Skills for Hydrogen Safety

Erasmus+ KA202 - Strategic Partnerships for vocational education and training

Co-funded by the
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of the European Union

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Overview of HySkills modules

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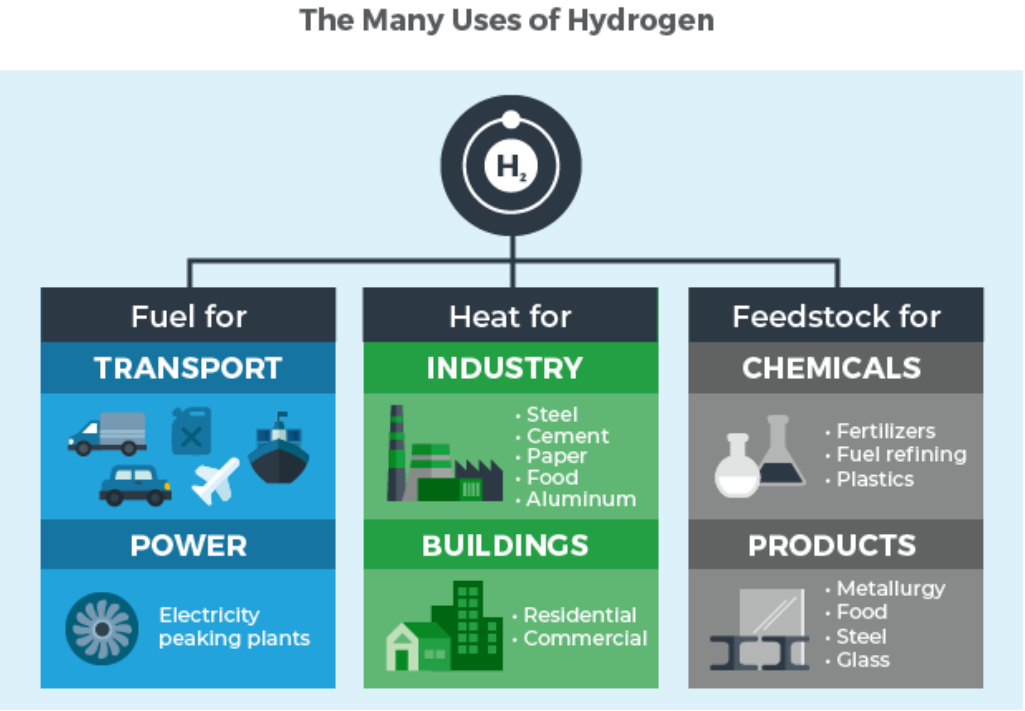
Hydrogen and its use cases



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HYSKILLS

A sign of current times

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How will removing reliance on Russian oil and gas impact the green energy transition?

09 March 2022 (0 Comments)
Posted by: William Barns-Graham

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Hydrogen can help decarbonize the economy, through massive investments and appropriate policy support, according to new UN report

Circular Economy ▷ | Climate Change ▷ | Sustainable Development ▷ | Sustainable Energy ▷ | SDGs ▷ | Hydrogen ▷

