHYC Hydrogen School. In October 2026, our Autumn School organised by the University of Groningen will provide learners with insights into the regulatory, economic, and commercial dimensions of hydrogen deployment. In 2027, our Winter School organised by the University of the Basque Country will focus on the technical aspects of hydrogen, ensuring a comprehensive and multidisciplinary ETHYC learning experience. Follow our social media to stay up to date with our future events.

Looking ahead, ETHYC aims to share the outcomes of the five-country mapping exercise, highlighting existing expertise, educational gaps, and opportunities for collaboration across Europe. These insights will guide the development of a bespoke hydrogen course that integrates the knowledge and strengths of all project partners while creating opportunities for wider academic and industry connections. The project was designed to address an important gap: there is currently no EU-wide postgraduate training programme dedicated to hydrogen technologies, despite growing demand for skilled professionals across the hydrogen value chain. In the long term, ETHYC aims to fill this gap by becoming the postgraduate training opportunity, shaped as a joint Erasmus Mundus programme or a Doctoral Network.



PhD- researcher Kelsey Pailman facilitating the development of the ETHYC survey during the Groningen ETHYC Regional Workshop, organised by Prof Evrim Ursavas and Patricia Poppendick at the University of Groningen, Netherlands



From Twente to Jülich: Building Connections for the Next Generation of Hydrogen Researchers

Hydrogen research is inherently collaborative. Whether developing new materials, improving electrolyzers or designing future energy systems, researchers draw on expertise from many different disciplines. Hydrogen at the University of Twente (HyUT) brings together UT researchers working across these fields, creating a community where researchers from different disciplines can easily exchange knowledge and ideas. Organised jointly by researchers from the University of Twente and Forschungszentrum Jülich, the annual summit brings together scientists from both institutions to discuss their research, exchange ideas and explore new collaborations. For members of the HyUT community, it provides an opportunity to build on collaborations with an international network of colleagues.



HER members involved:
University of Twente,
Forschungszentrum Jülich

The partnership also gives researchers access to complementary expertise and facilities. While the University of Twente has strengths in areas such as membrane technology, electrochemistry and systems integration, Forschungszentrum Jülich offers world-class research infrastructure and expertise in energy materials and large-scale research facilities. The summit brings these complementary strengths together in a single program, creating opportunities for researchers to learn from one another and identify new areas for collaboration. The summit covers a broad range of scientific topics, with hydrogen researchers, from PhD candidates and postdoctoral researchers to principal investigators, contributing through presentations, workshops and discussions. Over the years, the event has grown from a relatively small meeting of principal investigators into a forum where PhD researchers play a central role in the programme. Today, around 150 researchers participate, reflecting the summit's continued growth and its increasing emphasis on early-career researchers.

One aspect that sets the Jülich–Twente Summit apart is the responsibility given to doctoral researchers. PhD researchers are involved in the organisation of the summit, chair parallel scientific sessions and contribute to discussions alongside postdoctoral and senior researchers. A dedicated PhD programme ahead of the main summit also gives them their own space to meet, exchange experiences and prepare for the wider scientific programme. This active role also gives PhD candidates the opportunity to develop skills that are difficult to gain through research alone. Chairing a scientific session, for example, requires them to introduce speakers, guide discussion and engage with research beyond their immediate field.

For many PhD candidates, the summit is also one of the first opportunities to present their research to an international audience outside their own research group. Informal conversations during poster sessions, laboratory tours and coffee breaks are just as valuable in promoting the exchange of ideas across disciplines. The programme also reflects the interdisciplinary nature of hydrogen research. Alongside hydrogen-related topics such as electrochemistry, membrane reactors and chemical conversion,

participants interact with researchers working on batteries, photovoltaics, CO₂ capture, and other complementary fields. For example, a PhD researcher working on hydrogen electrochemistry may receive feedback not only from fellow electrochemists, but also from researchers specialised in membrane technology, advanced materials or systems integration.

