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THE HYDROGEN EUROPE QUARTERLY

COP28: DELIVERING ON OUR 2030 AMBITIONS

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Welcome!

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From the CEO

Welcome to the Q4 2023 edition of the Hydrogen Europe Quarterly magazine. Our final issue of 2023 is a very special one, at nearly twice our usual size and with a focus on many of the issues that will be discussed at COP 28.

I am proud to present to you this issue of our inhouse magazine, which tackles the question of how to meet our ambitious decarbonisation goals for 2030 and beyond. Lots of progress has been made so far, but there is still plenty of work to be done!

In this issue, our main story covers the realities of upscaling hydrogen by highlighting the financial closure of NEOM's massive green hydrogen project and the lessons we can learn from it, while a discussion with Spain's Enagas highlights the importance of security of supply, and how it goes hand in hand with decarbonisation.

Our prominent person interview is a talk with the European Commission's new First Executive Vice President Maroš Šefčovič, who started the Industry Dialogue on Clean Tech with the hydrogen round table spending more than five hours with our sector. After the meeting he unveiled his nickname: "Implementovic" - sounds like a good programme.

In these pages you will also find features covering two hugely important EU initiatives: the Global Gateway strategy, which will connect us to our global hydrogen partners while building them up, and the SET Plan, which focuses on the importance of research and innovation to retaining relevance in the clean tech revolution.

Our member spotlight this quarter is one of the world's largest renewable producers, NextEra Energy Resources, and its move into hydrogen. Meanwhile our national member spotlight features a fascinating discussion with France Hydrogène and our regional member spotlight highlights the important work of the province of Zuid-Holland.

Finally, we hope you enjoy the important and indepth analysis of our team. On the policy side you will find articles on the importance of hydrogen storage, while our intelligence tackles the issue of meeting supply and demand challenges.

There is plenty more analysis and content to enjoy within these pages. I wish you happy reading, and a successful European Hydrogen Week. Together, we will achieve our climate goals.

Jorgo Chatzimarkakis
CEO, Hydrogen Europe

All hands on deck for our 2030 targets: how can we shorten our time to decarbonisation?

© Justin Jin

The focus of the upcoming COP28 conference will be on fast tracking the energy transition and cutting emissions by 2030 enough to limit global warming to 1.5°C above pre-industrial levels. For this issue of the Hydrogen Europe Quarterly, and on the eve of the European Hydrogen Week event, it was time to examine this question in detail. 2030 is only around the corner, and there is so much left to do. How can we shorten our "time to decarbonisation", and how can hydrogen contribute to this? To answer this question, we spoke to Arturo Gonzalo Aizpiri, CEO of Enagas, and Roland Kaeppner, Managing Director of hydrogen & green fuels at ENOWA, two leaders in the energy transition and in harnessing the potential of green hydrogen.

Significant time and energy have been spent in Europe, necessarily, on developing the regulatory framework needed for a bona fide hydrogen sector to thrive as an economic and climate tool. Not many would suggest this wasn't time well spent, and neither would they overly criticise the caution taken and care for detail shown by EU legislators during the process. A new sector, a new framework, a new opportunity that we must get right. However, it is clear that from a climate perspective we are running out of time. The main pillars of the hydrogen framework have been raised up, but if we are serious about meeting our climate targets, then the wheels must start to move before the final details have been hammered out.

Fortunately, there are early movers paving the way for the rest of the industry. There is already a budding electrolyser and fuel cell manufacturing sector in Europe, which will only be spurred on by the Net Zero Industry Act (NZIA) – the legislation committing to securing for Europe a healthy market share of most clean technology industries, including hydrogen. And there are plenty of innovators proving the concept for hydrogen mobility, hydrogen storage and hydrogen as an industrial fuel. What we are lacking so far is scale: projects in gigawatts, not megawatts, hundreds of thousands of tones over hundreds of tons. Projects which can demonstrate not only that the technology works, but that so can the economics.

Financial close for green hydrogen

Roland Kaeppner is managing director of ENOWA, the subsidiary of NEOM, developer of the renewable energy powered region and industrial complex being built in the Kingdom of Saudi Arabia. In May this year, NEOM Green Hydrogen Company – a joint venture between NEOM, ACWA Power, and Air Products – reached financial close on the world's largest green hydrogen plant. The US$8.4bn project will produce green ammonia at scale in 2026, all of which will be sold to Air Products under a 30-year offtake agreement. Notably, the project was financed with US$6.1bn in non-recourse project financing from a consortium of 23 local, regional and international banks and financial institutions.

Kaeppner was partly responsible for the introduction of hydrogen into the equation for this futuristic project. In his own words, he called the process "a bit of a fairy tale", sparked by a serendipitous encounter with Peter Terium, current ENOWA CEO and former CEO of Innogy and RWE.

"Our paths crossed at NEOM – the visionary who wanted to build a 100% sustainable renewable energy system, and the guy with hydrogen flowing through his veins. It was clear that this was the beginning of a big and great partnership," Kaeppner recalls.

One part of the recipe for these types of projects is obviously the people with the talent and drive to deliver them. The other part is the quality of the conditions pertinent to the project. In this case, the high levels of solar irradiance in Saudi Arabia are obviously a plus when one is trying to produce green hydrogen. Given that the number one factor in the cost of green hydrogen is the price of the energy used to make it, cheap solar power is gold dust. But it's not the only thing that makes Saudi Arabia a strong candidate for hydrogen success.

"The Kingdom is a world champion in energy export infrastructure. They know how to export fuels, how to build large infrastructure, and how to trade energy. It's an environment where there is a massive push towards clean energy," explains Kaeppner.

"The idea was to build, through NEOM, a nucleus for a national hydrogen effort to diversify the country's energy portfolio. Where are we now? A national clean hydrogen strategy, and the Minister of Energy touring the world explaining how it will replicate its low-cost hydrocarbon success with low-cost green hydrogen."

Hard to argue with! But Europe has plenty of regions with abundant solar resources. The mediterranean sun and the North Sea wind are able to produce cheap renewable power, and there is equally no shortage of European countries with vast experience in transmission and pipeline infrastructure. So what is the secret to attracting that level and structure of financing for such a project? What glimpse have we been offered into the hydrogen project development of the (hopefully) near future?

> **"The main pillars of the hydrogen framework have been raised up, but if we are serious about meeting our climate targets, then the wheels must start to move before the final details have been hammered out.**

"You have to bear in mind that for this first project we have an offtaker, without which it's difficult to finance on a non-recourse basis," explained Kaeppner, "but there was massive appetite to finance the project, we were basically oversubscribed."

Certainly, the presence of Air Products on an EPC and offtake contract for the entirety of the product is no small factor. Readers of the Hydrogen Europe Quarterly will be familiar with the refrain, expressed many times by many people, of the importance of an offtake structure. Indeed, the other refrain of "the chicken and egg" applies here too. Without ensuring a customer base for green hydrogen, why would anyone commit to producing it?

Incidentally, Kaeppner believes large projects like NEOM will solve that cliché too: "NEOM is activating the supply chain. It's a first step in the chicken and egg discussion, because putting in a big order activates the supply chain and motivate suppliers to make significant investments," he explains, pointing to a challenge experienced in securing electrolyser orders for a project of NEOM's size.

Progressing the sector

Arturo Aizpiri became the CEO of Spain's Enagas in February 2022 after nearly 16 years with Repsol. Combined with a stint in the Spanish Ministry of Environment, he has had a front row seat to the energy sector's trials, tribulations and transitions over the last two decades.

Enagas is one of Europe's most prominent transmission systems operators (TSOs), owning 6 of Spain's 7 regasification plants, giving the company a third of all European regasification capacity, as well as 40% of all LNG storage in the bloc.

For Aizpiri, the invasion of Ukraine and subsequent decision by the EU to diversify away from Russian fossil fuels was evidence of the importance of gas infrastructure to security of supply. The lessons learnt here would also be useful for hydrogen.

"Security of supply and decarbonisation are two sides of same coin," says Azpiri, pointing to REPowerEU and making the case that working to accelerate the deployment of renewable gases, especially green hydrogen, will achieve both objectives. And while Enegas is still a gas TSO, and will be for a while yet, Aizpiri has no doubt that the transition will redraw the energy map.

"Natural gas will gradually decrease in demand while hydrogen will increase and replace it in cases where electrification is not possible or efficient," he explains. "We are acting as catalysers for the hydrogen market in Spain, designing the primary infrastructure network, and working for international interconnections in the H2 Med corridor."

These kinds of corridors will ensure unfettered access to hydrogen for Europe's end users, and the list of these is growing. While the greening of existing grey hydrogen in Europe is paramount, there are plenty of use cases in development across many sectors that will provide producers with offtake options.

"From discussions we are having it's clear that appetite is growing," says Kaeppner, "there are players in the maritime, steel, and fertilisers sectors who are ready to sign offtake contracts and not wait for governments to fix the problem. All of them are starting to understand they'll have an early mover advantage."

And when the projects are ready, and the offtakers are in place, we will see the kind of appetite for financing as NEOM was able to demonstrate is out there but is just waiting for more certainty. For large interconnector projects, like Enagas' H2 Med Corridor, the timeline is a little longer.

"I think there will be huge interest in this kind of infrastructure from commercial banks and from infrastructure funds. The financial sector will certainly have a key role to play, there is a substantial capex programme across Europe. But it's too early to talk about this now, governments still have to determine the ownership structure," explains Aizpi.

It is clear though that on the utility scale production side, NEOM is a much-needed proof of concept, despite the favourable conditions and all-star lineup. There is no shortage of capital liquid, technically knowledgeable and economically ambitious developers, manufacturers, and operators that are capable of performing a similar feat. Perhaps the biggest lesson from NEOM, if it wasn't already known, is that consortia are the way forward in this business. The results are sure to be lucrative.

"The whole clean H2 economy is going to be a massive GDP engine. There's a massive supply chain attached to it and massive R&D hype. It will create a lot of positive aspects to any economy," Kaeppner says.

We leave our readers with another familiar refrain: the need for a clear framework around which to make these investments.

Enagas's control room © Justin Jin for Hydrogen Europe

"Hydrogen has no colour. The definition of carbon content in each molecule is what's important so there needs to be a clear definition on carbon content. What must stop is a dogmatic approach to what is good or bad," says Kaeppner.

"We need national regulatory schemes, remuneration schemes, we need rules of the game aligned in Europe. We can't have more than 20 systems. We need aligned responses from member states to the parts that fall within national competence. So, my message is – try to cooperate among different regulators, to put forward aligned proposals that give ground to a real European hydrogen market and a real EU response to this big challenge," concludes Aizpi.

Global Gateway: connecting the world for the energy transition

The Global Gateway strategy, set out by the European Commission and the EU High Representative, has as its mission to "boost smart, clean and secure links in digital, energy and transport sectors and to strengthen health, education and research systems across the world." In 2023, ninety key projects were launched worldwide across the digital, energy and transport sectors through Global Gateway. We spoke to James Mnyupe, Presidential Economic Advisor and Hydrogen Commissioner in the Namibian government, Jacques Vandermeiren, CEO of Port of Antwerp-Bruges, and Nathalia Ervedosa, Commercial Director for EU markets at Invest Piaui, about the links being created and the solutions being found.

Team Europe, the joint initiative between the EU, European multilateral banks, and member states, will mobilise up to €300bn of investment between 2021 and 2027 for sustainable projects with lasting community benefits. Within that initiative, Global Gateway is designed to be Europe's answer to a narrowing global investment gap.

The inaugural success of the Gateway was the Africa-Europe Investment Package, which contained around €150bn of investment dedicated to improving cooperation with Europe's African partners. The package will support Africa in accelerating the green and digital transitions, as well as stimulating sustainable growth and strengthening health and education systems.

Since then, Global Gateway has reached out to Asia Pacific and to Latin America and the Caribbean, the latter of which is set to benefit from €45bn of investment, as announced by European Commission President Ursula von der Leyen.

Supported by international partners

The positive response to the strategy is already apparent, and the political dividends are appearing, preceding the eventual economic benefits that the strategy is expected to yield.

In Namibia, Global Gateway is set to mobilise €1bn into the country's economy, "essentially to help incubate a green industrialisation hub," James Mnyupe, Presidential Economic Advisor and Hydrogen Commissioner in the Namibian government, tells the Hydrogen Europe Quarterly.

Namibia, with its abundant solar and wind resources, is focused on becoming sub-Saharan Africa's first exporter of green hydrogen. In May, Hyphen Hydrogen Energy – which counts Enertrag as a shareholder – received the greenlight to move forward with a feasibility study for its US$10bn green hydrogen project in the country. The plant will be built in phases, eventually producing 2 million tonnes of green ammonia a year for regional and global markets when it reaches full commissioning, which is expected before 2030.

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> **The Global Gateway strategy fosters global collaboration for sustainable energy, connecting nations and boosting the green hydrogen economy.**

Namibia's hydrogen journey took off with the post-pandemic economic recovery plan on the 18th of March 2021, called the Harambee Prosperity Plan II (HPPII). Within the 2nd pillar of HPPII, there were calls for the development of a "green and blue" economy as well as plans to set up a Green Hydrogen Council to oversee the development of a green hydrogen and ammonia industry.

The country's 2022 Hydrogen Strategy estimated that by 2040 Namibia could produce 15 million tons of green hydrogen, create 400,000 jobs, and increase GDP by more than 50%.

Simply put, Hydrogen is a way to "inject some fuel into the tank of the Namibian economy," says Mnyube, and "Global Gateway promises a strong partnership with the Namibian government to deliver".

"The Global Gateway Forum was a great platform to showcase to others around the world what dynamic even level partnerships could look like. But ultimately the best deliverable will be the execution and delivery of the various programs within it, on time and in manner that truly impacts the Namibian people and their regional neighbours," he adds.