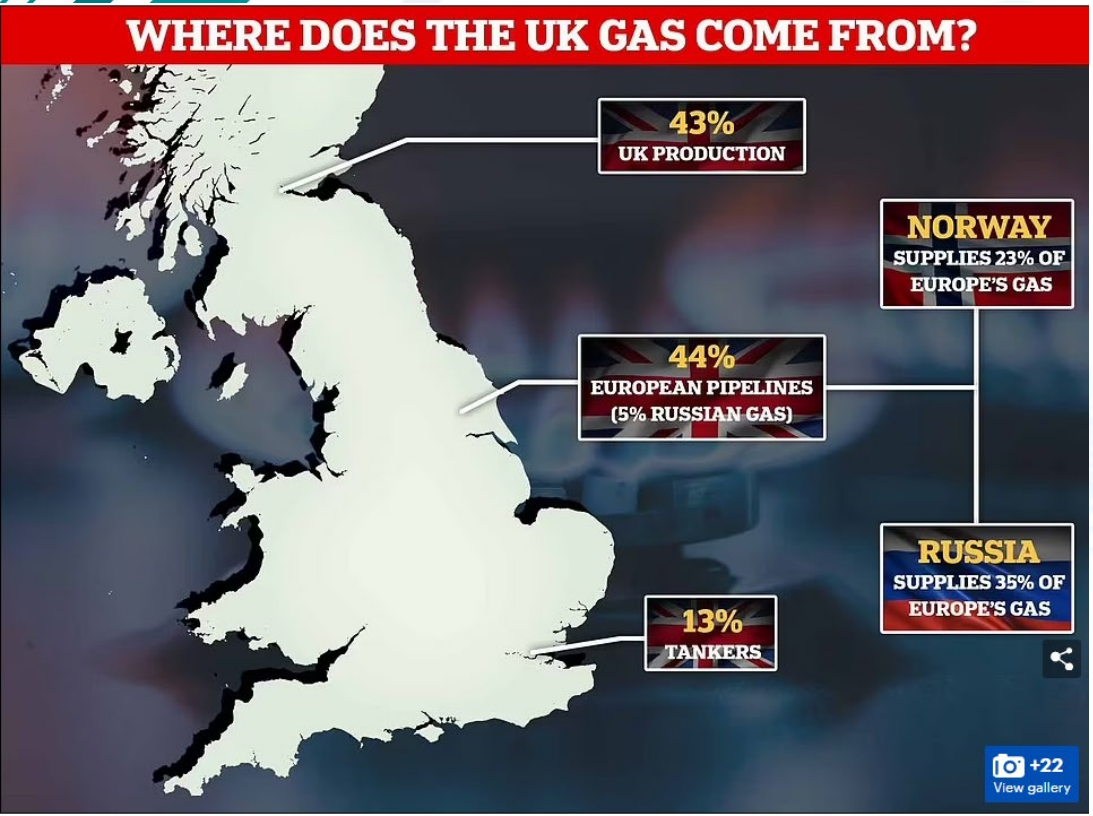
04 November 2021

The shift to a decarbonized Hydrogen-based economy that can achieve Carbon Neutrality by 2050 in line with the objectives of the Paris Agreement, requires swift and extensive expansion of renewable and low-carbon hydrogen production. This will require massive investments and appropriate policy support, according to a new UN Policy Brief released today.

The potential of H2 to decarbonize the economy

Hydrogen (H2) is a bulk chemical that is used primarily today in petroleum refining and in the production of ammonia (for fertilisers) and methanol. When used as a fuel, it does not generate direct emissions of pollutants or greenhouse gases.

A sign of current times



The world's current state of affairs effects many avenues of life and not just energy.

However, in times like these key questions should be asked concerning our energy security and how we should consider our future.

Not only should energy demand be considered but this is a prime historical time to get the transition to net zero achieved in the right way and potentially lead by example.

Why Hydrogen?

Climate Change Act 2008

Paris Climate Agreement (December 2015)

Newly launched Energy Bill/Action Plan

United Nations Sustainable Development Goals (UN SDGs)

Applicable SDG's: 7, 8, 9, 11 & 13

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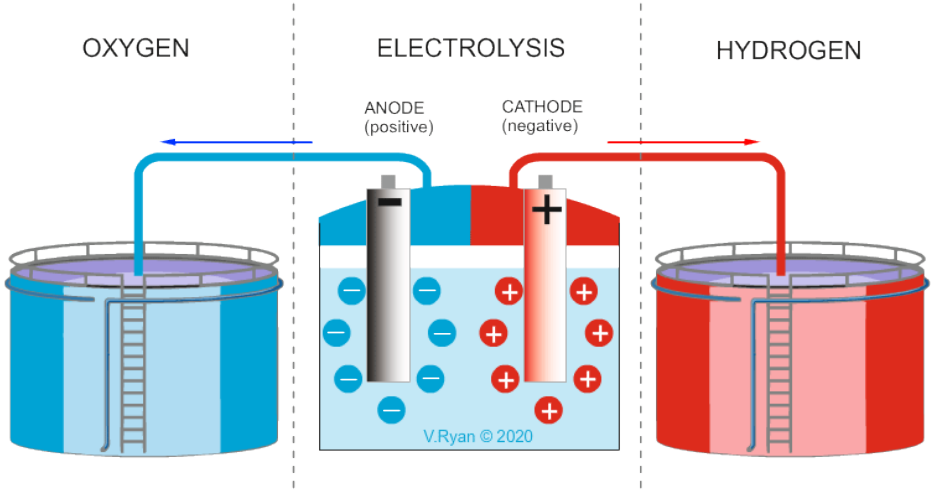
Water electrolysis to produce Hydrogen