For HyUT researchers, this broad perspective is one of the summit's main strengths. Discussing similar challenges with colleagues who approach them from different disciplines often leads to new ideas and it builds relationships that continue long after the meeting has ended. The role of PhD researchers has grown alongside the summit itself. Earlier editions focused mainly on principal investigators, whereas today PhD candidates are a visible part of both the scientific programme and the discussions. That shift has changed the character of the meeting. It is no longer only about presenting research results, but also about giving young researchers the opportunity to practise communicating their work, receive feedback from outside their own field and establish contacts that may develop into future collaborations.

Previous editions have already led to new research collaborations and opportunities for graduate students to participate across institutional boundaries. Perhaps the most valuable outcome, however, is less tangible: collaboration is a skill in itself. Learning to explain your research to someone from another discipline, asking questions outside your own expertise and building relationships with researchers from another institution are all experiences that become increasingly important throughout a scientific career.

The Jülich–Twente Summit will continue to bring together researchers from Twente and Jülich, with a strong focus on early-career researchers. For members of the HyUT community, it remains a valuable opportunity to exchange ideas, strengthen existing collaborations and establish new ones. As hydrogen research becomes increasingly interdisciplinary, opportunities to meet researchers from other institutions become more valuable. The summit provides a setting where scientific exchange and professional development go hand in hand, helping participants broaden both their research perspective and their professional network.



Building hydrogen skills through applied testing

CATIM - Portuguese Technological center for the metal working industry

At CATIM – Technological Center for the metal working Industry, the skilling challenge is being addressed through practical laboratory work that helps turn uncertainty into usable knowledge.

CATIM has developed technical and laboratory capabilities to support the safe and industrially viable adoption of hydrogen through the testing of gas equipment operating with hydrogen-methane blends. The resulting experimental evidence on combustion, efficiency, safety and fitness for the intended purpose also provides a practical basis for developing technical skills that are increasingly important for the hydrogen transition.

At the centre of this effort is CATIM's laboratory capability to test gas equipment under representative hydrogen-methane operating conditions (Figure 1). Supported by a dedicated experimental setup, it provides technical test results and creates a practical environment where industry relevant questions can be explored under realistic operating constraints.



Figure 1. Testing setup used to assess equipment performance under hydrogen-methane operating conditions.

The main beneficiaries include equipment manufacturers, system integrators, laboratory and testing professionals, process engineers, and standardisation experts. Manufacturers and system integrators can use this knowledge to better understand how existing designs behave when hydrogen is introduced. Laboratory and testing professionals can build experience in measurement, validation and interpretation. Process engineers and standardisation experts can use the results to support decisions on adaptation, qualification and safe operation. More broadly, companies preparing for the adoption of new energy solutions can use this type of evidence to support their teams through that transition.

What makes this approach distinctive is its focus on realistic operating conditions. CATIM has tested both industrial and domestic gas equipment using hydrogen-methane blends with hydrogen additions of up to 20% by volume in methane, without modifying the original equipment configuration and without actively adjusting the

system according to hydrogen content. This makes the results particularly valuable, because they reflect the practical constraints of existing equipment in real industrial and domestic settings.

Another strength of CATIM's approach is the link between testing, conformity and industrial transition. Hydrogen related technologies are evolving quickly, while regulatory and standardisation frameworks are still developing. In this context, practical evidence matters. Testing helps build confidence, supports pre-standardisation work, and provides the kind of technical understanding that companies need when they are considering whether and how to adapt existing equipment and processes.

This also means that the work contributes directly to skills development. The competencies involved are not abstract. They include understanding combustion behaviour, assessing safety, interpreting test results, analysing process impact and navigating validation and conformity requirements for new gaseous fuels. In this sense, CATIM's work goes beyond demonstrating technical feasibility. It can also help prepare professionals to deal with the real challenges of hydrogen industrialisation.

One of the most important lessons so far is that the transition to hydrogen depends as much on technical readiness and confidence as on the technology itself. It is not enough for a solution to exist. Companies and professionals need to understand how it performs under real conditions, what its limits are, what risks it may introduce and what validation is required before deployment. Testing equipment, taking measurements and interpreting results are therefore part of workforce preparation.