Nathalia Erdevosa, Commercial Director for EU markets at Invest Piaui – the state in Brazil's northeast – views Global Gateway in a similar way. Piaui, too, is positioning itself for a global role in the energy transition. As one of the country's largest green energy producers, and with those same plentiful renewable resources ensuring it has some of the biggest potential for hydrogen in all of Latin America, it is extremely well placed to produce cheap green hydrogen for use and export.

In October, it signed a Letter of Intent with Green Energy Park to build a 5GW green ammonia production and export facility. It will now launch a feasibility study for the project that would potentially be capable of producing and exporting around 5 million tonnes of green ammonia annually.

The state of Piaui is actually expecting to host at least 8GW of upstream facilities that will supply Green Energy Park's global distribution network with an initial focus on European end markets, including its own ammonia midstream facility at the North Adriatic Sea in Croatia.

This project, alongside other memoranda signed for multi-GW hydrogen schemes, means huge amounts of investment – around US$50bn - will be needed to deliver them. This is where Global Gateway comes in.

"Global Gateway is very important to Piaui's hydrogen ambitions, and we hope to receive good support from the initiative," says Ervedosa.

"Finding the financing required is a challenge, but we have big partners and are always seeking the most experienced companies to come on this journey with us."

Connecting Europe

Only an hour's drive from Hydrogen Europe's offices, the Port of Antwerp-Bruges has always been a crucial contributor to Belgium's economy. It is the second largest port in Europe, handling around 290 million tonnes of international maritime cargo per year.

Jacques Vandermeiren, CEO of Port of Antwerp-Bruges, knows how important ports are to the energy transition, and the role hydrogen can play here.

"Moving from fossil fuels to renewable fuels, electrons and molecules, is the big challenge for us. Our priority for the next decade is to make hydrogen happen. Dreaming of climate neutrality is one thing; implementation is another," he says.

Naturally, expertise as an energy port will come in handy here. Vandermeiren is no stranger to the technical and logistical requirements for importing gases.

"We are already familiar with ammonia, methanol, methane, and this familiarity is a great advantage for dealing with the green versions of these products."

From a European perspective, Port of Antwerp-Bruges – like the nearby Port of Rotterdam - is perfectly placed to serve the bloc's energy needs. For Vandermeiren, it was inevitable that the company would invest into hydrogen.

"With Belgium being in the middle of Europe, located at an energy crossroad, and with an important industrial cluster around us, it was evident that we would and should play an important role in the hydrogen supply chain," he recalls.

As such, the Global Gateway initiative offers huge complementarity to Europe's port operators – those responsible for our international connections are sure to benefit most from an initiative focused on harnessing those connections.

"Partnerships are key for us, and international collaboration is the essence to us as a port – it's in our DNA. We are strong believers in the Global Gateway approach. It helps us export EU values globally, strengthening green port ecosystems," says Vandermeiren.

From 2026, Port of Antwerp-Bruges will expand capacity, and begin receiving its first green molecules on its platform. One of the countries it expects to import from is none other than Namibia.

In October, on the eve of the Global Gateway Forum, Commission President Ursula von der Leyen and President of Namibia Hage Geingob endorsed the roadmap for the €1bn EU–Namibia strategic partnership on sustainable raw materials value chains and renewable hydrogen. The EU will also support an upcoming study for the development of the Port of Walvis Bay into an industrial and logistics hub for the region, contributing to its integration and economic development. This process will be led by Port of Antwerp, which views Namibia a "key partner" and a "concrete investment opportunity." This follows the signing of a memorandum of understanding between Port of Antwerp and Namport earlier this year.

Meanwhile, through Global Gateway, Vandermeiren and his team are also linked with Port of Duqm in Oman, which has the potential to be turned into another important hydrogen export hub.

© Hydrogen Europe

Meeting the challenge

Global Gateway is a fantastic strategy from a diplomatic and economic perspective for Europe and its partners. Bringing the world together through collaboration on monumental endeavours like the energy transition can only be a good thing.

But what is needed to make sure that the full potential of the initiative can be exploited, for the benefit of all its participants?

For Ervedosa, Europe still needs to lead on standardisation and harmonisation to ensure the global partners know what path to tread.

“Europe should design clear rules for the certification of green hydrogen that the world can follow,” she says, echoing a call that has been made by many during the development of Europe’s hydrogen regulation.

For Vandermeiren, the key is another type of alignment – getting all the ducks, of both public and private persuasion, in a row.

“The biggest challenge for Global Gateway is how to align all the public and private actors, and developing an understanding of each stakeholder’s role and responsibility. We need investment, we need state aid, we need auctions, and we need to develop the market globally. It’s a huge challenge but we’re convinced that it’s possible!” he says.

Mnyupe offered a different perspective, but one that would benefit from the solutions mentioned by the two other interviewees: that Global Gateway can aid developing countries in staying abreast of the growing international competition from the US and China.

“The truth is the green hydrogen opportunity is one that has now been recognized as a strategic one by most developed nations around the world. They have mobilised financial resources to capture this opportunity for themselves like never before, making it very hard for developing nations to lead this revolution despite being endowed with the natural resources to do so,” he explains.

“The Global Gateway could craft a very different narrative to one we have witnessed before by helping countries like Namibia that aspire to leapfrog their developmental pathway and in the process de-risk the global growth agenda.”

SET Plan another important tool in the hydrogen arsenal

The European Commission calls its Strategic Energy Technology Plan (SET Plan) "a key stepping-stone to boost the transition towards a climate-neutral energy system through the development of low-carbon technologies in a fast and cost-competitive way." Bringing together EU member states, companies and research institutions, the plan promotes cooperation and the coordination of national R&I activities into low-carbon energy solutions. We spoke to Rosalinde van der Vlies, Director of the Clean Planet Directorate in the European Commission's Directorate-General for Research and Innovation, about its growing profile and importance.

Established in 2007, the SET Plan has become one of the main instruments of the energy union's 5th pillar on research, innovation, and competitiveness. On 20 October 2023, the "Communication on the revision of the SET Plan" was adopted to align its strategic objectives with those of the European Green Deal, the European Green Deal Industrial Plan and REPowerEU.

Rosaline van der Vlies, Clean Planet Director at DG Research & Innovation, shows great enthusiasm for the increased attention being paid to this important pillar of the transition. "The SET Plan really brings together industry, academia, member states and the Commission in a platform for collaboration between the public and private sectors," she says. With this October "revamp" of the SET Plan, as van der Vlies calls it, they hope to "engage Member States and more private sector actors into the working groups. It will be interesting to see but we are expecting a huge participation there."

Those working groups refer to the 14 Implementation Working Groups (IWGs) in the SET Plan, each focusing on one key technology grouped around a set of ten "actions". These range from macro targets like "reducing the cost of technologies" and "energy efficiency for industry" to more specific items such as "competitiveness in the battery and e-mobility sectors" or "carbon capture and storage".

Notably, until this revamp, hydrogen was dispersed across the various working groups without a specific focus. With the substantial rise of green and low-carbon hydrogen since the plan's last revision in 2018, this latest communication sets up "a new IWG on hydrogen to implement the strategic R&I agenda of the ERA pilot on green hydrogen in line with the Clean Hydrogen Partnership and the Commission staff working document on European R&I actions to support the ERA pilot on green hydrogen."

For van der Vlies, this will "create a one-stop shop for hydrogen and facilitate bringing all the various initiatives together. It's an opportunity to connect the thus far detached hydrogen areas and ensure complementarity."

The Dutch national is a public proponent of the molecule and has been since she was first introduced to it. A member of the Clean Hydrogen Partnership's governing board for three years, it was at her first meeting in which, she says, she was struck by "the deep potential and multiple applications of hydrogen."

The first trip she took following the lifting of Covid-19 restrictions was for a hydrogen conference in her home country of the Netherlands, in the presence of the King of the Netherlands Willem-Alexander – himself a supporter of hydrogen - and which included a site visit to the Netherlands Hydrogen Valley, named HEAVENN.

The project is a large-scale demonstration, actually consisting of several smaller projects, bringing together production, distribution, storage and end-use of hydrogen into one circular and local ecosystem. Green hydrogen produced in the northern Netherlands would serve transport and energy needs of the surrounding communities.

"It was really amazing to see how the hydrogen economy can work at the local level

© Justin Jin for Hydrogen Europe

"It was really amazing to see how the hydrogen economy can work at the local level," van der Vries said of the trip. "It was particularly special, after being locked in our homes for months, to be able to interact with a dedicated stakeholder community."

The timing of the trip coincided with a new emphasis put by the European Commission onto R&I activities in the EU Hydrogen Strategy, convincing van der Vries that R&I would be a difference maker in the short and long term for European clean technology achieving affordability, efficiency, and circularity.

These principles of research, innovation and competitiveness have in recent memory provided Europe with a head start in clean technology development. It can be said that a neglect of these same principles contributed to letting that lead slip. When it comes to hydrogen, European lawmakers do not want to miss out again. Putting in place a well-organised, complementary, and forward-looking R&I policy will do much to help these aspirations.

And doing so now is all the more vital given the recent news around the Net Zero Industry Act (NZIA) and Critical Raw Materials Act (CRMA). Part of the Green Deal Industrial Plan, the relationship between them and the SET Plan has been reinforced vocally by the European Parliament who said in NZIA talks that the plan should play an important role in delivering its objectives. This is because their objectives are one and the same – maintaining EU leadership in key clean technologies, reinforcing the EU's competitiveness across the entire value chain, and delivering energy security and energy independence for Europe.

NZIA is targeting global market shares of 15% in wind energy; 11% in battery storage; and 24% in electrolysers, among other important sectors. Doing so will mean a speedy and significant ramp up in manufacturing capacity, offtaker availability and transport infrastructure – but it is absolutely possible.

Through intensive and dedicated R&I activities, the SET Plan will be able to support these NZIA industrial ambitions in the clean tech sectors including hydrogen, now the 15th dedicated IWG under the plan. In this way, Europe is demonstrating its commitment to a technology neutral energy transition – the most important criterion is decarbonisation potential. The SET Plan is not set up to take ideological positions, but to accelerate workstreams at the national and EU level that will develop real, competitive solutions.

"I do think it's a 'sleeping beauty', the potential of which we haven't yet fully realised, in terms of how it can help us deliver on our priorities," van der Vries adds hopefully.

Hydrogen Europe COP28 STATEMENT:
Reducing Time to Decarbonisation by Accelerating Clean Hydrogen Deployment

Eight years after the signing of the Paris Agreement and its pledge to keep global average temperature increases within 1.5 °C of pre-industrial levels, COP28 is set to be a watershed moment in the global race to net-zero by 2050. Dubai will host the first Global Stocktake, which will evaluate how the world is doing in tackling the climate crisis. As exceptional heat waves, wildfires and floods marked a summer of extremes all over the world, affecting developing and island nations most, one thing is clear: we are not moving fast enough to build a decarbonised, prosperous, and fair future for all. The world has a narrow window to mitigate and adapt to climate change, cutting emissions in half by 2030 and reaching net zero by 2050, to make this summer an exception, not the norm.

COP28 must reduce time to decarbonisation, accelerating climate action and ambition. As economies speed up and scale up their efforts, clean hydrogen will be key.

COP28 UAE

In a time of heightened concerns about energy security, industrial competitiveness, and rising energy costs, accelerating climate action will not only ensure a cleaner but also more affordable and more secure energy system that provides for all. Clean hydrogen, its carriers, and its derivatives are instrumental energy vectors that can substantially contribute to a technologically diverse approach to decarbonisation.

CLEAN HYDROGEN CAN FAST TRACK DECARBONISATION. Limiting global warming to 1.5°C requires rapid, deep, and sustained reductions in greenhouse gas (GHG) emissions this decade. Clean hydrogen can substitute fossil hydrogen used in the refining and chemical sectors, as well as offer ways to decarbonise a range of other sectors – from transportation, to steel, cement, heat and power, among others – responsible for a significant share of global CO2 emissions. As one of the few viable and scalable options we currently have for large and long-term storage, clean hydrogen can support a faster and deeper integration of intermittent renewables by easing congestion on already saturated grids. Clean hydrogen and its derivatives are also the only practical way to transport energy from renewables over long distances, connecting regions with abundant solar and wind resources within Europe and across the world.

CLEAN HYDROGEN CAN STRENGTHEN ENERGY SECURITY. Since Russia's invasion of Ukraine last year, the urgency of securing stable energy supplies, diversifying sources, and ensuring predictable prices has been top of the agenda for European governments. Clean hydrogen can help all countries reduce fossil fuels import dependence, mitigate price volatility, and boost the flexibility and resilience of the energy system through diversification, all while accelerating decarbonisation and establishing long-term, secure, win-win relationships with new partners. In its REPowerEU plan, the EU has targeted both domestic production and imports of hydrogen with the goals of 10MTPA of each by 2030, showcasing that energy transition and energy security go hand in hand.