In water electrolysis, a voltage is applied to the cells and a direct current (DC) passes between two electrodes, in contact with an ionic conducting medium, with hydrogen and oxygen produced by the decomposition of water.

$$H_2O + electrical\ energy \rightarrow H_2 + \frac{1}{2}\,O_2$$



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Characterisation of Hydrogen source

Colour	Process	Impact
Green Hydrogen	Electrolysis, using renewable energy (wind, solar etc.) to split water into its component parts ($H_2 + O_2$).	No carbon emissions, ability to "store" surplus electricity from renewable sources.
Yellow Hydrogen	As above, using nuclear power instead of renewable energy.	Low carbon emissions, ability to "store" surplus electricity.
Brown Hydrogen	Gasification, using coal/biomass/waste to heat water and break it down. Also known as "town gas".	Along with the component parts of water, other harmful elements are produced: carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4), and ethylene (C_2H_4).
Grey Hydrogen	Steam Methane Reforming (SMR), using methane to heat water and break it down.	As above, produces other harmful elements: CH_4 and CO_2
Blue Hydrogen	SMR and carbon capture, use and storage (CCUS).	Grey hydrogen but with carbon capture so it is seen as a lower carbon option.
Turquoise Hydrogen	Using Molten Metal Pyrolysis, natural gas is passed through a molten metal that releases hydrogen and solid carbon.	Solid carbon can be used for industrial applications, so it is seen as a lower carbon option.

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Overview of Hyskills

- Co-funded by the Erasmus+ Programme of the European Union.
- Rationale: Will be a skills gap in the upcoming hydrogen sector and therefore a need for a suitably educated workforce.
- “HySkills”; an industrially relevant, modular, vocational education and training (VET) course aimed at educating learners for the hydrogen sector.
- The HySkills modules will focus on fundamentals of hydrogen, imparting technical & practical knowledge as well as the important critical safety considerations of hydrogen.
- Started December 2020, consortium consists of 5 transnational partners with expertise in hydrogen, sustainability and education. The main outputs of the project are units, modular course and a “train the trainer” programme and handbook.

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OVERVIEW

South West College (SWC) is one of the largest vocational and technical Colleges in the United Kingdom.

- Employs over 900 staff
- 22,000 full-time and part-time learners
- Annual turnover of £42million.

The College is rurally located in the western region of Northern Ireland

- Four campuses located across counties Fermanagh & Tyrone

The College ranges from Level 1-7 which includes

- Further Education,
- Higher Education
- Apprenticeship Programmes.

The College offers a broad range of modern and industry-relevant
curriculum delivered across three faculties:

- Professional and Social Sciences,
- Built Environment Creative and Life Sciences
- Automotive, Computing and Engineering.

INNOVATION

SWC currently has four innovation centres;

- **STEM:** Science Technology Engineering Maths
- **IDEA:** Product Design and Development Studies
- **CREST:** Centre for Renewable Energy and Sustainable Technologies
- **IMAGE:** Creative Industries Studio

The innovation centres act as interactive learning and exhibition spaces in which SWC learners, local schools, entrepreneurs and companies from a variety of industries attend to encourage them to participate in creativity, innovation and informal learning.

ERASMUS+

SWC are positioned as one of the UK's leading organisations in Erasmus+ projects achieving funding under all three key actions covered by the Programme. Currently the college have 14 live Erasmus+ projects valuing €3.7m in areas including:

- Entrepreneurship
- Engineering
- Renewable Energy
- Hospitality

Expertise in Sustainability – EU Projects

Renewable Engine

- Development of technologies for the more effective utilisation of Renewable Energy.
- Techno-economic analysis of Hydrogen as an energy storage vector coupled with decentralised renewable energy sources (Heat / Transport).
- Carbon Capture Utilisation & Storage (CCUS).

Housing 4.0

- Digital Construction for small, affordable low carbon / zero-energy homes.

FASTER

- Design, installation and operation of 73 rapid charging points for EVs.

CREST

- Centre for Renewable Energy & Sustainable Technologies.

DEFMA

- Digital & Environmental Skills for Facilities Management.

Movesmart

- Rapid route planning for energy efficient personalised mobility.

REPUTE

- Promotion of the use of renewable energy in public transport.