Hydrogen skills are built through hands-on experience: testing real equipment, generating reliable data and strengthening technical understanding. CATIM's participation in European and international standardisation and technical networks related to gas equipment and hydrogen helps connect this knowledge with industrial needs, conformity requirements and the wider European transition towards hydrogen adoption.

Looking ahead, CATIM's ambition is to further develop this capability in support of both technical assistance and skills development in the hydrogen field. This means expanding testing scenarios, deepening collaboration with companies and reinforcing the connection between testing, validation, knowledge transfer and training. The broader goal is to help prepare people, companies and technologies for a safer, better-informed and more industrially relevant transition to hydrogen.

Hydrogen Lectures and Lab Videos

Technical University of Denmark

Educational videos are an efficient tool for teachers to diversify their teaching methods, which is important considering the diverse body of learners. Though, making videos is time consuming and demands both deep knowledge and communicative skills of those making the videos. With the Green Skills for Hydrogen project, Technical University of Denmark (DTU) had an occasion to work in depth with video production. This resulted in two types of video content that is intended to expand with more videos and more topics in the coming years.

In the Green Skills for Hydrogen Lectures, leading researchers from DTU introduce to both fundamental knowledge about electrolysis and fuel cells, and give insights into new cases of research results and explorations. These videos are available openly on YouTube, giving hydrogen teachers the possibility of easily integrating this content into their courses. The level of the videos varies from basic to more advanced. All videos are rather short, focusing on one topic. The idea was to enable modularity, i.e., that they can be selected and combined in a variety of teaching contexts, like Lego-pieces can be combined into many different shapes.

The other video format that we developed, was the Green Skills for Hydrogen Lab Series. With this, we wanted to make a contribution to international efforts in giving more people access to experience what happens in laboratories. By applying an ethnographic approach to demonstrating the processes, our idea was to make the core technologies of the green hydrogen economy tangible by inviting viewers into the laboratories where electrolysis cells and fuel cells are fabricated using state-of-the-art processes and tested. Even though the videos were recorded at DTU Energy, the underlying processes are scalable and are typically used by industries in the field.

Especially the laboratory videos are unique since they in a matter of minutes reveal week-long laboratory processes. The videos are stripped of all the stress, the friction, the failures of actual laboratory work. In this sense they are far from revealing what it is actually like to work in a scientific laboratory. On the other hand, they still give a unique insight into the number of processes, the texture of materials, the safety measures, etc., which are characteristic for technologies within the hydrogen sector. There is no talk or explanation of the processes in the videos. This is intended since with this approach we invite teachers to do the talking - to watch the videos with their students, explain what is going on, giving anecdotes and insights from their own laboratory practice, for example how they would have done things differently and much more.

Thus, the videos do not give the full picture, but they can act as a catalyzer for discussion of materials science and other.

There have been several expected and surprising experiences after publishing the videos. Many lecturers incorporate the videos in their ordinary university (and other) courses. Some of the lecturers have created new possible research collaborations,

as colleagues in other countries identified common interests via the videos. These examples prove that video lectures are an efficient tool, not only for education but actually also for research dissemination.

A side effect of having the lab videos available is that they are being used for onboarding of for example new employees for laboratory work. With many PhD students and post docs starting every year at DTU Energy (or other institutions), these small insights give them a step ahead regarding understanding what it is they have to learn and do.

We are hoping to further build on the concepts and the content in the coming years, openly inspiring hydrogen teachers across the globe on ways to vary their teaching with digital tools like videos. We want to enhance usefulness by implementing comments to the lab videos explaining deeper or additional topics to what is seen in the video. Furthermore, we want to include more relevant lab processes.



Green tape of electrolyte layer for a solid oxide cell (SOC), made using the tape caster at DTU Energy to the left. The electrolyte layer is on top of a plastic band, that is later removed. All the layers of the SOC are put together and sintered giving stiff cell at the end

Example of a video lecture about electrolysis given by Anke Hagen from DTU Energy



Learning Hydrogen Where It Happens: Green Energy Center Europe's Living Lab Approach to Skills

FEN Research GmbH

At the Green Energy Center Europe in Innsbruck (Austria) a hydrogen lesson does not end with a slide deck. Students can move from a discussion about electrolysis and storage to exploring real infrastructure, while truck drivers can learn safety and operating procedures beside the vehicle they will use. This practical setting underpins the Tyrolean activities within the Hydrogen Centres of Vocational Excellence¹ (H2CoVE), coordinated by FEN Research GmbH² with schools, universities and industry partners.