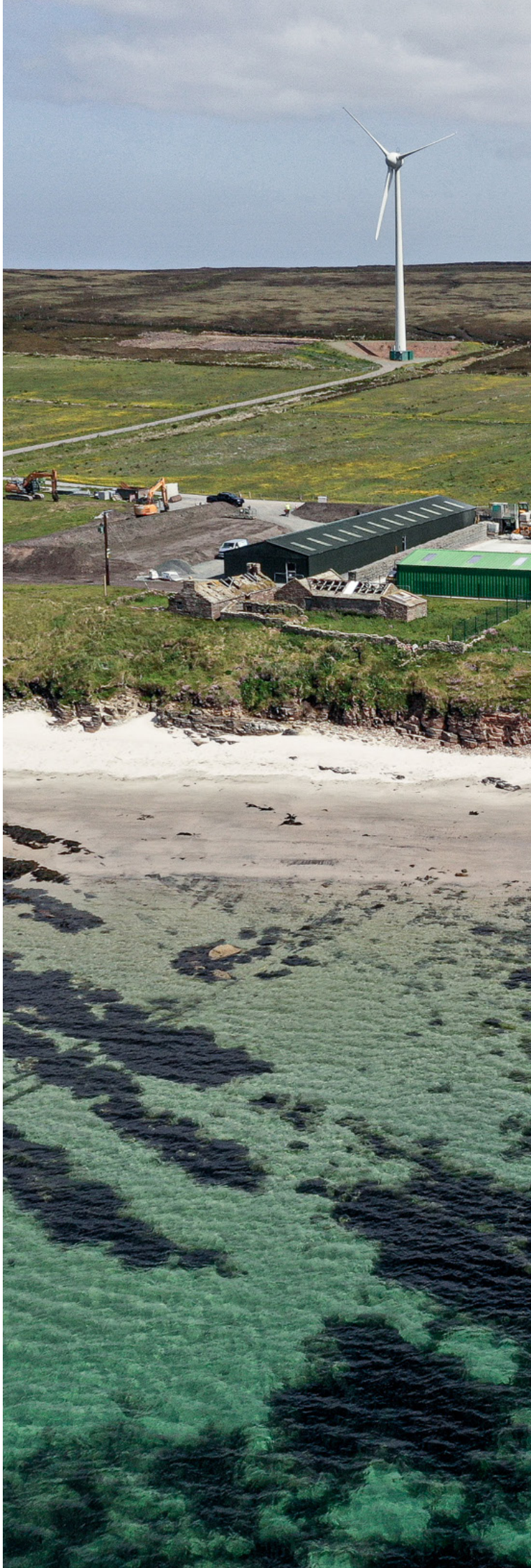
CLEAN HYDROGEN CAN DELIVER FOR DEVELOPMENT. The development of clean hydrogen economies is a unique opportunity for developed and developing countries to foster economic growth, envisage new decarbonised industrial activities, and create skilled jobs, accelerating decarbonisation while advancing socioeconomic goals. In Europe alone, the hydrogen sector is expected to support 500.000 new jobs by 2030. To make clean hydrogen deliver for development around the world, new win-win partnerships that increase green financial flows, provide long term market access, integrate value chains, and foster a global skills and training revolution are being set up to advance not only the vision of Paris but also the Sustainable Development Goals (SDGs). It also offers opportunities in countries where new jobs are needed, reducing one of the fundamental causes of migration.

COP28 and the Global Stocktake offer a unique opportunity to look into the future and support a more ambitious decarbonisation agenda, highlighting the role that hydrogen can play for climate, security of and economic development. To this end, Hydrogen Europe wants to underline the importance of establishing clear and achievable goals, increasing fair incentives and financial support, and fostering a stable and reliable policy framework.

UPSCALING AMBITION THROUGH CLEAR AND IMPLEMENTABLE GOALS. The European Union, along with other international partners, is calling for an agreement to triple renewable energy capacity generation to at least 11,000 GW and double energy efficiency to more than 4% by 2030, as well as to phase-out unabated fossil fuels well ahead 2050. Agreeing on these new measurable, implementable targets at COP28 is key to accelerate renewable energy sources generation and scale-up the abundant, cheap, and available renewable energy necessary for renewable hydrogen uptake. Recognising the role that low carbon hydrogen can play as an energy transition solution key for upscaling the hydrogen market, these goals should be coupled with the integration of key technologies, such as CCS, in a transitional phase and in specific sectors. The Global Stocktake is also a unique opportunity to encourage all nations to couple these new global goals with detailed national 2030 and 2040 emission reduction targets in updated Nationally Determined Contributions and new energy transition plans as soon as possible. Along with the EU's National Energy and Climate Plans, these roadmaps must include tangible actions to support a dramatic scale up of new clean hydrogen production as a key means to speed up the decarbonisation of sectors like refineries, chemicals, shipping, steel, aviation, cement, and aluminium, among many others.

BOOSTING FINANCE FOR CLEAN TECHNOLOGY AND GREEN INFRASTRUCTURE. According to the IEA, although global investment in energy transition technologies reached a new record of USD 1.3 trillion in 2022, yearly investments should more than quadruple to over USD 5 trillion to stay on the 1.5°C pathway. Large private sector investments will need to be unlocked by innovative solutions in concessional and impact finance to meet the scale of the challenge. Leaders at COP28 must foster the reform of multilateral development banks and international financial institutions, and advance blended financial instruments, mechanisms, and risk-sharing facilities. Critically, negotiators will also need to find further innovative financing instruments to close funding gaps, reduce the green premium and upscale nascent technologies needed for the production of clean hydrogen and other clean fuels so they can reach competitive prices in the medium term, with solutions such as fixed premiums, green bonds, carbon pricing and carbon credits. The European Union has a key role to play in these discussions, including through accelerating the full implementation of its pledge to invest € 300 billion in developing countries through Global Gateway plan, which Hydrogen Europe supports through its Industry Advisory Group, strengthening EU-MENA cooperation by swiftly advancing the REPowerEU corridors and, overall, both fulfilling the 100 billion climate pledge and setting new ambitious targets for international climate finance from 2025. Initiatives like the recently announced India – Middle East – Europe Corridor and the Green Hydrogen Fund for Chile are good benchmarks for others to emulate and that need swift implementation.

ESTABLISHING AN ENABLING AND RELIABLE POLICY FRAMEWORK FOR HYDROGEN. While government incentives are a critical catalyst for investment in clean hydrogen, they are only a part of the story. The success of clean hydrogen markets hinges upon the ability to set coherent and transparent rules, standards, and norms to facilitate its deployment across countries, regions, and sectors. Governments play a key role in providing the reliability and long-term predictability that the private sector needs to foster new markets and cross border flows of decarbonised energy solutions like hydrogen and its carriers, avoiding fragmentation, reducing non-tariff barriers to trade and levelling the playing field. In this context, COP28 can help advance discussions to define feasible and flexible standards and commonly agreed, transparent and CO2-based certificates at a global scale. Supporting ambitious sustainability and social and economic development benchmarks, including through sustainability standards for technology, should also be part of the agenda.



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The Global Stocktake and next COP28 are a rare occasion to assess and re-evaluate our global response to the climate crisis, substantially reducing time to decarbonisation by accelerating our deployment of clean technology solutions like clean hydrogen. The EU, together with the UAE and its partners in the MENA region and across the globe, can make COP28 a success by upscaling ambition, boosting international finance and establishing the enabling policy frameworks necessary to realize the climate, security, and development benefits of clean hydrogen.

International Partnerships will be key to unlocking hydrogen's potential

Strengthened international cooperation is key to building a global hydrogen economy and unlock clean hydrogen's global potential for decarbonisation, energy security and socioeconomic development. As countries put forward hydrogen strategies, the EU should strengthen international partnerships to scale up hydrogen uptake at home and abroad, speeding up its efforts to meet the objectives of the Paris Agreement and the Sustainable Development Goals.

Europe's leading clean hydrogen vision is now coupled with a robust policy framework. After the Russian Invasion of Ukraine, REPowerEU established a clear vision to produce 10Mt and import 10Mt of hydrogen into to the European Union. The much-debated Delegated Act has defined renewable hydrogen and given predictability to domestic hydrogen projects and international players interested in the EU market. Instruments like the inclusion of hydrogen and ammonia in the Carbon Border Adjustment Mechanism (CBAM) have been put in place to level the playing field which, together with a set of other carrots and sticks like the new Hydrogen Bank and the strengthened Emissions Trading System (ETS), are creating the right incentives for hydrogen uptake in Europe. Nonetheless, Europe cannot go at it alone.

Clean hydrogen trade is set to play a significant role not only in the swift decarbonisation required for a net zero scenario, but also in creating a secure and fair global hydrogen economy. As countries all over the world design hydrogen strategies to decarbonise a wide range of sectors, many strategies are also putting forward ambitious hydrogen export goals. Clean hydrogen trade can help transport the energy from the sun and the wind over long distances, connecting regions with abundant renewable resources to energy hungry demand centres in Europe and across the globe. The IEA estimates that, according to the current pipeline of projects, more than 16Mt and 25Mt of hydrogen could be traded globally by 2030 and 2040 respectively and foresees around 20% of hydrogen to be internationally traded by 2030 in a net zero scenario[1]. Critically, clean hydrogen trade will not only play a critical role in matching supply and demand but can also become a key driver for socioeconomic development and an enabler to increase energy access, decarbonise energy systems, foster technology cooperation, transfer skills and knowledge, and support the establishment of new green industrial activities in emerging economies, among many others.

INTERNATIONAL PARTNERSHIPS WILL BE KEY TO ADDRESSING THE CHALLENGES AFFECTING GLOBAL HYDROGEN UPTAKE AND TRADE. While the climate, security and economic benefits of hydrogen are clear, hydrogen development is currently stalled by insufficient supply incentives and offtake support, limited global infrastructure and lack of mutually agreed international certification schemes, including on environmental issues, among others. International cooperation is at the heart of the solution and will be key to fostering market creation, financing the infrastructure needed to connect suppliers with off takers and agreeing on global, CO2 based hydrogen certification. The establishment of win-win international partnerships will be instrumental in unlocking hydrogen's potential and positioning the EU as a key player not only in ensuring its own demand needs are met, but also in supporting the development and decarbonization co-benefits that hydrogen can bring to developing countries, an opportunity the EU cannot miss.

The EU is currently establishing a network of hydrogen partnerships that are on the right track. To date, the European Union has established a wide range of international hydrogen partnerships, from Memorandums of Understanding to Green Partnerships and Global Gateway plans, with countries spanning the globe from the Middle East to Latin America. In 2022, the European Commission signed hydrogen relevant agreements with Morocco and Egypt, and further agreements are now being put into place with Algeria. In the context of the G20, the EU has also partnered to create the India – Middle East Economic Corridor, including a clean hydrogen pipeline, which will achieve a 40% reduction in time and 30% reduction in cost in India-Europe trade and strengthen EU cooperation with the Middle East. In Latin America, the EU used the EU-CELAC meeting to put forward an investment agenda for the region with a clear renewable energy and hydrogen focus and signed bilateral agreements with relevant hydrogen provisions with Argentina and Chile. Most of such agreements have also included partnerships for the secure supply of critical raw materials, essential not only for clean hydrogen but for most clean energy technologies driving the energy transition. Many Member States have either been precursors of these agreements or followed suit, with Germany and the Netherlands taking the lead. The EU has also put the right structures in place to cooperate with potential economic competitors, with dedicated hydrogen conversations in the Trade and Technology Councils with India and the US.

[1] https://www.iea.org/reports/global-hydrogen-review-2023

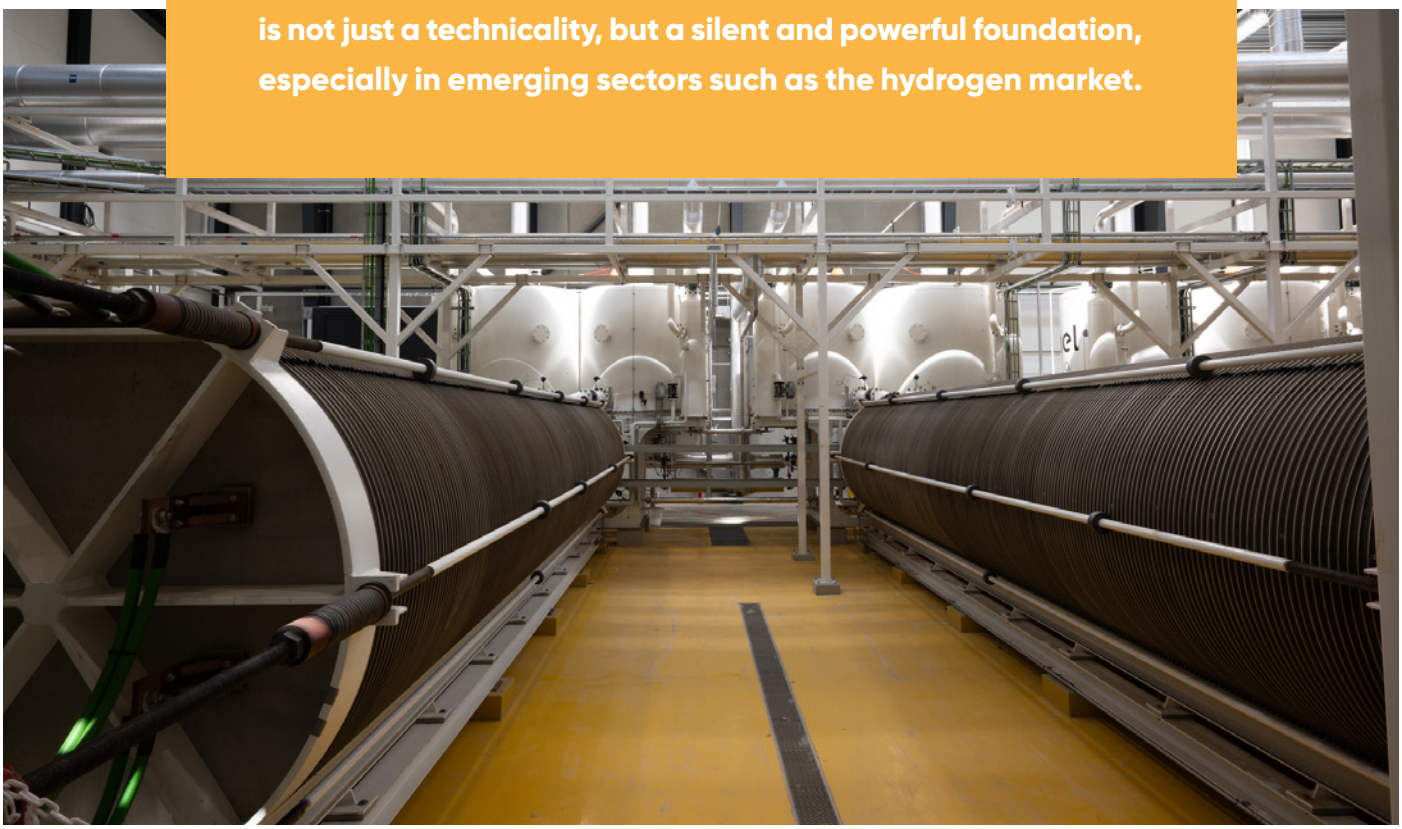
AS THE NETWORK OF INTERNATIONAL HYDROGEN PARTNERSHIPS GROWS WIDER, IT MUST ALSO GROW DEEPER. Current partnerships need to be operationalised, implemented, and expanded in order to support the uptake of clean hydrogen at home and abroad. Domestically, the European Union needs to support the demand side with offtake support mechanisms through the international leg of the Hydrogen Bank while finalising the current legislative framework and swiftly implementing it at the national level to give certainty and clarity to international players. Internationally, Europe can define a positive win-win agenda that ties hydrogen with development cooperation and international climate finance, making sure that hydrogen uptake in developing countries balances domestic use and exports and contributes to a robust socioeconomic development with clear, commonly agreed sustainability standards. Such partnerships should swiftly advance work on certification, which will be essential to ensure consistency, clarity, and comprehensive coverage across the entire lifecycle of hydrogen production and use. Critically, partnerships must also boost international finance for green infrastructure through swift implementation of the Global Gateway and other instruments like the Connecting Europe Facility. **COP28 CAN BE THE NEXT STEP FOR THE EU TO NOT ONLY DEFINE A COHERENT VISION, BUT ALSO TO WALK THE TALK.**