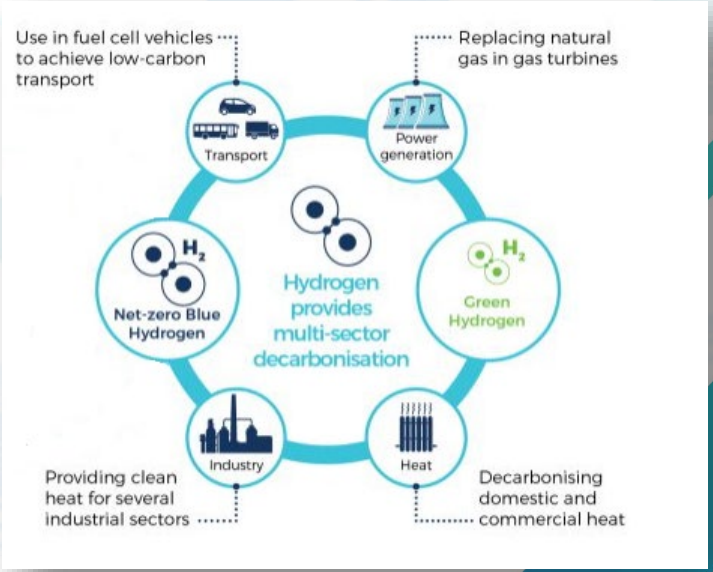
BATTERIE

- Promotion of smart technologies and utilisation of alternative fuels.

HySkills: Skills for Hydrogen Safety

Context

- **Paris Agreement** – Newer "green" and sustainable technologies will be adopted.
- Green Hydrogen (H_2) key to **decarbonising** a number of sectors:
  - Transport, industry and domestically.
- Hydrogen offers many benefits as both a **fuel source** and an **energy carrier**.
  - **Fuel source** – water the only by-product of combustion in a fuel cell.
  - **Energy carrier** – can store/transport a large amount of energy.



Source: http://www.element-energy.co.uk/2019/11/hyimpact-series/

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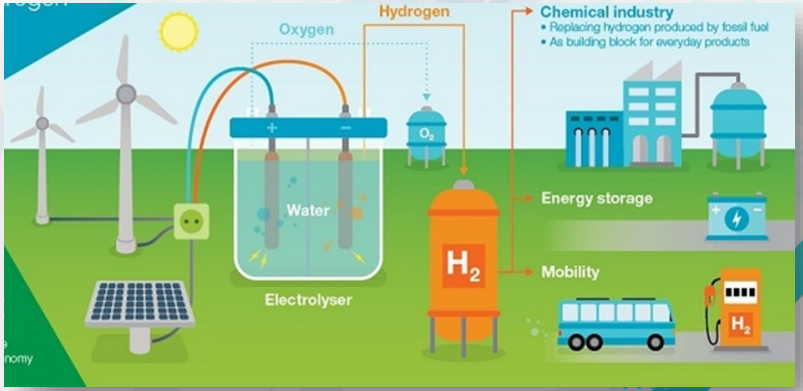
Decarbonisation >>>>> increased uptake of hydrogen-based technologies and infrastructure:

- Fuel Cells
- Fuel cell vehicles (FCVs)
- Combined heat & power units (CHP)
- Hydrogen systems (generation plants) & infrastructure
- Hydrogen refuelling stations (HRS)
- Other associated technologies

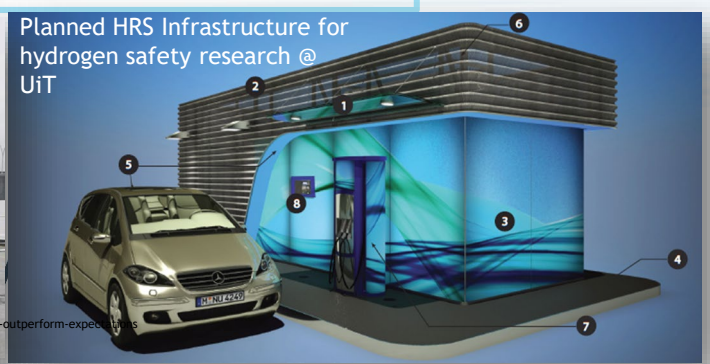


Source: https://www.akzonobel.com/en/for-media/media-releases-and-features/akzonobel-and-gasunie-looking-convert-water-green-hydrogen

H_2 Bus, Aberdeen

Source: https://www.imeche.org/news/news-article/aberdeen%27s-hydrogen-buses-outperform-expectations

Planned HRS Infrastructure for hydrogen safety research @ UiT



1) Acrylic canopy
2) Façade panels, perforated steel
3) Perforated graphic panels
4) Elevated floor surface
5) Steel frame with LED light insert
6) Steel frame structure
7) Dispenser
8) Otc unit

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Rationale for HySkills

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Northern Ireland set to get 100 zero-emission buses

By Conor Macauley
BBC NI Agriculture & Environment Correspondent

6 days ago

Minister for Infrastructure Nichola Mallon and Translink staff with one of the new hydrogen-powered buses

Northern Ireland is set to get 100 zero-emission buses, which will come into service over the next two years.

