Interreg North-West Europe GenComm

European Regional Development Fund

H_2GO NEWS

June 2021

H_2CAT- The Catalyst for Hydrogen Innovation

H_2CAT - The Pathway for Increased NI Competitiveness

BACKGROUND

With the communication of December 2019[i], the European Commission has committed to 'tackling climate and environmental-related challenges that is this generation's defining task'. The EU has defined a set of strong measures aiming at achieving zero net greenhouse gas emissions by 2050 and decoupling economic growth from resource use. This decoupling creates sector-coupling activities in energy, transport and industry with Hydrogen as the energy vector. Deployment and investments in hydrogen have accelerated rapidly in response to government commitments to deep decarbonisation, establishing hydrogen as a key component in the energy transition.

Northern Ireland can champion this ambition and as a result drive economic growth and job creation. H_2CAT will establish an integrated role for hydrogen in an integrated energy system; the integration of the electricity, gas and hydrogen grid is beneficial for a well-functioning hydrogen market and is essential for an effective and efficient Northern Irish energy market.

HYDROGEN MOMENTUM

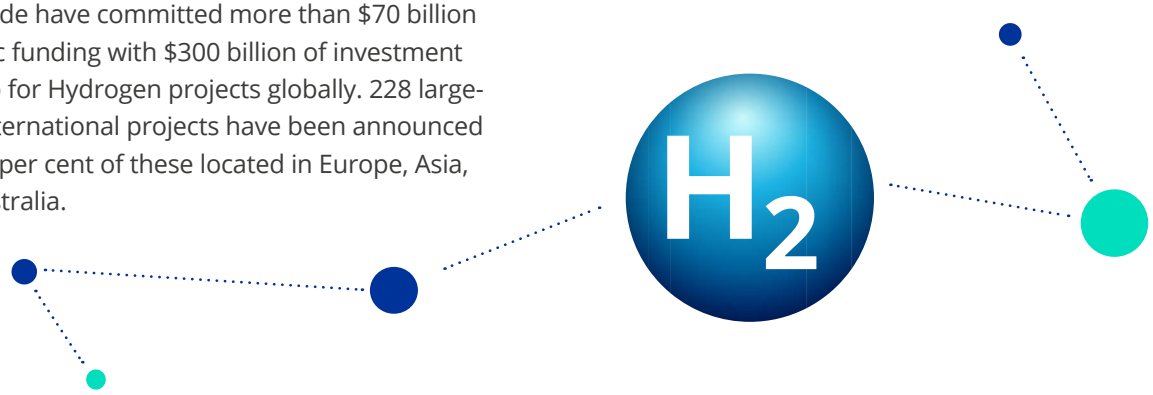
There is significant momentum across the entire hydrogen value chain, and it is accelerating cost reductions for hydrogen production, transmission, distribution, retail and end use applications. Underpinned by a global shift of regulators, investors and consumers toward decarbonization, hydrogen is receiving unprecedented interest and investments.

At the beginning of 2021, over 30 countries have released hydrogen roadmaps. The industry has announced more than 200 hydrogen projects and ambitious investment plans. Governments worldwide have committed more than $70 billion in public funding with $300 billion of investment lined up for Hydrogen projects globally. 228 large-scale international projects have been announced with 85 per cent of these located in Europe, Asia, and Australia.

From a total cost of ownership (TCO) perspective, Hydrogen can become the most competitive low-carbon solution in more than 20 applications by 2030, including long haul trucking, shipping and steel.

The deployment of Hydrogen projects through three cluster types is already gaining traction:

1. **Industrial centres that support refining, power generation, and fertiliser and steel production;**
2. **export hubs in resource-rich countries;**
3. **and port areas for fuel bunkering, port logistics, and transportation.**



GREEN ENERGY INNOVATION CATALYST

H_2CAT will be a 'one-stop shop' to assist companies become more competitive with regard to their business/production processes, products or services using hydrogen technologies.

H_2CAT will do this by providing access to technical expertise and experimentation, so that companies can 'test before invest'. The task will also include the provision of innovation services, such as financing advice, training and skills development vital for a successful energy transition and sector transformation. Driving innovation and deployment of the energy decarbonisation journey will be central to H_2CAT.