As the world takes firm steps to create a global hydrogen market in favour of decarbonization, energy security and development, international cooperation, and the role that the European Union plays in leading the charge, will define the strength at which we collectively speed up and scale up our efforts to meet the objectives of the Paris Agreement and the Sustainable Development Goals.

By Pau Ruiz Guix, Officer, Trade & Industrial Policy, Hydrogen Europe

Standardisation and Quality Infrastructure: A Win-Win for Hydrogen

In the rapidly evolving technological landscape, standardisation is not just a technicality, but a silent and powerful foundation, especially in emerging sectors such as the hydrogen market.



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Although often underestimated, standards underpin product reliability, safety, and interoperability, and enhance the tradability and fungibility of equipment and products. They are economic linchpins, driving around 30% of annual economic growth and delivering a staggering 20 times return on investment for every euro spent. For consumers, standards ensure safety and reliability; for businesses, they provide investment security and a common reference point across value chains, enabling scalability into new markets. In addition, the integration of quality infrastructure - which includes standardisation, accreditation, metrology, and conformity assessment - increases process efficiency by ensuring that products and services comply with established standards and regulations, thereby enhancing consumer safety and confidence. In essence, standardisation and quality infrastructure together pave the way for innovation, economic expansion, and a smooth transition to a circular economy, guaranteeing that processes are not only understood but also optimised for sustainability and efficiency.

The transition to a clean hydrogen economy, particularly in energy-intensive industries such as chemicals, steel, and aviation, is underscored by the potential to significantly reduce carbon emissions and comply with stringent regulatory frameworks. According to a McKinsey study for the Hydrogen Council[1], clean hydrogen could avoid 6 gigatonnes of CO2 emissions and create a $2.5 trillion market by 2050. Various regions of the world, including the EU and nations such as the US and India, are investing heavily in clean hydrogen strategies and initiatives to achieve significant greenhouse gas emission reductions and net zero targets in the coming decades.

In this scenario, the role of standardisation and quality infrastructure is paramount. Ensuring the sustainability of hydrogen and its derivatives through certification, in particular for its production, storage and transport, requires globally harmonised standards and accounting frameworks.

> **“ Ensuring the sustainability of hydrogen and its derivatives through certification, requires globally harmonised standards and accounting frameworks.**

A recent collaborative paper from Hydrogen Europe and H2Global Foundation[2] emphasises the importance of digitalization, showcasing platforms that assist organisations in managing their renewable energy and hydrogen value chains, and highlights the crucial role of incorporating digital certification tools and practices. These not only automate and simplify processes, but also support different sustainability frameworks and carbon accounting methodologies, ensuring that hydrogen markets are not only sustainable, but also adhere to global standards and certifications, ensuring safety, reliability and trust among consumers and stakeholders alike. This strategic combination of standardisation, quality infrastructure and digitisation will be key to managing the complexities and maximising the potential of the hydrogen economy.

However, there are many challenges on the road to establishing clean hydrogen and its derivatives as a sustainable energy carrier. **ONE GLARING ISSUE IS THE GLOBAL INCONSISTENCY OF CERTIFICATION SCHEMES, WHICH HAMPERS CROSS-BORDER HYDROGEN TRADE AND REGULATION.** Given the nascent nature of the industry, standards and regulations are still evolving, creating a certification paradox where operations and certification are intertwined in a cyclical dilemma. Different methodologies across regions and organisations lead to inconsistencies in hydrogen certification, while life cycle gaps, particularly in stages such as transport, provide an incomplete emissions picture. Regulatory ambiguity, exemplified by regulations such as the EU’s renewable fuels of non-biological origin (RFNBOs) and the US’s 45Q, hampers project development, while the additionality puzzle and confusion over scope and thresholds lead to debate and confusion over what qualifies as ‘low carbon’ or ‘renewable’. Sectoral hurdles, investor reluctance due to prevailing ambiguity, and a race against time to address these challenges before key events such as COP28 further complicate the path to a clean hydrogen economy. Addressing these challenges will require a harmonised, global approach to standardisation and regulation to ensure consistency, clarity, and comprehensive coverage across the entire lifecycle of hydrogen production and use.

Hydrogen Europe is working diligently within relevant organisations in the field of Quality Infrastructure and Regulations, Codes and Standards (RCS) to represent the European hydrogen industry throughout the value chain. This is a complicated, complex, and demanding task. Imagine navigating through a library where each book tells the story of hydrogen and its derivatives, but they’re written in a myriad of “languages” or in our case standards, each offering a unique narrative, but collectively forming a complex, multifaceted story. The global certification of hydrogen and its derivatives is similarly complex, with at least 11 major global standards, each with its own definitions and criteria, potentially complicating matters as the international hydrogen market rapidly expands.

Consider the early days of mobile phone chargers: a realm of diverse, brand-specific chargers that eventually evolved towards standardisation for universal benefit. The clean hydrogen sector, with its regional and contextual differences in standards, faces a similar crossroads. Not all standards comprehensively address sustainability requirements, raising the question of interaction: How might the future of hydrogen and its derivatives trade unfold amidst this diversity of standards? The way forward beckons a harmonised, global approach to navigate the complexity and unlock the sustainable potential of clean hydrogen.

[1] https://hydrogencouncil.com/en/study-hydrogen-scaling-up/

[2] https://hydrogeneurope.eu/wp-content/uploads/2023/09/H2Global-Stiftung-Policy-Brief-05_2023-EN.pdf

A compelling example is the European Single Market, which thrives on careful standardisation, enabling the smooth movement of products and services through adherence to mutually agreed standards, ensuring quality, safety, and compatibility. That's why Hydrogen Europe is advocating for a Digital Product Passport for hydrogen. It is proven that the common denominator are the data and values required by regulation, codes, and standards. Once these values are fixed thought the value chain with a Digital Product Passport that ensures interoperability, trade and free movement of goods and services can be ensured via this Digital Product Passport for hydrogen.

Imagine the internet, a domain whose vast potential was not fully realised until universal protocols and standards such as HTTP and HTML were established. In our vision, the Digital Product Passport for hydrogen is poised to become the unifying standard, similar to these internet protocols, that will drive our green energy future.

By Maximilian Kuhn, Advisor, Hydrogen Europe

Want to know more?

Check our joint paper on Standardizing Hydrogen Certification at hydrogeneurope.eu/in-a-nutshell/reports/

After AFIR: Hydrogen Europe's Hydrogen Refuelling Stations Mapping

On 25 July 2023 the Council approved the provisional agreement on the Alternative Fuels Infrastructure Regulation[1] (AFIR). The text, published on the Official Journal of the European Union on 22 September, mandates the deployment of a pan European refuelling network for hydrogen in the road sector for both private and commercial vehicles.

The text obliges Member States to deploy one hydrogen refuelling station every 200 kilometres on the Trans-European Transport Network (TEN-T) core network and at least one hydrogen refuelling station in every urban node by 2030, ensuring a daily minimum supply capacity of one tonne of hydrogen. Once details of the agreements were made public, Hydrogen Europe had, rather simple, questions: how many stations should be built? What is the bare minimum needed to comply with targets?

A first estimation was made by dividing the length of the TEN-T core network by 200 and add 424, that is the number of urban nodes as proposed by the European Commission in the revised TEN-T Guidelines[2]. The result was 657, which eventually turned out to be overestimated, as hydrogen refuelling stations in urban nodes can also be counted for the TEN-T network. Therefore, we needed to start again.

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[1] Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU

[2] Proposal for a Regulaion of the European Parliament and of the Council on Union guidelines for the development of the trans-European transport network, amending Regulation (EU) 2021/1153 and Regulation (EU) No 913/2010 and repealing Regulation (EU) 1315/2013

What we knew

Thanks to further information from the European Commission, we received more details on how to interpret the Articles. For instance, it became clear that the daily capacity requirement is the most important one, meaning the number of stations is subordinated to the supply capacity: as long as the one tonne per day requirement is satisfied, the actual number of stations built that together meet that threshold is not relevant; it could be just one station, or it could be four smaller ones capable of 250kg per day. Of course, this reasoning is easier to apply within urban nodes, less so along the TEN-T network. The Regulation also includes a derogation for the stretched of TEN-T network whose total annual average daily traffic is less than 2.000 heavy-duty vehicles. In this case, the daily supply capacity can be reduced up to 50%.

What we did

On the basis of this information, we started a desk research exercise using an existing database that has been expanded over time. The goal was to gather as much information on the location of the existing hydrogen refuelling stations network and the daily capacity of each station; this was done asking members to provide information that has been anonymized and aggregated into a single map.

We quickly realized that we had to make some assumptions to be able to perform such a task:

- All hydrogen refuelling stations to have 1t/day capacity
- Hydrogen refuelling stations along the TEN-T network to serve both directions
- Include all existing and publicly accessible hydrogen refuelling stations, regardless of their refuelling pressure
- Lacking information on traffic volumes of TEN-T networks, we assumed none of them was eligible for the derogation on daily capacity
- Consider a rough classification of hydrogen refuelling stations based on their daily supply capacity:
    - **Small:** less than 100kg/day
    - **Medium:** between 100 and 500kg/day
    - **Large:** more than 500kg/day

Initial results

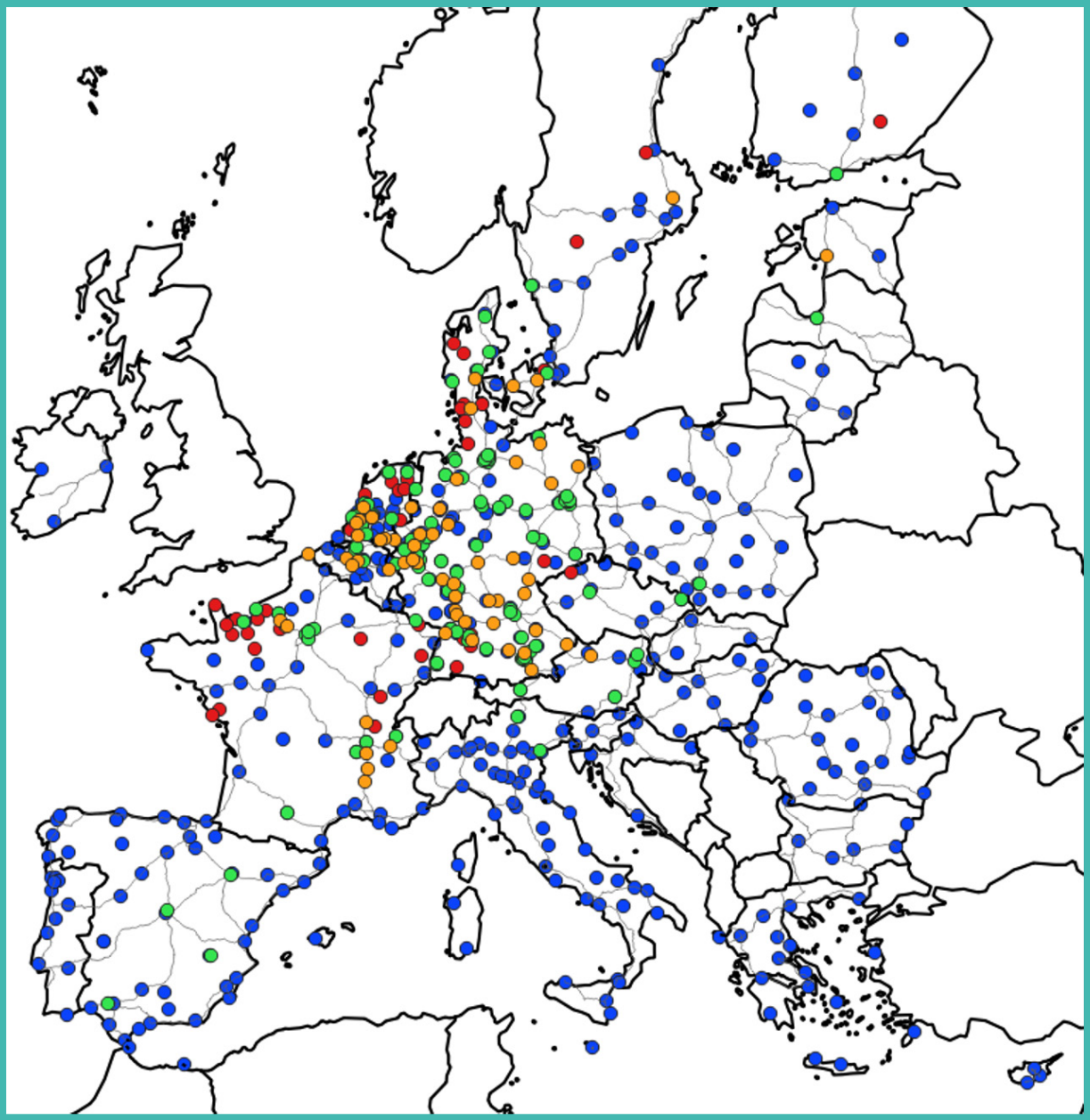
The first round of calculations confirmed that Member States are expected to go through an important deployment of infrastructure to meet the 2030 target set in AFIR Article 6. The results are as follows:

- 330 stations needed in urban nodes
- 98 stations needed along the TEN-T core network
- 45 existing stations cannot be counted to meet AFIR targets because they're outside of urban nodes and/or too far from the TEN-T network

It should be stressed that the above numbers are the stations that should be built in the future, and they should be added to the existing hydrogen refuelling station network. Moreover, we were not able to retrieve information on the daily capacity of 93 hydrogen refuelling stations, 72 of which are eligible for AFIR targets.