Twenty of them will be hydrogen powered and the other 80 will be battery operated.

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Rationale for HySkills

- UK & EU funding commitments for sustainable technologies:
  - UK - £90M funding in February 2020 to reduce carbon emissions, with £28m specifically for projects related to green H_2 production.
  - EU - funding from FCH JU and other sources, including private and national/regional funding in Horizon 2020 equates to over €1.5B for a range of H_2 projects.

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- The transition to Hydrogen will result in **the creation of many technically skilled jobs** transnationally. This includes technical workforce involved in:
  - Manufacture/maintenance of H_2 vehicles.
  - Hydrogen systems and associated infrastructure.
  - H_2 refuelling stations.
  - Fuel cell power generators.
  - Hydrogen generation plants.

This creates a need that must be addressed: as new green H_2 technologies (and the associated systems) are adopted there **must** be a fully equipped workforce available with the ability to work with H_2 in a **critically safe** manner.

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Specific Objectives

- The partners aim to develop a modular training course enhanced with **practical training** focused on the subject of hydrogen safety skills.
- The project will also seek to attain and implement a suitable method of **accreditation** for the course.
- It will align directly with **hydrogen industry sectoral needs**.

1. *To undertake a **comparative needs analysis** across the 5 EU partner countries to map the relevant safety and technical skills of future workforce in the hydrogen industry and influence the design and content of the HySkills training course targeting:*
   - *Sector employers, industry experts , research experts , existing H_2 projects and other relevant bodies/consortia.*
2. *To enhance the labour market relevance of VET learners by **designing a modular training course** and practical training giving **accredited safety skills** with a view to creating a fully equipped workforce able to fully integrate into hydrogen related industries.*
3. *To initially strengthen the key competences of 90 learners through the **pilot delivery** of the HySkills modular training course within the partner institutions.*
4. *To develop and pilot a **teacher training programme** to 50 teachers & trainers to enable the effective delivery of HySkills.*
5. *To introduce **modern training delivery methods** and open access resources (e.g. online toolkit) for staff and learners across Europe, building capacity for the future hydrogen workforce.*

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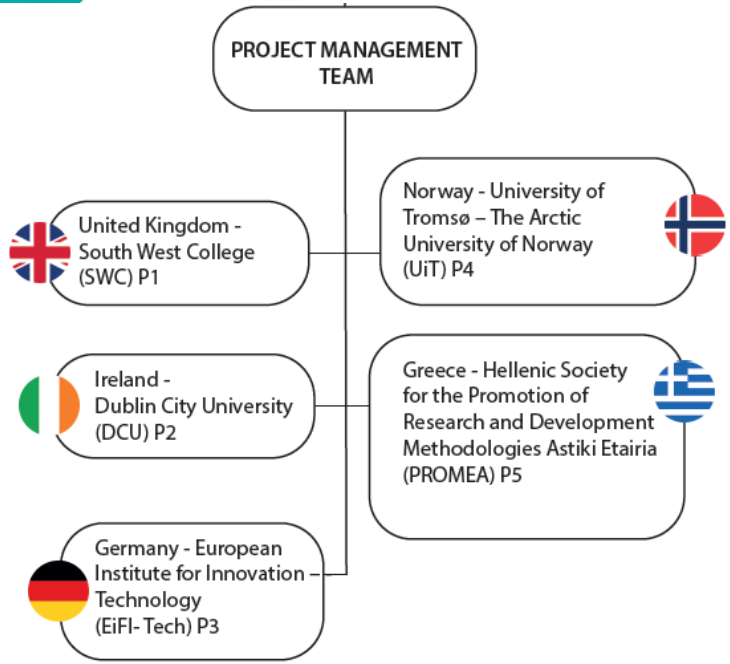
HySkills Collaborative Partnership

Overall Project Coordinator:
South West College (SWC)



Essential for the future workforce:

1) A sound knowledge and understanding of the potential hazards of H_2 in its various states.
2) Knowledge of safety implications involving working with H_2.
3) "Hands-on" Technical competency skills.