H_2CAT will focus on

- Production
- Applications, Usage and Sustainability
- Engineering and design
- Commercialising potential
- Collaboration
- 'System scale' skills development
- Reliability, safety and communications

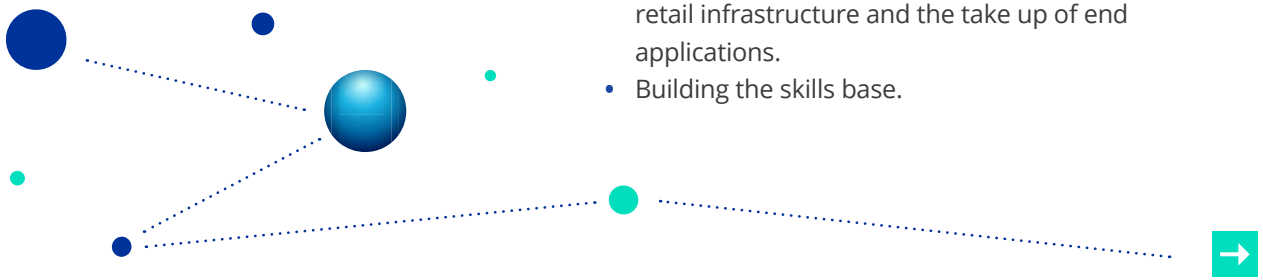
The Hydrogen economy will help ensure Northern Ireland remains competitive internationally.

IMPLEMENTATION

Across Europe, it is expected that hydrogen utilisation clusters will emerge with large-scale hydrogen off-takers at their core.

Whilst Northern Ireland vies to compete with these clusters on an industrial scale, we do have significant advantage in the knowledge and utilisation of hydrogen. As a result of the visionary work of many partners and projects including GenComm, HAZEL, SMARTH2 and others, Northern Ireland is ahead of the hydrogen curve in Research and Development.

Therefore, we have significant knowledge capital and a unique public sector partnership that provides market and technology advantages for a fourth cluster: Hydrogen optimisation, innovation, entrepreneurship and deployment.



CAPTURING THE PROMISE OF A H_2 ECONOMY

H_2CAT will work in cohesion with partners from all sectors to capture the promise of a H_2 Economy for NI, securing:

- Strong government commitment to deep decarbonization, backed by financial support, regulation and clear hydrogen strategies and targets.
- Sustained momentum with ambitious strategies, translated into concrete measures such as sector-level strategies with long-term targets, short-term milestones, and the necessary regulatory framework to enable the transition.
- The establishment of industry-led value chains for equipment, scaling up of manufacturing, attracting talent, build capabilities, and accelerating product and solution development.
- The required support to scale up carbon transport and storage, hydrogen shipping, distribution and retail infrastructure and the take up of end applications.
- Building the skills base.

NI COMMERCIAL ADVANTAGE

What can the hydrogen economy do for Northern Ireland?

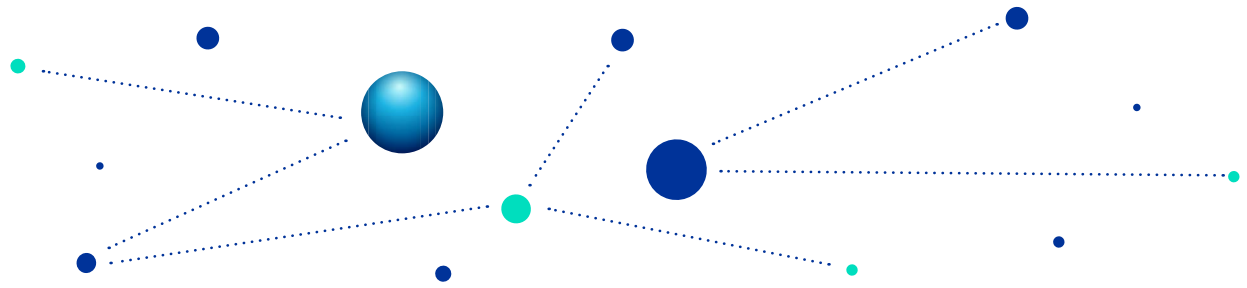
- Enable gas companies to utilise existing infrastructure and generation network to maintain relevance whilst integrating intermediary fuels
- Empowering petrochemical [or] hydrocarbon based companies to utilise intermediary fuels such as grey/blue hydrogen (natural gas/ CCUS) to maximise asset utilisation and avoid stranded assets
- Informing industry to make long-term planning for decarbonisation and transfer to green energy options
- Establishing a new 'innovation value chain' for this emerging low carbon sector. This would enable and empower industry and others to develop on a distributed basis across the region, avoiding supply chain bottle necks, delivering a regionally balanced economy