In other words, the absolute minimum number of hydrogen refuelling stations needed for EU Member States to meet AFIR Article 6 target could be as little as 428 by our current understanding. Commitment levels obviously vary greatly between countries: Italy and Spain would need to build more than 100 hydrogen refuelling stations in total, which is due to a high number of urban nodes and a nearly non-existent hydrogen refuelling network, whereas the Netherlands would only need 15 and Luxembourg would only need to meet the capacity target, as the location target is already met.

The visual representation of the exercise we conducted currently looks like this:



URBAN NODES. As a reminder, urban nodes are not just cities and towns but also include logistics hubs and multimodal terminals.

EXISTING HYDROGEN REFUELLING STATIONS IN URBAN NODES.

HYDROGEN REFUELLING STATIONS ALONG THE TEN-T CORE NETWORK.

EXISTING HYDROGEN REFUELLING STATIONS THAT CANNOT BE COUNTED TO MEET AFIR TARGETS
(because they are not located in an urban node nor close enough to the TEN-T core network).

Lastly, it should be stressed that the above map is to be used only for advocacy purposes and active dialogues with EU institutions and Member States.

First conclusions

As obvious as it was already, the map provides a clear response at first glance: the European hydrogen refuelling network is severely underdeveloped, especially in urban nodes (represented by blue dots).

The map does not provide any information on the daily capacity supplied at a specific location, but based on the data in our possession we can report that only the cities of Berlin, Hamburg and Munich have a daily supply capacity that meets or exceeds the 1t/day requirement. The other cities that are close to meeting the capacity target are: Düsseldorf (150kg needed) and Frankfurt (less than 300kg needed); Antwerp, Grenoble and Lyon still need at least 400kg. To our knowledge, Paris has 8 hydrogen refuelling stations in place but as we only know the capacity of two of them (330kg/day in total) we can only assume that the city is very close to meeting the target.

Questions and next steps

As the map is meant to be a living document, it is being constantly checked and updated against information available on the internet and feedback provided by Hydrogen Europe members. For example, it appears that at the time of writing the number of existing hydrogen refuelling stations in Spain was initially miscalculated, meaning that most of the existing green dots on the map should be red instead.

As we progressed with the exercise, questions arose on how to interpret the wording of AFIR rules. Some of those questions are:

- Are hydrogen refuelling stations on the TEN-T core network meant to serve both directions? If so, should they provide 2 tonnes per day?

- In case of a station counting for both an urban node and the TEN-T network, should it have a capacity of 2 tonnes per day? And should the requirement of serving both directions be applicable, should that capacity be further raised to 3 tonnes per day?

- How is the distance calculated? What are the reference points used? For instance, where's the actual end point of a "TEN-T road exit"?

- Is the 10km requirement meant to just reach the HRS or should it be considered as the total distance, meaning the HRS must be located within 5km from the TEN-T exit?

- How are the 200km calculated in terms of capacity? Can the 1 tonne per day be distributed along a 200km stretch of should there be a single hydrogen refuelling station dispensing 1 tonne per day every 200km?

- How neighbouring Member States are supposed to cooperate and pick locations and how will they cooperate with states of the Western Balkans and the Eastern partnership?

- Weight-based Urban Access Regulation may prevent heavy-duty vehicles from accessing hydrogen refuelling stations within urban nodes. What's the impact on AFIR targets? How can a station be counted towards the target if it cannot be used at certain times of the day/week?

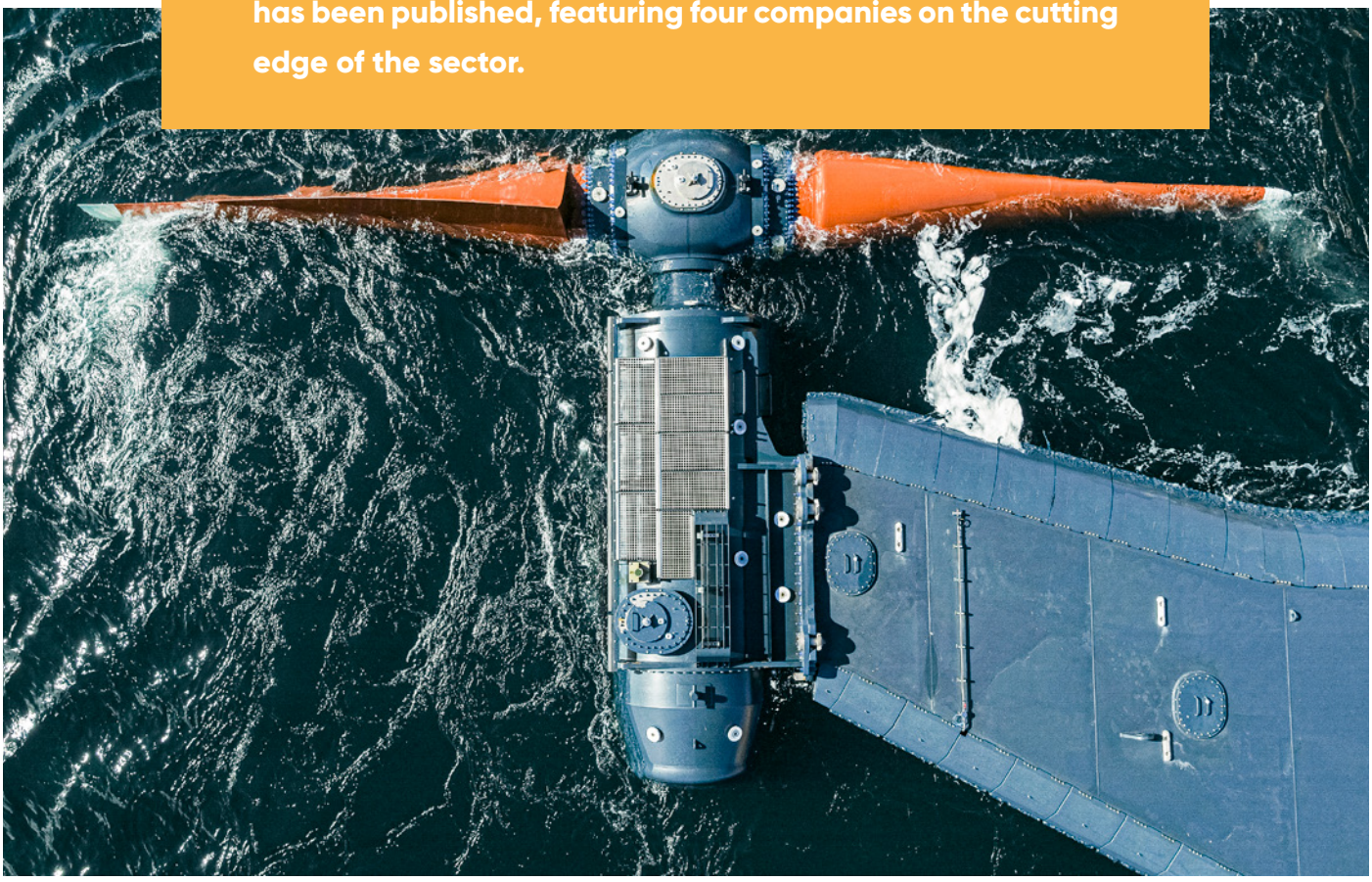
Of equal importance, it is not clear how and when the industry will be involved, considering that Member States must send their draft National Policy Frameworks by the end of next year.

On our end, we will keep fine tuning the mapping with the objective of proposing a clear representation of the magnitude of the effort required, as well as becoming the key coordinating interlink between the EU institutions, Member States, and the industry so that the common goal of decarbonizing road transport happens as fast and as efficiently as possible.

By Matteo Azzimonti, Officer, Transport Policy, Hydrogen Europe

Heroes of Hydrogen 2023: heroes always rise again

The second edition of the Heroes of Hydrogen photobook has been published, featuring four companies on the cutting edge of the sector.



© Orbital Marine Power

In Scotland's Orkney islands, the research organisation European Marine Energy Centre (EMEC) produces its own green hydrogen through a combination of onshore wind and tidal power. As well as selling some of the product to interested research projects, some of it is also used in the local community to power ferries and heat the local airport.

In Northwestern France, a stone's throw from Nantes, Lhyfe is securing its present with an established onshore green hydrogen production centre and is securing our future with the world's first offshore wind powered electrolyser. Figuring out how to reliably produce green hydrogen from offshore wind will be key to securing a low-cost supply of the molecule for offtakers.

© Hydrogen Europe

In Denmark, Everfuel is preparing to open its 20MW electrolyser plant, where it will sell green hydrogen to an adjacent refinery thereby decarbonising its processes. This is just the beginning for the company, which is hoping to expand the project to 1GW by 2030!

And last but not least, Advent Technologies, from its production facility in Patras to its upcoming IPCEI-winning electrolyser manufacturing centre in Kozani, is securing a role for Greece in the hydrogen revolution. Meanwhile, it is running sizeable operations across Europe and even as far away as Indonesia.

These four companies were chosen for their vision, entrepreneurship, and courage. For the positive legacy they will create and of which we will all benefit. Their stories are told alongside photos intended to capture the magic of what they are doing, and what we hope many shall emulate.

© Advent Technologies

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Perhaps most importantly, our heroes show that even in times of adversity, **REAL HEROES ALWAYS STAND UP AGAIN.**

If you are a member of hydrogen europe or an exhibitor at the european hydrogen week event, you can look forward to receiving your very own hardback copy of this book at the event.

If you are neither a member nor an exhibitor, the book will be available online at the end of the year!

Flagship Project TransHyDE

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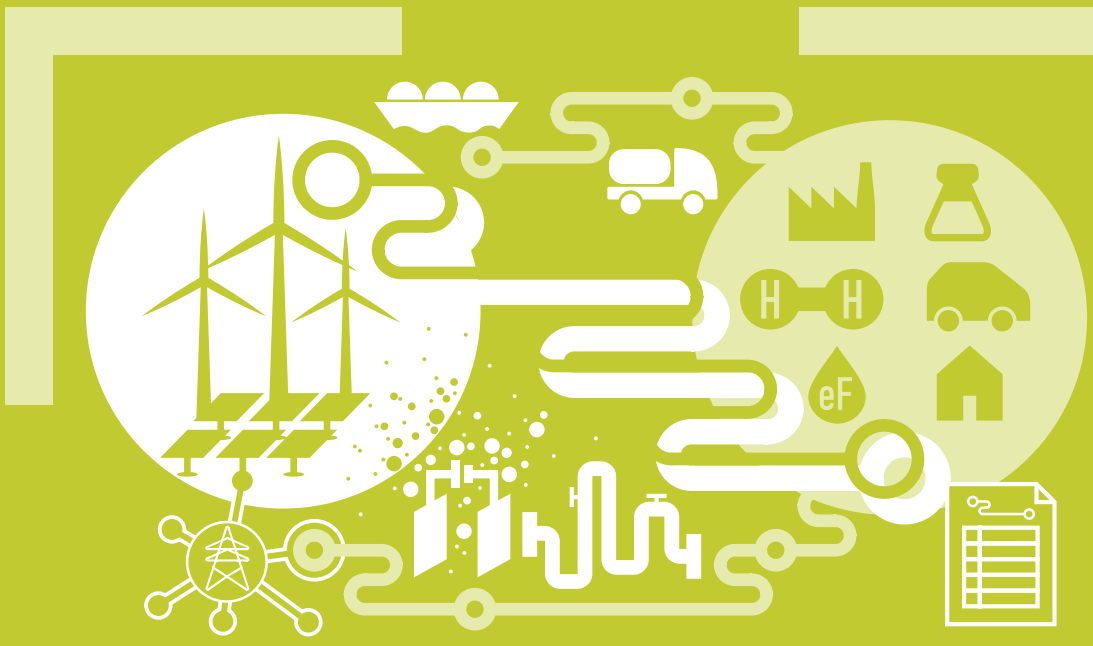


Hydrogen Infrastructure - Facing the Challenges

- □ Benefits of an integrated approach to infrastructure challenges – taking advantages of synergies
- □ Hydrogen flows and cross-border connections – satisfying demand, enabling growth
- □ Import vs. local production – opportunities and limitations
- □ Energy carriers in transition – co-development of infrastructures
- □ Hydrogen demand from industry – understanding the transition
- □ The role of hydrogen in the energy transition – silver bullet or specific solutions in different sectors?