The HySkills course will be aimed towards providing **vocational skills** training for the hydrogen sector coupled with fundamental **health and safety competence**.

Partner Summary

United Kingdom - South West College (SWC) P1

Ireland - Dublin City University (DCU) P2

SWC have expertise in large scale sustainability projects and green technologies through the Renewable Engine Project. Have VET expertise delivering part-time and full-time vocational courses to approximately 1500 students annually.

DCU Have R&I experience in Energy Sustainability, Hydrogen & Fuel Cell Technology Development. They have invested in a new hydrogen lab facility for testing fuel cells, electrolysers and storage materials. They are involved in several other H_2 projects.

EiFi Tech have expertise in H_2 technology and H_2 diversification through their involvement in HyTrEc & HyTrEc2 projects.

Germany - European Institute for Innovation – Technology (EiFI-Tech) P3

UoT have technical expertise in H_2 technology and fuel cell applications in transport and logistics. Also involved in the HyTrEc2 project leading the development of hydrogen and fuel cells technologies for cold climates and in process of establishing a HRS test facility.

Norway - University of Tromsø – The Arctic University of Norway (UiT) P4

Greece - Hellenic Society for the Promotion of Research and Development Methodologies Astiki Etairia (PROMEA) P5

PROMEA experienced in promoting and supporting research & development methodologies and managing of VET projects. Specifically in resource efficiency, circular economy and environmental sustainability projects.

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Activities/Outputs

IO1
Learning Outcomes & Learning Units

IO2
Training Course

IO3
Train the Trainer Programme

Five multiplier events
(UK, IRE, DE, NO, GR)
to support the dissemination and exploitation of the intellectual outputs (IO1-IO3).

Dissemination
- 3 email campaigns
- 6 press releases
- 3 Erasmus+ Guest Blogs/Case Study
- Twitter Page

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Impact

HYDROGEN ECONOMY…

Facilitating the transition

SKILLING TODAY FOR TOMORROW…

Creating a technically skilled and competence workforce

SUPPORTING GREEN INCENTIVES

To reduce GHG and aid decarbonisation of sectors

COLLABORATION…

Enhancing collaboration with a range of H_2 stakeholders

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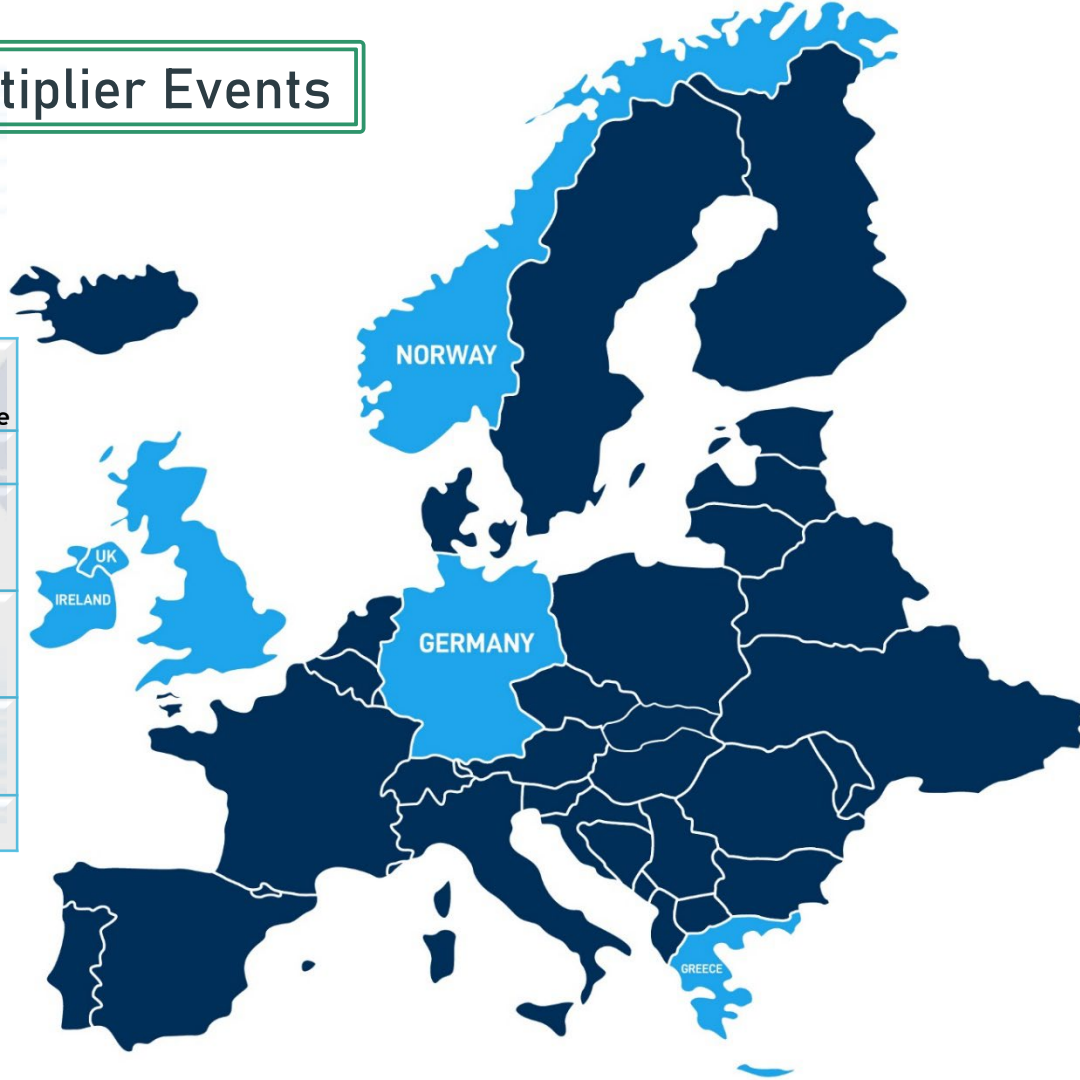
Multiplier Events