H_2CAT PILLARS

The catalyst will encompass five interlinked pillars that will support, empower and champion the low carbon sector advantages for Northern Ireland:

1. Research & Development
2. Innovation and Entrepreneurship
3. Skills and training
4. Industry engagement, competitiveness
5. Community Engagement

Smart integrated renewable energy systems supported by a skills' delivery mechanism, solid integrated Research and Development, innovative approaches and community engagement will overcome some of the challenging barriers, and deliver an international advantage for Northern Ireland.



H_2CAT AIMS

1. Establish Northern Ireland as a H_2 centre of excellence
2. Position and maintain Northern Ireland's standing as a renewable energy technology deployment platform
3. Create a supply chain of hydrogen production and energy use
4. Establish energy resilience and sustainability
5. Develop H_2 technology industry accelerators
6. Engage with finance and commercial opportunities
7. Establish H_2 clusters and H_2 Industry consortia
8. Equip Northern Ireland with the skills necessary to exploit all low carbon sector opportunities
9. Accelerate the share of hydrogen in the Northern Ireland energy mix
10. Capture the promise of a H_2 and low carbon economy for Northern Ireland.

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[i]The European Green Deal, COM(2019) 640

Net Zero H_2ero

Over the last year hydrogen has become one of the hottest topics with regards to the energy transition at least in Europe. Now, some Asian countries as well as the US are discussing the role this multi-talented molecule could play in achieving the internationally and legally binding Paris Agreement goals.

The European Union is following up on its hydrogen strategy, launched in July 2020, and 2021 will be the year for action in different fields. Parallel to this strategy, the EU has also launched the **European Clean Hydrogen Alliance** which works towards preparing a concrete pipeline of projects in six different areas: production of hydrogen, distribution via infrastructure, use in mobility, use in buildings, use in industry and finally use in the energy system. This mirrors the entire hydrogen value chain and makes it clear: it's a Decathlon that we are talking about here and you need a carrier, a vector and a chemical substance to do it.

Hydrogen is all of that which is why we can call it the **$h_2$ero** for net zero. We are already seeing this happening across Europe with communities pushing to decarbonise, like Aberdeen (Scotland) which is shifting away from oil and Groningen, moving away from gas. Both pushing their respective regions from a fossil fuels to a hydrogen economy. To move towards a clean European society, hydrogen is of paramount importance, especially in the hard to abate sectors where electrification is impossible, e.g., in maritime, aviation and heavy-duty transport, but not only: energy-intensive industries, like iron and steel or chemicals, are also looking at hydrogen as an enabler of a renewably based economy.

In order to achieve this, there are still hurdles. For example, to do justice to the future central role of hydrogen in the European economy, a robust and proprietary framework for hydrogen is required encompassing existing and new legislation. This includes also the need for infrastructure adaptations that could also be perceived as a barrier. However, that's exactly the challenge that the decathlete needs in order to perform. The current network can be converted into a multifunctional hydrogen infrastructure enabling the transport, distribution, storage and end-use of hydrogen and its derivatives. Many of the projects that will be engineered during the second half of this year will start implementation already in the next year.

We need a coordinated action but we definitely also need to overcome ideological disputes between different technologies. In such a complex system transition as the one we are currently witnessing, there is room for all of them: it depends on the right system engineering to provide the system efficiency allowing all these technologies to perform.

Hydrogen can support this fundamental transition, being able to support the decarbonisation of many sectors – from the hard to abate to the heating one – providing the opportunity to grasp enormous clean solutions. The technologies are ready, they need to be put together and be exploited now!