This approach has deeper roots in Green Energy Center Europe's³ training history. In 2016, WIFI Austria (Institute for Economic Promotion of the Austrian Economic Chambers⁴) became the first major training organisation to use the Green Mobility Teacher train-the-trainer programme, which included hydrogen vehicles, refuelling, and workshop safety.⁵ This long-standing partnership established the principle that continues to shape today's hydrogen training: new technologies become usable when people can practise with real equipment, understand the risks and develop the confidence to operate safely.

The learners are deliberately diverse. In 2025, students from the HTL Kramsach Glas und Chemie school joined Austria's first H2CoVE pilot course at Green Energy Center Europe. The programme combined hydrogen fundamentals with a study visit to the MPREIS hydrogen production site in Völs, where students could follow the chain from production and storage to practical use.

The same principle applied to people already in the workforce. In 2025, for example, MPREIS truck drivers received training in hydrogen technology, fuel cells, high-voltage systems, safety procedures and refuelling, followed by hands-on work with a Hyundai XCIENT hydrogen truck. Participants received certificates recognising the competencies gained. The training materials were developed in collaboration with the Green Energy Center Europe Codex partners and feed into the vocational education work of H2CoVE in Tyrol.⁶⁻⁷

University education is another part of the same learning ecosystem. In January 2026, 25 master's students of Energy and Sustainability Management from the Applied University of Kufstein took part in a Living Lab workshop⁸ that connected H2CoVE with the REINFORCE⁹ and FLEXI¹⁰ research projects. Rather than considering hydrogen

as an isolated technology, students explored the interaction between long-term hydrogen storage, batteries, monitoring, digital tools and user behaviour within an energy system.

Therefore, what makes the approach distinctive is not one course or one target group. Rather, it is the shared environment in which education, research and industry converge. In the Living Lab, learners not only hear about hydrogen technologies, but also see how the systems operate in practice, learning directly from the people responsible for implementing and running them.

The results are already visible among learner groups. Austria's first H2CoVE pilot course brought vocational students into direct contact with an operational hydrogen value chain. Meanwhile, the truck-driver programme translated knowledge of hydrogen and high voltage into competencies for daily logistics operations, and this was repeated later that year. University workshops provided a systems perspective and international H2CoVE exchanges connected the Tyrolean experience to a wider European learning community. Together, these activities demonstrate that the Living Lab model can be adapted for different learners while maintaining a focus on practical experience.

The most important lesson from this work is simple: the deployment of hydrogen requires the development of hydrogen-specific skills. People need to have the confidence and competence to use, maintain and explain hydrogen technology, and to make sound decisions around it. The Green Energy Center Europe therefore aims to transform real projects into repeatable learning opportunities, ranging from school and university education to professional upskilling, while strengthening the collaboration between education and industry. The next ambition is to develop regional qualification pathways that closely reflect real operating conditions, thereby contributing to a skilled European hydrogen workforce.¹¹



"Vocational students connect hydrogen fundamentals with an operational production and use environment of Demo4Grid and HyWest in Tyrol."



¹¹ <https://green-energy-center.com/hydrogen-skills-as-system-infrastructure/>

¹ <https://h2cove.eu/>

² <https://www.fen-research.org/>

³ <https://www.green-energy-center.com>

⁴ <https://www.wko.at/wifi-economic-promotion>

⁵ [Ausbildung zum 'Green Mobility Teacher' / Train-the-Trainer Programme \(1 June 2016\)](#)

⁶ [Hydrogen Truck Driver Training, HyWest meets H2Alpin and H2CoVE \(14 May 2025\)](#)

⁷ [Hydrogen Truck Driver Training, Second Course within H2CoVE and HyWest Activities \(4 December 2025\)](#)

⁸ [Bringing Together Education, Research and Innovation \(30 January 2026\)](#)

⁹ <https://reinforce-cetp.eu/>

¹⁰ <https://flexi-cetp.eu/>

The Energy Transition Hub Torino: an Integrated Ecosystem for Europe's Hydrogen Skills

Polito - Politecnico di Torino

At the Energy Transition Hub Torino, we believe people learn best when they work on real technologies and real challenges. Instead of studying hydrogen only in a classroom, students and young researchers follow the same journey as hydrogen itself: from examples of clean production to examples of safe use in industry and transport.