Event	Country of Venue
E1: HySkills Information Seminar	Germany
E2: Demonstration Workshop- HySkills Training Course	UK
E3: Launch Event: HySkills Teacher Training Programme	Ireland
E4: HySkills: Skills for Hydrogen Safety	Greece
E5: Final Showcase	Norway



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Overview of HySkills

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Hyskills Modules

- Hydrogen Basics
- Hydrogen safety, risks, standards and regulation
- High pressure fittings and connections
- Hydrogen storage
- Operation and maintenance of electrolysers and fuel cells
- Transportation and delivery
- Hydrogen combustion
- Hydrogen sensors, detectors and monitoring

DCU
EIfI TECH
UoT
SWC

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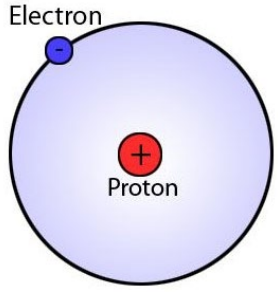
Module 1: Hydrogen Basics

- Recognise the importance of hydrogen in the energy sector as a potential clean fuel in the context of the current energy transition.
- Describe the chemical properties of hydrogen gas and the different methods that are employed to produce it, differentiating between their environmental impacts.
- Identify roles for hydrogen in electricity production, energy storage, heating and transport.
- Discuss current and future technologies for hydrogen storage, distribution and combustion.
- Identify applications for hydrogen in industry as a chemical and industrial feedstock.



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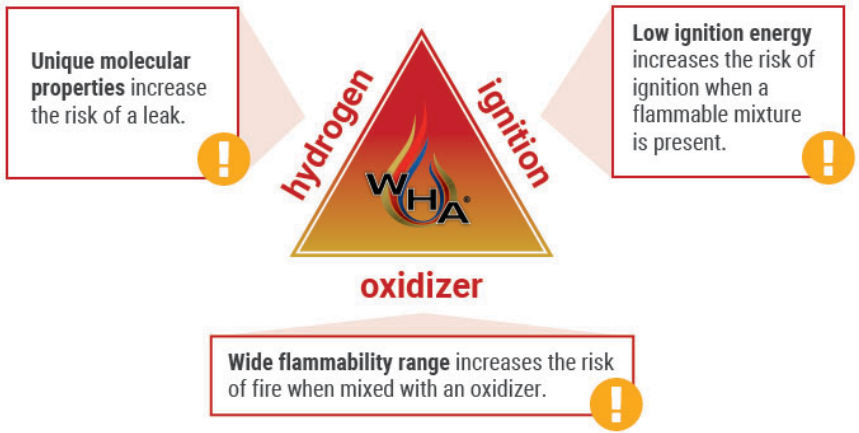
Module 2: Hydrogen safety, risks, standards and regulation

- State the current Health and Safety legislation covering employers and employees.
- Prepare to handle hydrogen gas.
- Perform a risk assessment exercise within a given hydrogen environment.