Jorgo Chatzimarkakis
Hydrogen Europe Secretary General

GenComm Partners Compose New Government Hydrogen Paper

GenComm project partners, National University of Ireland Galway (NUI Galway), Dublin City University and HyEnergy, have published a new report into the opportunities presented by hydrogen in Northern Ireland's green energy transition. The report published in March 2021 is called: 'Hydrogen opportunities in the Northern Ireland Energy Transition'.

The report was funded by Northern Ireland's Department for the Economy to contribute to the evidence base for the development of a new Energy Strategy.

It reviews progress Northern Ireland is making towards its decarbonisation goals, its unique challenges, and opportunities, and identifies the potential roles for hydrogen in enabling greater renewable energy deployment,through energy storage and reduced curtailment and sector coupling. It then identifies energy demand sectors that hydrogen could help in decarbonising, such as buses, trains, and its use in the gas grid for heating.

The research team presents the results of case studies for green hydrogen, hydrogen produced by electrolysis powered by renewable electricity, deployment in Northern Ireland in 2030. Scenarios for decentralised, regional, and centralised electrolysis and end use are explored. The results demonstrate the technical, environmental, and economic feasibility of hydrogen production and use at scale in Northern Ireland.

The report goes on to explore the unique strengths Northern Ireland can bring to bear on hydrogen in the energy transition. These include world class onshore and offshore renewable energy resources, an entrepreneurial and innovative engineering and manufacturing sector, strong and modern electricity and gas interconnections with Great Britain and Ireland, and large-scale salt cavern storage sites.

Ian Williamson, Hy Energy (GenComm partner)

H_2GO News have in this issue published some key text from the 44 page report:

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Northern Ireland is uniquely positioned in the United Kingdom (UK) and Europe to become a leader in hydrogen deployment and technology. Abundant, and in many cases untapped, onshore, and offshore renewable resources, modern gas and electricity networks, interconnection to both Ireland and Great Britain, a relatively small geographic area, availability of salt cavern storage, and an internationally recognised track record of engineering and manufacturing innovation give Northern Ireland a competitive edge.

Third-level education and research institutes, exemplified by Belfast Metropolitan College and Ulster University, are leading the way in hydrogen training and safety.

The analysis described in this report presents scenarios for the deployment of hydrogen in Northern Ireland's transportation and heating sectors in 2030. Costs of delivered hydrogen and emissions savings for localised, regional, and centralised value chains for locations throughout Northern Ireland are calculated and compared. End-use applications include gas grid injection at volumes of 15% in the Northwest and Greater Belfast areas, fuelling 500 trucks and 300 double-decker buses in Belfast and Derry / Londonderry, and 8 trains in Belfast. Modelling shows that larger scale regional and centralised hydrogen production results in low unsubsidised costs of £2.53 - £4.99 per kg, and higher carbon dioxide (CO_2) savings.

GenComm partners at the Translink depot Milewater Road

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There are a wide variety of potential production scenarios for hydrogen in NI. As outlined, the larger wind farms in NI could produce hydrogen on-site, providing an extra market for their energy and help reduce their own dispatch down.

Another possible permutation is to situate larger production sites in areas of high wind such as the Fermanagh-Omagh or Derry-Strabane regions. Such production would be connected to the electrical grid and could help to alleviate dispatch down grid issues in addition to producing hydrogen for use locally in heat and transport.

Dr Rory Monaghan, NUIG (GenComm partner)

A large-scale centralised production system situated near Islandmagee and Belfast is a very real prospect for NI due to its:

- Access to large amounts of electricity due to location near high voltage electricity grid and interconnection with Scotland
- Proximity to large potential demand, including:
  - The natural gas grid via the SNIP
  - Ballylumford and Kilroot power stations
  - Buses and heavy goods vehicles in Belfast and the M1 corridor
- Potential for large scale hydrogen storage at Islandmagee and potential future salt caverns at Larne
- Suitability of Belfast port for export of renewable hydrogen and its derivatives

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The use of NI as a testing ground for various renewable electricity and hydrogen production technologies, will allow the Province to build on, and increase, its skilled workforce.

Production capacity will increase whilst, at the same time, positioning NI as a key location in which to test the viability of locally built technology, using local expertise, land, and knowhow.