TransHyDE Project System Analysis

Side Event European Hydrogen Week

21st November 2023, Expo Brussels

Hall 11, Meeting Center

click here for project video

or scan

PROMINENT HYDROGEN PEOPLE: EVP Maroš Šefčovič

In each issue of the Hydrogen Europe Quarterly, we interview a prominent person in the hydrogen sector to talk about their involvement and interest in hydrogen, as well as about the key issues that concern them. For this issue, Hydrogen Europe spoke to EVP Maroš Šefčovič, a Slovak diplomat and politician serving as Vice-President of the European Commission for Interinstitutional Relations since 2019

Mr. Executive Vice President, when did you first learn about hydrogen and its potential? Were you immediately convinced of its potential or did it take time?

I had known about the technology of hydrogen for several years already, but it was not until we started working on the Energy Union that I began to appreciate its potential. Back in 2018, when I was Vice-President of the European Commission for the Energy Union, we were developing the EU Strategy "A Clean Planet for All" and we realised that there are some parts of our economy which cannot transition to climate neutrality by electrification alone. For example, this was the case with the decarbonisation of some harder-to-abate industrial processes such as steel production, where hydrogen was immediately identified as an opportunity. Later, the ideas for the use of hydrogen expanded significantly across sectors such as transport, energy storage and heating to the point where today we see it as a key pillar of our clean energy transition. This could not have happened without the help of the pioneers in the scientific community and the business and civil sectors who were championing hydrogen's potential for all these years.

What opportunities does hydrogen offer Europe?

There are many ways in which hydrogen can offer an opportunity for Europe but let me focus on two essential ones.

Firstly, hydrogen can be the missing link in the EU's clean energy transition. As we laid out in the Commission's Strategy for Energy System Integration, hydrogen is key to the sectors where electrification does not offer all the solutions such as steel, cement, fertilisers, or chemicals. Furthermore, hydrogen can serve as a bridge between the balancing needs of the electricity system and the intermittent nature of renewable energy sources. It can be a

form of daily or seasonal energy storage which offers flexibility to the system and ultimately turns our vision for system integration into reality.

Secondly, hydrogen is one of the main avenues through which Europe can lead the clean energy transition. The wider deployment of hydrogen technologies offers an increase in clean energy jobs and fossil-free growth for our economy. Moreover, it is a way for

Europe to preserve and boost its competitiveness and take up a key role in the development of a global hydrogen value chain. This is exactly what we in the European Commission want to enable.

How do you assess the European landscape for the hydrogen economy so far? What are you most proud of? What work remains to be done?

We have seen very strong interest in hydrogen both from policymakers and the business community, and we now need to accelerate its deployment. At the European Commission, we are doing all that we can to build an environment conducive to attracting investment in the sector and we are working on an ambitious and nurturing regulatory framework.

Our Hydrogen and Gas Decarbonisation Package, coupled with the Net-Zero Industrial Act, will give the legal certainty and long-term visibility needed to encourage investors. I am glad to see that the European Parliament and the Council are advancing with the negotiations on these key legislative files. I hope that we will see an agreement in the coming months so the framework can be implemented swiftly. The homogenous application of these rules will be one of the Commission's key priorities as they will constitute the fundament of the whole hydrogen market.

Recently the Commission also adopted two delegated acts – one setting the criteria for renewable fuels of non-biological origin (RFNBOs) and the other clarifying the rules for the calculation of greenhouse gases used to produce RFNBOs. In addition, we will develop a similar act for low-carbon hydrogen, produced from nuclear energy.

We also see a definite need to accelerate the development of domestic capacities along the entire value chain. To this end, the Net Zero Industrial Act aims to make good use of non-price criteria in public procurements and auctions. This will allow the sustainability and resilience of electrolysers produced in Europe to be properly considered.

We should also optimise the available funding. For example, we will discuss, together with the European Investment Bank, possible actions such as dedicated financial guarantees for the hydrogen sector, including electrolyser manufacturers, which could ensure affordable credit lines and loans to develop production capacities.

In short, our priority now is to do everything that we can to create an ecosystem ensuring that hydrogen is produced in Europe, using domestically manufactured technologies. We want Europe to be the global home of clean hydrogen.

In your view, what is the biggest challenge to scaling up the European hydrogen economy. How can it be overcome?

We organised the first Clean Transition Dialogue on hydrogen in October, where we invited key actors from the sector to share their insights on how to rapidly upscale hydrogen production and use and create a business case for the hydrogen industry in Europe. The biggest challenge is the chicken and egg dilemma: how can we best encourage the growth of a hydrogen market? Should we first focus on building capacity for production or boost demand? Or should we lay down the infrastructure as a matter of priority and wait for flows?

In solving this challenge, we need to preserve Europe's leading position and accelerate hydrogen roll-out in the face of adverse global competition. We believe that the future of our clean tech must be made in Europe, and we are committed to supporting our industry in this vital sector.

Making the clean transition a success requires massive investment and unprecedented support. The total amount of funding required to produce, transport, and consume 10 million tonnes of renewable hydrogen is estimated to be up to €471 billion, with as much as €300 billion needed in addition for renewable electricity production. We have already done a lot to that end, having mobilised unprecedented financial resources through the Innovation Fund, the Recovery and Resilience Facility and the Connecting Europe Facility. We are also developing the Hydrogen Bank where we have committed a total of €3 billion for auctions for domestic production.

We are also looking into ways to build on our successful experience with the joint purchase of gas under the EU Energy Platform. We recommended to the Parliament and the Council to include in the Hydrogen and Gas Decarbonisation Package an option to extend joint purchasing, on a voluntary basis, to hydrogen. Demand aggregation can solve the transparency challenge in the hydrogen

market by bridging the gap between suppliers and buyers. It has the potential to become one of our flagship measures to develop the nascent EU hydrogen market.

Joint purchasing of hydrogen can also provide critical insight about the infrastructure which we would have to develop to enable the hydrogen market. As our energy system becomes more integrated, hydrogen will serve as a connecting link between gas and electricity. This means that we must take decisive steps and bolster our engagement with industry to allow joint and integrated infrastructure planning as soon as possible. 2030 is not that far away and we need to frontload our efforts to achieve the REPowerEU renewable hydrogen targets for 10 million tonnes of domestic production and 10 million tonnes of imports.

As you can see, much remains to be done. We know that hydrogen has the economic potential to accelerate the energy transition but has not yet reached the tipping point in terms of deployment. This is why we are stepping up our engagement with industry in order to find the best way forward.

What do you hope to achieve in your new role?

I took on this new responsibility as Executive Vice-President at a turning point for the European Green Deal. Agreement on the Fit for 55 package had just been found, putting us firmly on the path to achieving our climate goals for 2030. We must now lay down the groundwork for the next decade and identify the targets for 2040 as well as the best way to achieve them.

Until the end of this mandate, less than 300 days away, I will focus on three main tasks. Firstly, I will boost the Commission's engagement on the Green Deal with both citizens and industry. This transition is an opportunity for all Europeans as well as our businesses and there is a clear need to have their support and hear their voice as we design the policies that will shape tomorrow. Secondly, I will work to see that all pending legislative proposals are adopted by the end of this mandate. There are a number of key milestones that need to be completed and the Commission stands ready to support the Parliament and the Council in the negotiations. Finally, I will make sure that we increase our efforts in supporting the implementation of Green Deal legislation. The Fit for 55 package implies a significant change in the way Europe runs its economy and the Commission will do everything it can to help Member States and businesses take advantage of these new opportunities.

What advice would you offer Europe's leaders for achieving the EU's decarbonisation goals?

I would call on all European leaders to recognise the need to both accelerate the green transition and seize the opportunities that it brings for our economy. The global race is on to be at the centre of green production, rules and financing. And we want Europe to be the global home of clean hydrogen. Therefore, we must act swiftly not only to address the climate emergency, but also to ensure the full deployment of this strategic sector.

The European Green Deal is our response to the climate change and biodiversity crisis, the impacts of which are becoming increasingly apparent in the everyday lives of Europeans. But it is also Europe's growth agenda. Our decarbonisation must go hand in hand with reindustrialisation and sustainable economic growth and we should do all that we can to boost our competitiveness and keep our leadership in clean energy technology while we can.

Member spotlight:
NextEra Energy Resources

The Hydrogen Europe Quarterly's member spotlight covers one of Hydrogen Europe's diverse membership and its activities and ambitions in hydrogen. One of the largest renewable energy producers in the world, NextEra Energy Resources is now working to take a leading role in the hydrogen sector too. We spoke with Jason Wasserman, executive director of green hydrogen at NextEra Energy Resources, about the rationale behind the US company's new focus and the opportunities ahead.

NEXTera® ENERGY RESOURCES

With climate goals and climate consequences looming, the need for more renewable energy capacity cannot be overstated. Fortunately, there are plenty of companies, from SMEs to utilities, ready to answer the call. And with green hydrogen now ascending to a key component of the global decarbonisation strategy, renewable energy has come into even greater focus.

As Jason Wasserman explains, with NextEra Energy Resources a world leader in renewable energy and storage "it was natural for us to become a driving force in the development of the green hydrogen economy."

For the last two years Wasserman, who has over a decade of experience in the energy sector, has been executive director of green hydrogen at NextEra Energy Resources, a subsidiary of the US-based Fortune 200 company, NextEra Energy, with over 67GW of power capacity in operation. And this provides NextEra Energy Resources with abundant knowledge and capital to expand into the hydrogen sector.

> **By the end of the decade, green hydrogen is expected to reach parity with a lot of other more carbon intensive solutions.**

"We have an incredible renewable energy pipeline of 250GW in the development queue, and unparalleled experience in renewable energy and energy markets, that could underpin our green hydrogen investments," Wasserman explains, with NextEra Energy Resources viewing hydrogen as a US$20bn investment opportunity. Of course, no multi-billion-dollar utility makes any investment without confidence in the economics. For a nascent sector like hydrogen, the economics are still taking shape amid a great appetite in the international community for accelerating the energy transition.

It is becoming increasingly clear, however, that hydrogen will benefit like any other sector from economies of scale. That is where governments come in with incentive schemes and workable regulatory framework, and it is where larger companies like NextEra Energy Resources also come in as early movers – ready to build at-scale and really stimulate the growth of the market.

By the end of the decade, green hydrogen is expected to reach parity with a lot of other more carbon intensive solutions. But the key to achieving that parity the speed at which the sector can deploy at scale. The ramp-up will help to drop prices like what was seen with solar photovoltaic.

NextEra Energy Resources is certainly not waiting around for that ramp-up to happen. The company's sister company, Florida Power & Light Company (FPL), is making good progress on its Cavendish NextGen Hydrogen Hub in Florida which produced hydrogen last month in October. The project consists of a portion of the energy from a solar farm (FPL Cavendish Solar Energy Centre) being used to produce hydrogen that will then be compressed, stored, and blended with natural gas. That blended hydrogen product will be used as fuel to produce electricity in natural gas power plants, thereby offsetting part of their emissions. Construction of the $65 million project is expected to be complete by the end of the year.

Secondly, NextEra Energy Resources has signed an MoU with Linde to develop a $1 billion electrolysis-based green hydrogen facility near Phoenix, Arizona. The Gila Hydrogen Facility will produce up to 120 metric tons of liquid hydrogen every day with an intended use of decarbonising "West Coast mobility and industrial end-markets".

And while Wasserman assesses the US Inflation Reduction Act positively, calling its offered tax credit for hydrogen producers a "potential opportunity to decarbonise new markets utilising renewable electricity," NextEra Energy Resources' ambitions in hydrogen long predate it.

Amid a focus on tech neutrality, Wasserman believes that hydrogen – which he adds will be key to unlocking hard to abate sectors that are today relying on the fluctuating price of fossil fuels – is one of the solutions. Not to mention the fact that in some regions like Florida and large swaths of the southern US have such abundant renewable energy resources that green hydrogen production can, or soon will be, cost competitive.

So what's missing from the equation?

"We're looking for policy certainty which is critical to identify potential opportunities. Having certainty is very important, but the level of excitement couldn't be higher. We need public policy that supports the development of green hydrogen as a way to decarbonise the economy," Wasserman muses.

There are steps being taken already that have greatly impacted the building out of the global economy.

NextEra Energy Resources' hydrogen division has grown rapidly from when Wasserman joined. There is plenty of work left to do before hydrogen becomes a staple of our decarbonised world, and the US utility is ready to do its part. As the hydrogen sector continues to grow, so will the company as it looks to capitalise on its lofty position within the clean energy sector to lead in the next great clean technology revolution.

National Member Spotlight: France Hydrogène

For each issue of the Hydrogen Europe Quarterly, we will speak to national hydrogen associations of countries focused on becoming major contributors to the global hydrogen market. For this issue, we spoke to Christelle Werquin from France Hydrogène about one of Europe's biggest hydrogen economies.

France Hydrogène
Engagée pour la transition écologique

"It's been very interesting to link my two passions – EU affairs and the challenge of building Europe with the energy transition," says Christelle Werquin, General Delegate of France Hydrogène, the French national Association for hydrogen that today counts more than 450 members.

Werquin began her career 20 years ago in Brussels, working for the EU institutions and always maintaining an interest in the energy transition. Six of those years were spent in public private partnership organisations. She has now been General Delegate at France Hydrogène for seven years and has overseen a rapid change in the association.