The Hub is based at Environment Park in Torino and is managed by the Italian Institute of Technology (IIT) and Politecnico di Torino. It brings together laboratories, pilot plants, companies and public organisations. What can be experienced is not a single course or degree program, it is a shared learning environment for Master's students, doctoral candidates, young researchers and engineers from industry. They learn by taking part in projects that are developing technologies for energy transition.

The journey begins from green hydrogen and the researchers can work on new types of electrolyzers. The learners work on the materials inside these machines, on their main components and on complete prototypes. This can provide them with a clear view of how an idea moves from a laboratory bench towards a working product. They also learn how scientists and engineers cooperate to improve performance, reduce costs and make a technology suitable for industrial use.

Once hydrogen is produced, another challenge begins: it must be measured, tested and trusted. This is the focus of another part of the project. Learners work on questions that are essential for the market but are often invisible to the public. Is hydrogen pure enough? Is the amount being delivered measured correctly? Can pipes, tanks and machines safely withstand contact with hydrogen? How should an electrolyser or fuel cell be tested? By answering these questions, participants understand why common testing methods, reliable measurements and recognised rules are necessary before a new technology can be used on a large scale.

The third part of the journey takes learners into one of the most exciting areas of hydrogen innovation: aviation. This is an example of use of hydrogen. This part of the project studies how liquid hydrogen could be moved safely from a tank towards an aircraft engine. Liquid hydrogen must be kept at about -253°C , so even ordinary tasks such as pumping, controlling the flow and choosing materials become major engineering challenges. Researchers are helping to design pumps, valves, sensors and test equipment. They also use computer models to understand how the system will behave before it is built. The work gives them direct experience of safety, reliability and the needs of future zero-emission aircraft.

These three steps form a connected learning path. The first shows how hydrogen can be produced. The second shows how technologies can be tested and made trustworthy. The third shows how hydrogen can be used in a demanding real-world application. The wider Hub adds pilot facilities and links with companies, allowing learners to see what happens between a research result and a technology that can operate outside the laboratory.

What makes the approach special is the mix of people. Chemists, physicists, materials experts, mechanical and electrical engineers, sustainable mobility specialists and company technicians work on the same challenges. Each person brings a different part of the solution. Students develop knowledge in their own field, but they also learn to communicate across disciplines, understand the whole system and work with partners who have different goals and experience.

The lesson is simple: nobody can build the hydrogen economy alone. A promising material is not enough if it cannot be manufactured. A working machine is not enough if it cannot be tested safely. A new fuel is not enough if people do not know how to store, measure and use it. By bringing research, practical testing and industrial needs together, the Hub helps learners understand these connections from the beginning.

The Hub has already created a common space where young people can move between different technologies and meet researchers and companies. It also supports industrial doctorates, research careers and the transfer of knowledge to businesses. Our next ambition is to make this learning pathway more visible and accessible, and to connect it more strongly with European partners working on hydrogen education and professional skills.