When projects experience notable levels of success, expansion or replication of the technology would add value to NI's economy through outsourcing of the country's unique expertise and delivery from the supply chain which has grown to support the testing phase.

To facilitate and support the policy an inclusive NI hydrogen 'roadmapping' activity should be enabled and supported. This should be rapidly developed, locally coordinated by agnostic parties familiar with NI hydrogen and engage all relevant stakeholders.

Call for Energy Vision Made at Hydrogen Ireland AGM

A call for a hydrogen led vision for Ireland was made at the AGM of Hydrogen Ireland on April 23.

Hydrogen Ireland Board Member, Dr Rory Monaghan, NUI Galway, argued there is no set government position on hydrogen at present in Ireland and that Hydrogen Ireland have an opportunity to influence this by organising workshops and seminars.

Dr Monaghan said:

"We need a signal from government through policy how demand becomes stimulated. We are looking to stimulate the supply and demand at the same time in Ireland. Hydrogen Ireland understand the value proposition of hydrogen and we want to promote the role of hydrogen and related technologies. We can work with politicians, stakeholders and indeed communities to achieve this."

Dr Monaghan is the Lecturer of Energy Engineering in the School of Engineering at the National University of Ireland Galway (NUI Galway).

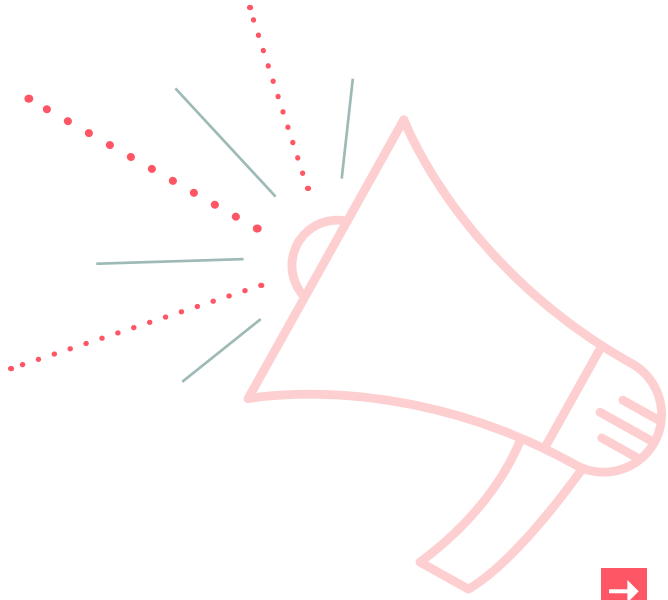
He is the Lead of the Energy Research Centre in the NUI Galway Ryan Institute, a Funded Investigator in MaREI, the SFI Research Centre for Energy, Climate and Marine, and the Director of the Energy Engineering Programme at NUI Galway.

He has been researching hydrogen and fuel cells since 2003 and currently leads the Long-Term Effects work package of the €9.3 million GenComm project, which is funded by the EU Interreg North West Europe Programme. He was commissioned by the Department of the Economy to prepare the Think Piece on Hydrogen Opportunities for Northern Ireland.

Dr Monaghan appreciates that Hydrogen Ireland have to inform industry to make long term planning for decarbonisation and to allow transfer to green energy options.

Hydrogen Ireland Board Member Paul McCormack echoed Dr Monaghan's thoughts saying:

"We need a singular voice from industry and academia, to be able to lobby government, to go to Dail Eireann, and the Northern Ireland Assembly and help stimulate, support then develop a hydrogen strategy."



Ian Williamson, President of the European Hydrogen Association and Hydrogen Ireland Board Member said:

"We are all becoming more environmentally aware and all realise how hydrogen can be used for things like heating and industry. We can learn now from the Northern Netherlands and we will be working on an Irish hydrogen valley project in the coming months.

Hydrogen will be one of a host of technologies that will work together to reduce emissions. Electrolysers and fuel cells will increase in scale and number to enable more applications, in turn lowering costs. Inter regional energy trading via sustainable hydrogen based chemicals will also start."