Originally a platform of fuel cell manufacturers alongside an academic membership from universities and larger research communities, the initial objectives of AFIPAC, as it was known at the time, was to promote the development of hydrogen technologies and the transfer of technologies and know-how to newcomers in the industry. Since then, the membership has changed to reflect a theme of bringing regional and local authorities together – "we were the first to bring local and regional authorities in!", says Werquin - to collaboratively build an independent society. This is done through consulting work, assistance in securing EU funding, and generally building up partnerships. The rapidly evolving field of hydrogen benefits perhaps more than most from this approach of bringing together a wide range of highly committed players.

"What particularly fascinates me with hydrogen is the dual role it plays in decarbonising hard to abate sectors and in re-industrialising European countries," Werquin enthuses. And the challenges, like the opportunities, are identical in France as in Europe – security of supply and demand, cost effectiveness, and transportability.

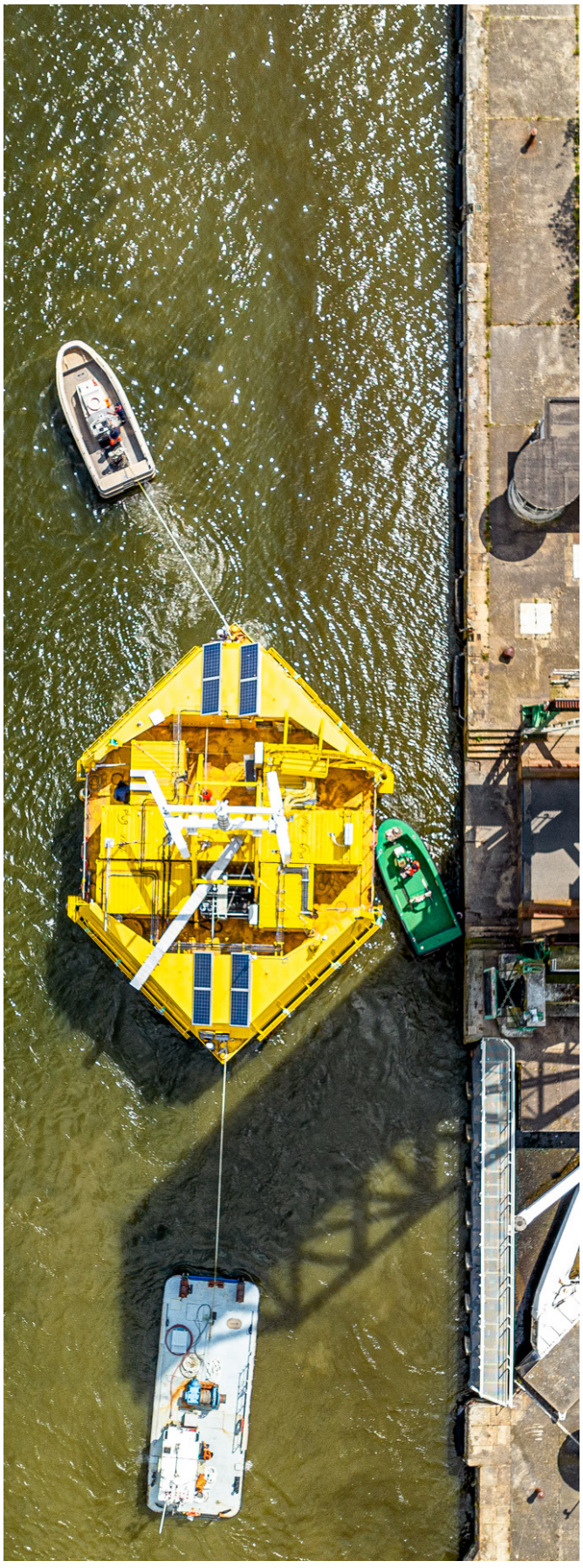
"Our mission is similar to Hydrogen Europe's – to be a privileged interlocutor with authorities to structure a high-performance, innovative French hydrogen industry and to promote hydrogen technologies for all industrial and economic stakeholders, even for the larger public," she adds, confident in France Hydrogène's aim of generating between 50,000 and 150,000 direct and indirect jobs by 2030.

The association now brings together all stakeholders of French industry along the entire value chain, with over 100 major industrial groups developing large scale projects, more than 200 SMEs, a plethora of laboratories and research centres of excellence, the aforementioned local and regional authorities, and competitive clusters. The ultimate aim of the game is to promote the scale up of competitive renewable and low carbon hydrogen.

France's 2020 hydrogen strategy provides more than €9bn in public funding to back the expansion of the sector, with a key objective of building 6.5GW of electrolyser capacity by 2030. Meanwhile a key priority is also the build out of hydrogen light and heavy-duty transport options by land, air and sea. France Hydrogène ran a study into the feasibility of these objectives and concluded that it was not only possible but could even be surpassed.

"What we showed was the project road is on course to meet the targets, not only the government scenario but also the most ambitious scenario," says Werquin.

France has a significant industrial base and is in fact already a notable user of hydrogen. Around 800,000 tonnes of the molecule are produced and consumed in the country – the vast majority of it grey. Werquin and her team believe that, while we wait for the uptick in green hydrogen supply, that using carbon capture



technology to turn grey hydrogen into blue is a logical idea that will contribute to decarbonisation in the here and now.

In terms of finalising a legislative framework, and in increasing the number of end users, the answer is increased collaboration.

“We need to be cooperative, and I hope this will improve, especially in discussions between France and Germany,” says Werquin.

In the short term, it’s all about proving the concept and demonstrating the viability of the hydrogen ecosystem, which will in turn encourage more uptake and investment into the value chain.

“We need to have projects that function in place in order to promote our industries on the international market,” adds Werquin.

And why should investors look at France? She’s got that covered too:

“We have a national strategy built upstream to downstream, which gives coherence to our market. We have an original approach to developing ecosystems, especially on mobility, in order to reduce costs and optimise uses that we want to share with European partners. The French hydrogen sector is ready to enhance a strong European hydrogen ambition! We also have substantial public funding. I hope this would be interesting for our partners.”

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Regional member spotlight: Zuid Holland

For each issue of the Hydrogen Europe Quarterly, we speak to an EU region striving to position itself as a key hydrogen contributor. For this issue, we spoke to Jeannette Baljeu, regional minister of the province of Zuid-Holland, responsible for the energy transition in ports and industry, maritime clusters, aviation, water, soil and climate adaptation.

The province of Zuid-Holland is the Netherlands' most populous, with over 3.7 million inhabitants and featuring the country's political capital, the Hague, and its second largest city, Rotterdam. The presence of the latter city, and the famous Port of Rottderam, also makes the province a key destination for the petrochemicals and logistics sectors but, perhaps most importantly, it is also the energy port for the Netherlands and the whole of Europe.

This is the view of Jeannette Baljeu, regional minister for the Province of Zuid-Holland focused on energy transition and ports. Since the acceleration of the energy transition in Europe circa 2018, the province felt the need to produce a climate strategy alongside the Port. A dedicated hydrogen strategy was also developed with a recognition of blue hydrogen as a first transition step with expected growth in green hydrogen over time.

These strategies helped to define and guide the region's industrial players response to the need for decarbonisation. "There has been a lot of talking in the past, but these days companies are really making investment decisions and executing transition projects," explains Baljeu, especially considering the infrastructure needs, subsidy requirements and market conditions to make a hydrogen transition a reality.

Baljeu is confident in the medium-term demand for hydrogen in Zuid-Holland, with the substantial petrochemicals sector followed by the development of clean maritime and aviation, not to mention the issue and opportunity of hydrogen transport beyond the Dutch border to Germany, where a host of potential hydrogen end-users are located. The Delta-Rhine corridor, a series of gas pipelines and power cables stretching from Rotterdam to Germany, is being prepared to be suitable for hydrogen transport.

And while regional groups like Zuid-Holland are getting things moving, with the speeding up or permitting processes, prioritisation and subsidies, Baljeu emphasises the need for corporates to make the leap. "Industry itself needs to have the means and the funds. We contribute in a small way, but it has to be business that makes the transition," she says.

The province of Zuid-Holland's remains an active partner in this undertaking: "Strategically we're focused on increasing demand, so we're looking at all these sectors and seeing how we can stimulate innovation. It's about providing support, not only through money and subsidy, but by acting alongside the companies asking 'how can we stimulate a sector?' or 'what needs to be done and known?'," explains Baljeu.

> **"If the national government wants to reach their goals, they have to invest in the infrastructure and in the way the port is structured in the energy sense.**

Uncontroversially, the Port of Rotterdam is a big part of the answer to many of these questions. The port alone can provide 30% of carbon reduction targets for the Netherlands, but this can only be done if it adapts to hydrogen, Baljeu says.

"If the national government wants to reach their goals, they have to invest in the infrastructure and in the way the port is structured in the energy sense," she adds.

Port of Rotterdam and the province of Zuid-Holland can rely on a strong supporting cast: Air Liquide, Air Products, BP, Uniper, and Shell are all notable stakeholders here with the means and the incentives to commit to the transition. Meanwhile, new companies like Battolyser, a tech start up which recently secured €40m from the European Investment Bank, partly to help expand its production facility in Rotterdam, where it is aiming to manufacture its combined electricity storage and electrolyser system at a large scale.

Ultimately, Zuid Holland is superbly placed to take advantage of the opportunities offered by hydrogen. With an established industrial base and its strategic location at the heart of Europe, there is no doubt that Port of Rotterdam and the surrounding province will be key players in Europe's hydrogen scale up. What is important, as Baljeu notes, is to ensure the people are brought along on this journey and shown how they can benefit from this.

"The transition is needed, but a lot has to do with whether, in the end, it's embedded in the community. It's about making sure that our community understands the benefits of this transition," she concludes.

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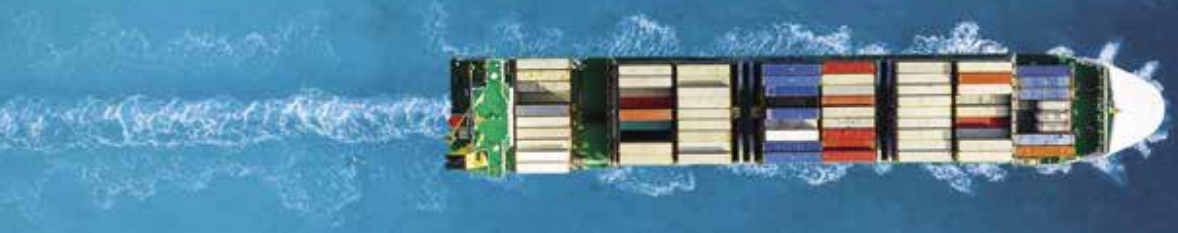

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How hydrogen can facilitate a just transition in developing countries

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On the path to net zero, green hydrogen (GH_2), an energy carrier produced by renewable powered electrolysis, is a game changer for hard-to-abate sectors such as steel, cement, the chemical industry, and heavy duty transport which cannot readily be electrified. It is currently the only sensible way we have to decarbonize these sectors.

In addition to its abatement benefits, UNIDO considers GH_2 as an opportunity for new industrial development pathways and skills upgrading. This is especially true for developing countries, many of which are well-positioned to be GH_2 producers due to their vast renewable energy potential.

However, as no mature GH_2 market currently exists, it will take a significant effort to ensure a just hydrogen transition in developing countries. Still, it is encouraging to know that an increasing number of countries are developing their national hydrogen, demonstrating that many countries are preparing to develop their local GH_2 industries and planning how best to benefit from the economic opportunities they provide.

THE JUST GH2 TRANSITION IN DEVELOPING COUNTRIES: A PATHWAY TO NET-ZERO INDUSTRIAL DEVELOPMENT

GH_2 provides developing countries with a viable option to achieve a just energy transition. Many such countries have high potential for GH_2 production, as they are often endowed with high renewable energy potential. On the path to net-zero industrialisation through GH_2, developing countries can unlock local benefits, including sustainable economic expansion, job growth, an increase in local skills and technical capacities and sustain a vibrant GH_2 export basket.

GH_2 can provide additional benefits to local communities. Because GH_2 is produced through electrolysis, it provides increased energy security in comparison to traditional fuels, which are dependent on geographically locked and hard-to-extract resources. GH_2 also has the potential to increase local food security, as green ammonia – a GH_2 derivative and an essential feedstock for fertilizer – can enable sustainable food production.

UNIDO SHAPING THE JUST HYDROGEN TRANSITION

Essential steps to increase global production and uptake of GH_2 include developing necessary policy and legal frameworks, coordinating international standards, and supporting research and development on GH_2 technologies. To address these needs, UNIDO launched its Global Programme for Green Hydrogen in Industry (GPHI) in July 2021.

The GPHI fosters GH_2 use to decarbonize industry and promote low-carbon industrial development around the world. Its activities include developing technical guidelines and standards, joint projects and promoting the adoption of innovative GH_2 financing schemes. Throughout, UNIDO collaborates with the public and private sector, financial organizations, and academia to ensure input from all stakeholders and along the GH_2 value chain.

BUILDING CAPACITIES FOR GH2 IN DEVELOPING COUNTRIES

Technical cooperation with developing countries to support an increase in production and uptake of GH_2 in industry is a major aspect of the GPHI. One major category of UNIDO interventions on this involves lending support to developing countries in the design and implementation of national industrial GH_2 strategies.

The GPHI is currently developing technical cooperation projects which aim to support increased hydrogen uptake in developing countries, on the path to net-zero industrial development. This includes the Global Clean Hydrogen Programme, which aims to provide technical cooperation to improve local GH_2 policy, financial, technical and knowledge capacities and to develop local pilot projects in several developing countries.

A UNIDO MODEL TO INCREASE GH2 UPTAKE IN DEVELOPING INDUSTRIES

GH_2 industrial clusters (GHIC)—which bring renewable electricity generation, GH_2 production and GH_2 up-takers physically closer together to increase inter-reliance—are a model developed by the GPHI. This model can be implemented to accelerate the GH_2 transition in developing countries.