CENTER FOR Hydrogen SAFETY

Module 3: Hydrogen high pressure fittings and connections

- Understand piping system criteria and installation of components up to the system's readiness to start up.

- Describe maintenance and repair procedures of high-pressure hydrogen installations in terms of inspection, grounding system, maintenance, and records.

Module 4: Hydrogen Storage

- Understand the different methods and technologies available for storing hydrogen.
- Understand the different methods of Hydrogen Compression Technologies.
- Understand the different methods available for storing hydrogen in liquid and gaseous forms in high-pressure Hydrogen storage vessels and cryogenic flasks and Solid-State Hydrogen Storage in metal hydride storage and carbon nanotube adsorption.

Module 5: Operation and maintenance of electrolysers and fuel cells

- Describe the basic principles of electrolyser & fuel cell technology systems.
- Describe the basic characteristics of fuel cells and the function of their component parts.
- State the relevant Standards and Regulations used for the design, installation, commissioning and maintenance of electrolyser & fuel cell technology systems.

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Module 6: Transportation and delivery

- Describe the situations where purging of hydrogen systems is required and the correct procedure for purging.
- Describe the basic characteristics of a hydrogen gas network and its component parts.
- State the relevant Standards and Regulations used for the commissioning, maintenance and operation of hydrogen Transportation and Delivery Systems.
- Demonstrate Competence in the Delivery of Gaseous Hydrogen to a Hydrogen Storage Facility.
- Demonstrate Competence in the Delivery of Liquid Hydrogen to a Hydrogen Storage Facility.

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How is hydrogen transported?

Via Road

- Above ground transport over distances up to 300 miles.
- Achieved through stored compressed hydrogen in trucks.

Via Pipeline

- Above or underground.
- Dedicated pipeline or blended with existing natural gas infrastructure.

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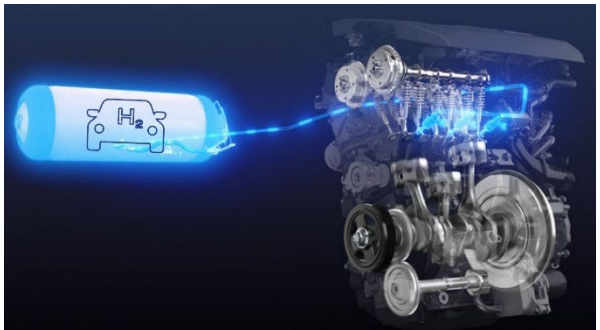
Module 7: Hydrogen combustion

- Describe the conversion of hydrogen in end use applications focusing on hydrogen combustion.
- Examine the principles of hydrogen combustion and safety technologies and systems.
- Describe and compare the operation and maintenance of different hydrogen combustion technologies.
- Demonstrate compliance with safety regulations and workplace policies, procedures and practices required for working with the combustion of hydrogen.



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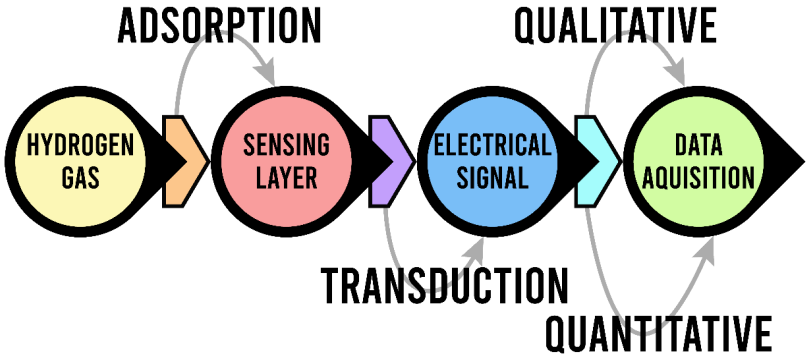
Module 8: Hydrogen sensors, detectors and monitoring

- Describe the technologies and strategies used in hydrogen detection..
- Describe the situations where the detection of hydrogen is required.
- Describe the maintenance and testing of hydrogen detectors.
- Describe the design criteria in specifying a hydrogen detection system.



Thanks for listening

Find out more at: https://hyskills.org/

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