Dr James Carton, Chair of Hydrogen Ireland recalled:

"We had our first workshop on hydrogen in Ireland in 2017 with 100 individuals at it, people wanted an association formed. In 2019 we formed Hydrogen Ireland, we want it to be a member focused association. We aim to develop reports and white papers as members require them. We hope to establish working groups among the association."

Hydrogen Ireland Board Member, Mark Welsh, Energy Services Manager at Energia said:

"The research we carry out has to fulfil industry requirements, that's why our board is balanced with academic and industry members. We have engaged in the past year with government, councillors and regulators and we have responded to the Northern Ireland Energy Strategy consultation."

James Carton, Chair, Hydrogen Ireland Association

Activities at IZES

IZES are looking for industrial partners with regard to the planned MSCA project! With regard to the currently open MSCA Doctoral Network (DN) call within the Horizon Europe programme, some of the current GenComm partners want to continue their successful collaboration and therefore want to submit a proposal within the MSCA sub-programme Industrial Doctorate (ID) with the deadline in November 2021. The planned project deals with the further development of Hydrogen technologies on a scientific and industrial level.

Dr Bodo Groß, IZES (Gencomm partner)

The aim is not only to educate the selected PhD students in scientific aspects, but also to provide them with entrepreneurial/industrial skills as part of their training. The background is that the number of very well educated people in this field, especially with the status **"Ready for Industry"**, is rather small in Europe compared to the expected workload in the coming years.

The necessary academic partners as well as some industrial partners have already been recruited for the project. We are now looking for further interesting industrial projects with the potential for a PhD thesis. The topics we are looking for should focus on the following three research areas: Hydrogen production, infrastructure and utilisation.

Curious? If you are interested, please send a short description of the PhD project to the coordinator **Dr. Bodo Groß (gross@izes.de)** from the German research institute IZES. You can find more information about IZES at **www.izes.de.**

IZES LAUNCHES ITS ACTIVITIES WITHIN THE APPROVED ADDITIONAL GENCOMM WORK PACKAGE UNDER THE NWE 2ND CALL FOR CAPITALISATION

The main objective of the work is to develop the so-called **Enabling Support Tool (EST)**, a user-friendly online tool that can be used for proactive planning of green Hydrogen based public transport.

The EST aims to inform, empower and enable policy makers, authorities and transport bodies within the regions Saarland, Luxembourg and Northern Ireland / Ireland to get the optimal solution for a given green H_2 demand based on existing local structures.

The first meetings with the new partners in Saarland, especially in the districts of Merzig / Wadern and Saarpfalz, are scheduled. In both districts, the local energy supplier, the main town and the district administration are involved in the project.

Dr. Bodo Groß
IZES

Making an Impact

GENCOMM will technically and financially validate and model the renewable hydrogen value chain and adapt it to a Decision Support Tool (DST) that leads NWE communities into sustainable, local and autonomous energy matrixes.

2017-2023
Total Budget
€9.3M

UK | IE | DE | FR | BE
Partners:
10

Hydrogen bus launch at Stormont

ACHIEVEMENTS

- Bio to H_2 plant in Stornoway (UK) complete and operational
- Installation of the solar operated HRS at the Saarbrücken (DE) side
- Decision Support Tool (DST) operational
- H_2 refueling station in Belfast (UK), new H_2 buses launched in Belfast
- 20 new H_2 buses ordered for use by Translink Northern Ireland

PUSHING RESULTS ONE STEP FURTHER

- Release of a white paper for policy makers throughout NWE to open opportunities for collaboration
- Establishment of Hydrogen Ireland, a new national association
- Hydrogen Triple Alliance linking and collaborating across 3 projects
- Creating and developing the Community Hydrogen Forum (CH_2F)
- 8 stage crisis management plan

IZES Hydrogen Refuelling Station:
Investigations Into Electrolyser Technology and Sustainability

The technical process of water electrolysis currently has the highest potential for efficient, large-scale hydrogen production using renewable electrical energy. It offers a viable solution to meet the global demand for sustainable, carbon-free fuel and thus provides a reliable means of energy storage.