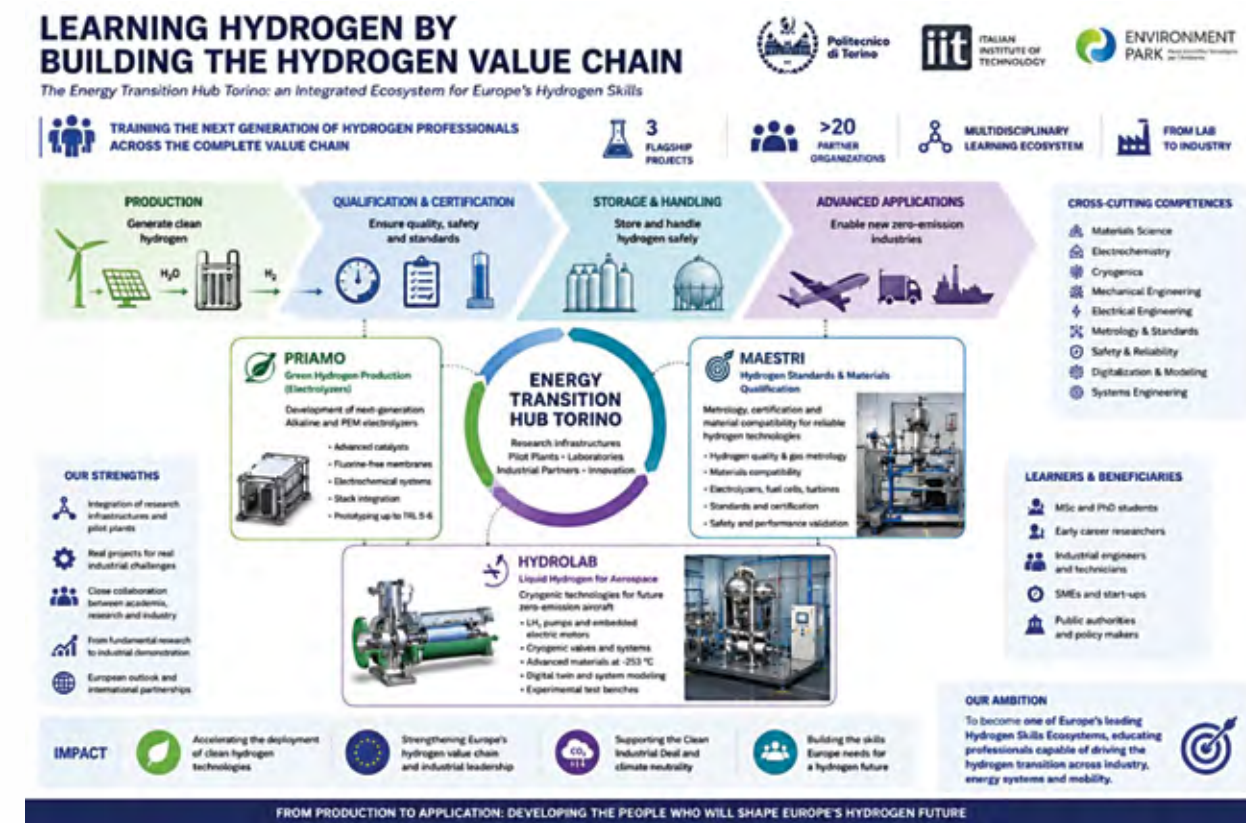


Figure 1. The Energy Transition Hub Torino learning pathway: from green hydrogen production to testing, safe handling and advanced applications.

Hands-On Innovation at the UPC Hydrogen Lab

Universitat Politècnica de Catalunya

Within the Specific Centre for Hydrogen Research (CER-H2), the Universitat Politècnica de Catalunya (UPC) created a proving ground designed to bridge the crucial gap between academic research and real-world industrial deployment.

Our initiative serves two primary groups: the industries tasked with deploying hydrogen technologies, and the next generation of engineers who will bring them to market. For energy providers, automotive manufacturers, and innovators, we offer a place to validate technologies under demanding, real-world conditions. For our master's and doctoral students, the lab provides an invaluable hands-on learning environment. We believe that an engineer cannot truly understand the complexities of hydrogen with its wide flammability range, high pressure demands, and unique fluid dynamic properties without physically working with it.

This hands-on methodology places our learners shoulder-to-shoulder with leading European energy providers and local Catalan and European manufacturers. Instead of merely reading about degradation mechanisms in a textbook, a student might spend their afternoon analysing real-time performance data from a specialised fuel cell test stand or performing a post-mortem analysis on a catalyst layer that failed during an industry partner's durability test. This collaborative ecosystem ensures our students are not just learning; they are actively solving immediate industry bottlenecks.