Two main processes, also available on a larger scale, have become established for the production of hydrogen by electrolysis. These are alkaline electrolysis (AE) and proton exchange membrane electrolysis (PEM). Both processes have their advantages and disadvantages. Alkaline electrolysis, for example, is considered the most advanced and, above all, the least expensive electrolysis technology. However, it is limited to lower current densities and thus lower hydrogen production rates.

Higher current densities can be achieved with PEM electrolysis, but it is twice as expensive as alkaline electrolysis and there is a risk of cell performance degradation due to ohmic resistance components caused by corrosive changes to the membrane electrode assembly (MEA). The high anodic potential and low pH in the boundary layers of the MEA are the reason for the increased risk of corrosion within the PEM cell. To minimize this risk, only platinum group elements (e.g. Pt, Ir) and their compounds have been considered as coatings /catalysts for use in PEM fuel cells in practice to date.

Rare earths and platinum group elements (PGE) play an essential role in the implementation of the EU's Green Deal and Digitization industrial policy reform projects. However, their global supply situation is the focus of worldwide attention. The dependence of European industry on precisely these raw material imports will continue to increase very strongly.

THE PROBLEM

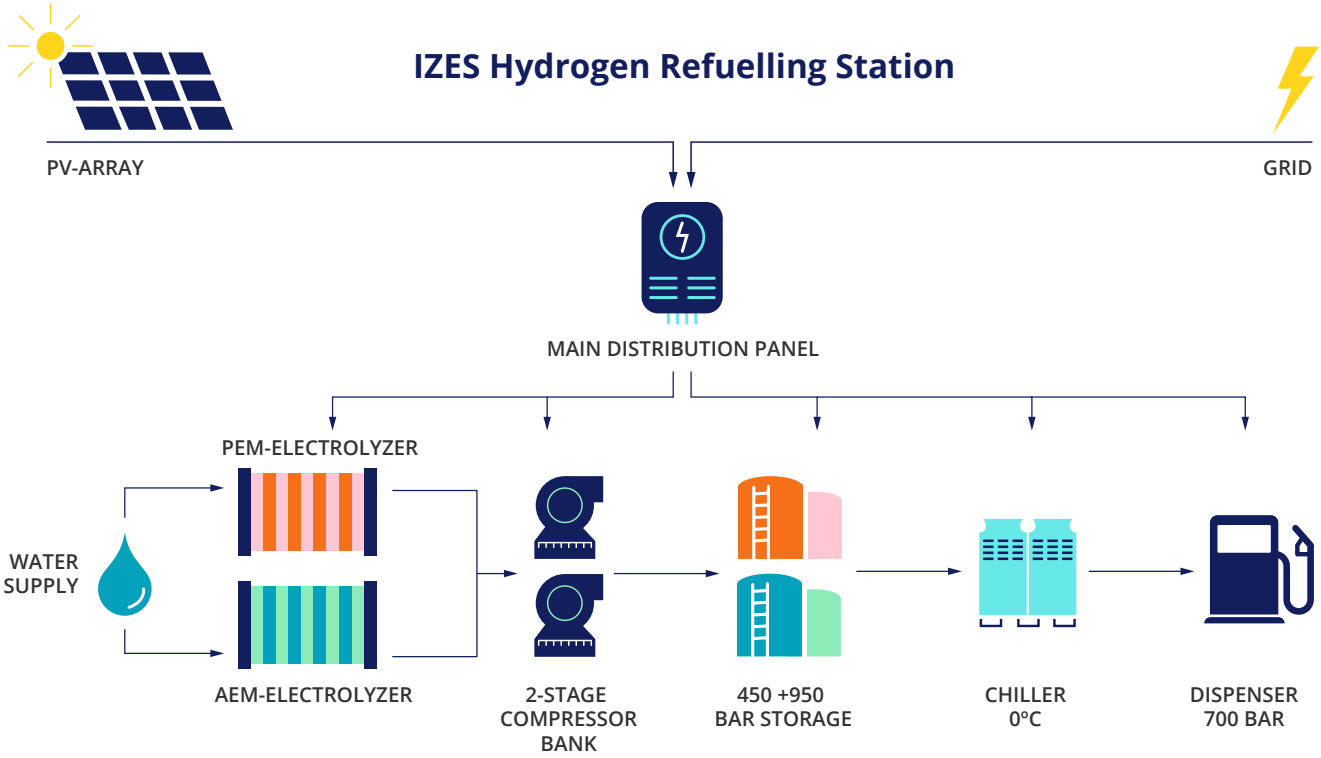
For Germany, it can be easily estimated by means of an example how large the platinum requirement would be if the hydrogen were to be produced primarily by means of PEM electrolyzer technology.