What makes our approach at UPC truly unique is our unwavering commitment to experimental validation and practical learning across the entire hydrogen value chain, with a heavy emphasis on safety, storage, infrastructure, and integration. We do not just look at how hydrogen is produced and used; we look at how it lives and moves.

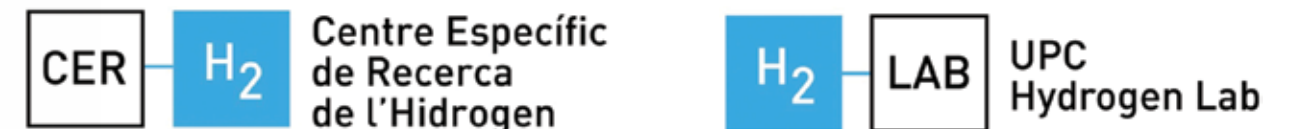
Our facility is equipped with dedicated testbenches to evaluate both production and power generation. We continuously test how 100W to 100kW PEM fuel cells and AEM electrolyzers, as well as fuel cell stacks up to 30kW, perform when subjected to the unpredictable, fluctuating power loads typical of wind and solar energy. We also operate custom rigs for evaluating autothermal and steam reforming processes, analysing catalytic activity and thermal profiling to bridge the gap between legacy fuels and clean hydrogen.

However, physical testing is only half of the equation. A key element of our methodology is how we bridge the physical and digital worlds. Every hour of stress testing on our rigs can generate hundreds of thousands of data points, which we use to validate advanced Computational Fluid Dynamics (CFD) models and train digital twins of hydrogen systems. This approach extends far beyond the bench scale: we operate our own on-site hydrogen production plant as a continuous "living lab." By feeding real-time data from this fully functional plant, alongside degradation metrics from our physical testbenches, into these digital replicas, we capture the true complexities of system integration.

To address the bottleneck of infrastructure, we built a large environmental chamber that allows us to test systems up to 100 kW and temperatures from -40 to 70°C with our automated test infrastructure for long-term accelerated stress testing.

One of our proudest success stories to date emerged directly from this rigorous safety environment: the successful design, testing, and validation of high-flow hydrogen valves for the automotive industry. By bringing together talented engineering minds to lead the design and utilising our custom high-flow test benches to validate the prototypes, we were able to provide the automotive sector with robust components that are essential for safe, heavy-duty hydrogen mobility.

Looking ahead, our ambition is to expand the UPC Hydrogen Lab into one of Southern Europe's premier testing and practical learning facilities for green hydrogen infrastructure. As we continue to share our data, train brilliant new engineers, and collaborate with international partners, we remain dedicated to one clear goal: ensuring that when Europe is ready to flip the switch on the hydrogen economy, the technology is tested, proven, and ready to deliver.



11 test benches and vented hoods for testing of hydrogen technologies



100 kW 2.5m x 2.5 x 2.0m environmental test station for hydrogen technologies -40 to 70°C automated operation

Acknowledgements

Recognising our members' commitment to hydrogen skills and workforce development

The development of this *Skills Magazine* reflects the collective commitment of Hydrogen Europe Research and its members to building the skills and expertise needed to support the growth of the European hydrogen sector.

We would like to express our sincere gratitude to the members of our *Skills Task Force* who actively contributed to the development of the White Paper on the EU-wide recognition of hydrogen-related qualifications and training. Their valuable insights, constructive feedback and dedication to refining the text have helped shape the paper's content and strengthen its recommendations.

We would like to give special recognition to the following members for their particularly active contributions to the White Paper:



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Aragon Hydrogen Foundation



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INIG-PIB



Ulster University

Finally, we would like to thank all HER members who contributed to this magazine by sharing their stories, initiatives and experiences. By showcasing the work already underway across the hydrogen value chain, they demonstrate how organisations are investing in people, developing talent and helping prepare the workforce for the challenges and opportunities of the hydrogen transition. Their contributions provide valuable examples of how collaboration between industry, education and training can translate ambition into action.

To all contributors, thank you for your time, expertise and continued commitment to workforce development in hydrogen. Your efforts are helping lay the foundations for a skilled and qualified European hydrogen workforce.



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