A PEM electrolyzer of the latest generation has an installed membrane area of approx. 125m² at an assumed efficiency of 80% and a capacity of 1MW, and supplies approx. 20 kg/h of hydrogen. The noble metal demand for such an electrolyzer is about 300 gr. at average coating quality and using latest cluster techniques.

Based on a hydrogen demand of approx. 800 TWh / anno (scenario FhG IMWS/IKTS, H2-roadmap 2019), the annual platinum demand for Germany alone (~83 million inhabitants) would amount to approx. 1t, if an expansion scenario for the electrolysis capacity of 3.2 GW per year is assumed. Added to this would be the platinum requirement for the production of fuel cells for heat supply, vehicles, etc. of the same order of magnitude.

These quantities would be supplemented by the requirements of today's platinum consumers (chemicals, glass industry, medicine, electrical, mineral oil, automotive, and investments). The current annual consumption would thus be nearly tripled for Germany.

In 2018, global production of platinum amounted to 190 tons, and recoverable platinum group metals reserves were estimated by the United States Geological Survey (USGS) in January 2020 to be 69,000t worldwide, of which 63,000t are located in South Africa alone. Globally, up to 334t/yr would have to be assumed to be required in 2030 for the production of PEM fuel cells alone. The scarcity of available material, locally precarious extraction conditions, and geopolitical dependence on existing extraction sites require alternatives.



TO SOLVE THE PROBLEM

The use of anion exchange membranes (AEM) in conjunction with water as the electrolyte offers such an alternative. Numerous studies have shown that most transition metals tend to be stable against corrosion at low potentials and high pH values.

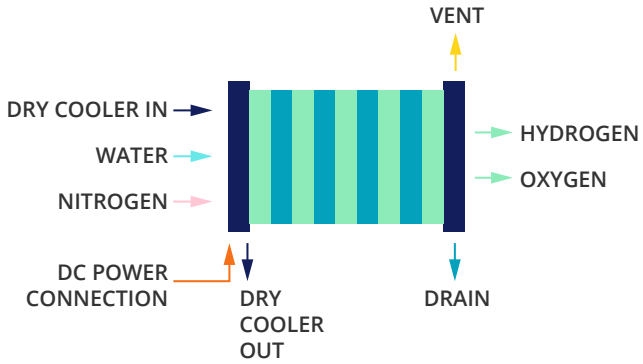
Therefore, the AEM, due to the lower standard potential and the anion conducting polymers used (basic environment, higher pH) offers the possibility of using noble metal free catalysts. Compared to PEM electrolysis, the AEM technique can thus allow the use of cheaper transition metals, and thus provide a much wider range of possible corrosion-stable catalyst materials.

IZES gGmbH in Saarbrücken, Germany, is currently commissioning a hydrogen filling station intended exclusively for research purposes.

A conventional PEM electrolyzer and one of the first commercially available AEM electrolyzers on a larger scale are used there for hydrogen production. Both electrolysers can be operated stand-alone or in combination for requirements resulting from fluctuating solar irradiation as well as for requirements under full load.

One of the numerous research foci of IZES gGmbH within the GenComm project will be the comparison of PEM and AEM electrolysers in terms of application technology on a pilot scale. Special measurement methods will be used to compare the effectiveness, controllability, manageability, maintenance and aging behaviour in regular operation. The data obtained will be made available to the GenComm consortium and will be used to validate simulation models.

Dipl.-Ing. (TU) Wulf Clemens
IZES gGmbH



SENSOR SELECTION

- Safe
- Just as exact as needed
- Inexpensive
- Transmitting frequency
- Expandable

Interreg North-West Europe GenComm
European Regional Development Fund

For more information

on the GenComm Project and our work in the green hydrogen arena contact

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Engage in the hydrogen evolution and join the CH2F

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