GHICs promote sustainable industrial development in a just and equitable way, as they trigger benefits for local communities, such as job creation, improvement of local skills and education levels, sustainable economic growth and the de-risking of renewable energy investment.

Guidelines for GHIC implementation were launched this year (2023) by the GPHI to provide guidance for governments and industries for the preparation, implementation and upscaling of green hydrogen pilot projects within GHICs.

ON THE CUTTING EDGE: GH2 TECHNOLOGY RESEARCH AND DEVELOPMENT

Established through the GPHI, the International Hydrogen Energy Center (IHEC) is based in Beijing, and aims to build capacity, disseminate knowledge and advance research in the area of hydrogen.

A flagship programme of IHEC, the International Hydrogen Energy Metallurgy and Chemical Demonstration Zone in Inner Mongolia is the world's first comprehensive demonstration project on GH_2 production. The IHEC also recently implemented a pilot project on GH_2 for heavy duty transport, in partnership with Beijing Sinohytec. The pilot was the world's largest demonstration of hydrogen fuel cell commercial vehicles to date and took place during the 2022 Beijing Winter Olympics.

DEVELOPMENT OF INTERNATIONAL STANDARDS FOR GH_2

Robust standards are fundamental to international trade, safety, and sustainability of hydrogen in industry. Internationally recognized standards will enable developing countries to develop their domestic renewable energy resources to support and scale-up low-carbon hydrogen production and establish markets whilst achieving a clean energy transition. All aspects of hydrogen standards need to be addressed, including scope, key definitions, and content. This is essential as countries with hydrogen projects need to prepare required infrastructure in advance to assess the conformity of the process and product against such recognized international standards.

UNIDO, in cooperation with the International Organization for Standardization (ISO) is supporting the development of international standards and certification schemes to establish transparency within the hydrogen economy by hosting high level, strategic planning events (e.g. plenaries and webinars).

CREATING A MARKET FOR GH_2

To achieve net-zero, renewable hydrogen production must increase from 95 Mt H2equ in 2022 to 600 Mt H2equ by 2050. UNIDO recognizes that to achieve this objective, immediate action must be taken to massively scale up the hydrogen market.

The GPHI seeks to address this need by partnering with 13 countries and the European Commission on behalf of the European Union, to host the International Hydrogen Trade Forum (IHTF). The IHTF provides a platform for key players within the hydrogen market to engage in dialogue and knowledge exchange towards a common goal: to foster an enabling environment for the emergence of a vibrant global GH_2 market.

A DOUBLE SOLUTION FOR DEVELOPING ECONOMIES

GH_2 provides developing countries with a double-solution to the climate crisis: it can unlock local economic and social benefits, while also bringing the hardest-to-abate sectors of the economy to net zero.

Through its many initiatives related to technical cooperation, development of policies, standards and regulations, research and development, and market development, UNIDO aims to provide these solutions by cooperating with its partners to support the introduction and scale up of GH_2 in developing economies.

By the United Nations Industrial Development Organization

Forging a Path: Euro-Mediterranean Hydrogen Cooperation

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The Euro-Mediterranean energy landscape has undergone a significant transformation as a consequence of the Russian invasion of Ukraine in February 2022. The European Commission's publication of the REPowerEU plan has provided a clear roadmap, emphasizing the need to accelerate the energy transition and completely phase-out hydrocarbon imports from Russia by 2027. In this emerging geopolitical context, the Mediterranean Basin is expected to play a crucial role in diversifying both fossil and renewable energy sources, upgrading the previously overshadowed role of Euro-Mediterranean relations.

In the meantime, low-carbon hydrogen has gained substantial prominence in the EU's efforts to decarbonise, develop infrastructure, shape industrial policies, and enhance energy security since the release of the EU Hydrogen Strategy in July 2020. The EU aspires to establish itself as a global leader as a standard-setter, technology developer and hydrogen importer, while hydrogen is identified as a pivotal component in the Net Zero Industry Act. Simultaneously, there appears to be a heightened interest in renewable energy and the deployment of hydrogen in the Mediterranean basin. Given the world-class renewable resources of Mediterranean countries, this

renewed focus is driven by the opportunities associated with the production of hydrogen and the development of its technological and industrial value-chain.

If COP27 in Sharm-El-Sheikh saw the signing of the world's first bilateral hydrogen agreement between the EU and Egypt, it is likely that this model of cooperation will be extended at the upcoming COP28 in Dubai with other Mediterranean countries. For Spain, the Southern Neighbourhood and the Euro-Mediterranean space are strategic priorities in its foreign policy. Therefore, the Spanish Presidency of the Council of the EU during COP28 is presented as an additional opportunity to continue building a quality partnership on energy and climate.

LOW-CARBON INDUSTRIAL INTEGRATION IN THE MEDITERRANEAN

The implementation of a European Carbon Border Adjustment Mechanism (CBAM) from 2026, initially including iron and steel, fertilisers, cement, aluminium, electricity, and hydrogen creates incentives for an accelerated industrial decarbonisation in the Mediterranean. Hydrogen is a key input in CBAM covered goods, mainly fertilisers, hydrogen itself and- in the future- steel, serving as a potential catalyser of low-carbon industrial value-chains integration. Consequently, the European Commission is working on a Mediterranean Green Hydrogen Partnership between the EU and those Mediterranean countries seen as potential competitive producers of the molecule.

A Mediterranean Green Hydrogen Partnership offers a promising opportunity for the region and its sustainable economic development. The development of a Euro-Mediterranean hydrogen market should prioritise cost competitive decarbonisation that includes its use in the region's existing industries: fertilisers, petrochemicals, and metallurgy. The creation of a low-emission market associated with these products would further the EU's geo-economic decoupling from Russia. Despite the invasion of Ukraine, the EU currently sources a significant quantity of fertilizers, direct-reduced iron, and steel from Russia. These are products whose decarbonisation

is possible through renewable hydrogen and whose production could be partially offshored to Mediterranean countries. Following this green friend-shoring process, the EU could support the development of renewable hydrogen and its downstream dimension in the Mediterranean, complementing other proposals, such as the creation of a pipeline-based Trans-Mediterranean hydrogen backbone.

Developing low-carbon hydrogen in the Mediterranean presents an opportunity to also reduce greenhouse gas emissions in the shipping industry. The Suez Canal, a critical maritime passage, sees around 12% of global trade, 10% of international oil and gas transport, and 22% of container trade. Hydrogen based fuel projects, such as e-methanol, are emerging on both shores of the Mediterranean. The basin has been identified by the main shipping companies as a potential laboratory and bunkering hub for one of the most difficult tasks in the global energy transition: the decarbonisation of seaborne trade.

Such industrial partnerships require new innovative financing and advisory tools. The EU is already creating some of them with Global Gateway, aimed at energy and digital infrastructure development together with public-private collaboration. However, the development of Global Gateway has so far been disappointing, requiring a new approach that improves its governance mechanisms, demonstrates its impact on the development of recipient countries, reduces the ownership deficit on the part of local stakeholders, and substantially improves its communication and credibility.

LOW-CARBON HYDROGEN AT COP28

This COP28 seems like the right forum to start designing the future low-carbon Mediterranean hydrogen and the development of a decarbonised industrial market. Initiatives already presented, such as the creation of mutually recognised low-carbon hydrogen certification schemes, a new transnational alliance to reduce permitting or the potential success of new Hydrogen or Just Transition Energy Partnerships could serve as a catalyser for new investment flows and regulatory homogenisation in the Mediterranean. COP28 also seems a propitious setting to address the complex issue of carbon management and bring national oil companies (NOC) on board with the global decarbonisation ambitions. Mediterranean NOCs will be key players in the development of renewable and low-carbon hydrogen in the region and the EU should try to attract them to new initiatives that include building joint-ventures, mutual learning, and technology transfer.

The Mediterranean is clearly one of the candidates to benefit from the reconfiguration of trade flows resulting from decarbonisation and the geopolitical processes of de-globalisation and friend-shoring. Beyond renewable hydrogen production capacities, it requires strategies that involve the development of new low-carbon industrial value chains and the integration of downstream products through commerce. For the Mediterranean, cooperation paths that prioritise industrial domestic consumption appear more socially, economically, and environmentally sustainable than those oriented primarily towards exporting the hydrogen molecule. The EU should pursue an industrial development narrative associated with hydrogen that avoids replicating unidirectional fossil energy flows and the region's dependency on extractive industries.

Finally, it is important to manage expectations in a reasonable way, presenting low-carbon hydrogen as an energy vector with its opportunities and limitations. The EU and the Mediterranean have complementary hydrogen profiles that could favour a new strategic rapprochement between the two regions. However, this cooperation should be framed within the much broader scope of action of the European Green Deal, the energy transition, and the sustainable development of the Mediterranean region.

By Ignacio Urbasos, Energy Analyst at Elcano Royal Institute

Working with the Regions to drive forward the Hydrogen Economy in Europe

The Clean Hydrogen Partnership is supporting hydrogen valleys through different means incl funding. Covering the entire value chain, they aim to establish regional 'green' ecosystems covering hydrogen production, storage, distribution, and final use.

Clean Hydrogen Partnership

Hydrogen Valleys are regional ecosystems that link hydrogen production, transportation, and various end uses such as mobility or industrial feedstock The concept is to demonstrate how all the different parts of the production and use of hydrogen as an energy vector fit together in an integrated system approach. They are considered already as steppingstones to a hydrogen economy which contributes to Europe's climate and energy security goals.

Since 2014, Clean Hydrogen Partnership' and its predecessor FCH JU, has pursued the concept of hydrogen territories, which have then evolved into the more recent concept of Hydrogen Valleys. This concept has gained momentum and is now one of the main priorities of industry and the European Commission for testing such innovative business models for scaling-up hydrogen deployments and creating interconnected hydrogen ecosystems across Europe.

Hydrogen Valleys contribute also to the REPowerEU objectives by scaling up green hydrogen production, supply and consequently meeting the growing demand from industry, transport, and other sectors. Accordingly, the European Commission allocated to the Clean Hydrogen Partnership an additional €200 million through REPowerEU plan, to double the number of Hydrogen Valleys in Europe by 2025.

The Clean Hydrogen Partnership has recently selected nine valleys following its 2022 call for proposals and grants have been just signed. They include two cross-border hydrogen ecosystems: the North Adriatic hydrogen valley and a transnational Baltic Sea valley, each producing at least 5 000 tonnes of hydrogen/year. Seven smaller hydrogen valleys, producing at least 500 tonnes/year each, are based in countries only few hydrogen projects: Bulgaria, Greece, Ireland, Italy, Luxembourg, and Turkey. Moreover, four additional valleys have been selected under the 2023 call for proposals. These recently selected projects of 13 Valleys are expected to mobilise investments of around six times the funding provided by the EU of more than EUR 800 million.

In addition to the basic demonstration of how hydrogen technologies work in synergy between production and end-use, a Hydrogen Valley should also work complementary with (or reuse of) other elements such as renewable production, gas infrastructure, electricity and thermal grids, energy storage, etc. A key objective is to demonstrate the notion of "system efficiency and resilience": 'it is not only the energy efficiency of a single application that matters but the overall energy and economic efficiency and resilience of the integrated system'.

Sharing knowledge, providing expertise, and creating learning opportunities

In addition to the funding/grants, the Clean Hydrogen Partnership has launched in 2022 the second initiative (after its successful first one in 2021) of "Project Development Assistance for Regions" (PDA for Regions), to support 15 local authorities from across Europe' s cohesion countries, Outermost Regions and European islands to develop hydrogen projects. These regions are receiving dedicated support from a team of experienced hydrogen consultants, offering tailored support in detailed project planning and development towards implementation, based upon the region's local specific needs.

Finally, the Partnership is supporting the European Commission with a more global approach on Hydrogen Valleys under its international collaboration and it has set up a dedicated worldwide platform for Hydrogen Valleys for exchanges of best practices and matchmaking activities. To date, around 60 European hydrogen valleys at different stages of development are part of the Mission Innovation Hydrogen Valleys Platform (more than 80 Hydrogen Valleys currently under development around the world), and more are expected - and invited to join. Based on extensive collection of primary data from the projects, the platform provides comprehensive insights into the most advanced and ambitious Hydrogen Valleys around the globe.

Mirela Atanasiu, Executive Director a.i.
of the Clean Hydrogen Partnership

Safe and efficient H_2 routing from tanks to fuel cell or H_2 combustion engine

The reduction of carbon dioxide (CO_2) emissions has become more and more important for companies across various industries, particularly in the automotive and industrial sectors. The urgency of the issue for companies also stems from their need to comply with increasingly stringent environmental regulations. This means that CO_2 reduction becomes more than just a matter of corporate responsibility but of strategic necessity. Hydrogen has emerged as a key player in the transition to a sustainable energy future. When produced using renewable energy sources, hydrogen is a clean and versatile energy carrier that enables the decarbonising of various industries.

> **Hydrogen has emerged as a key player in the transition to a sustainable energy future**

The possibilities offered by hydrogen are many. This is not the only reason why the H2 market is forming at a rapid pace. Among the active players on this market are young companies as well as those with decades of history, such as Poppe + Potthoff. Founded in 1928 in Werther, Germany, Poppe + Potthoff initially specialized in the production of precision steel tubes. Over the years, the company diversified its product portfolio while maintaining its historic focus on precisely meeting the individual demands of each customer. This heritage of precision and customer centricity laid the foundation for Poppe + Potthoff's transition into the hydrogen market: By combining the expertise of 1600 employees at 9 locations, Poppe + Potthoff has historically been able to develop a technological leadership in the development and production of media-carrying components in the diesel sector over the past decades. By transferring this expertise of more than 600 million delivered parts, Poppe + Potthoff offers its customers the development and manufacture of modular hydrogen supply systems.

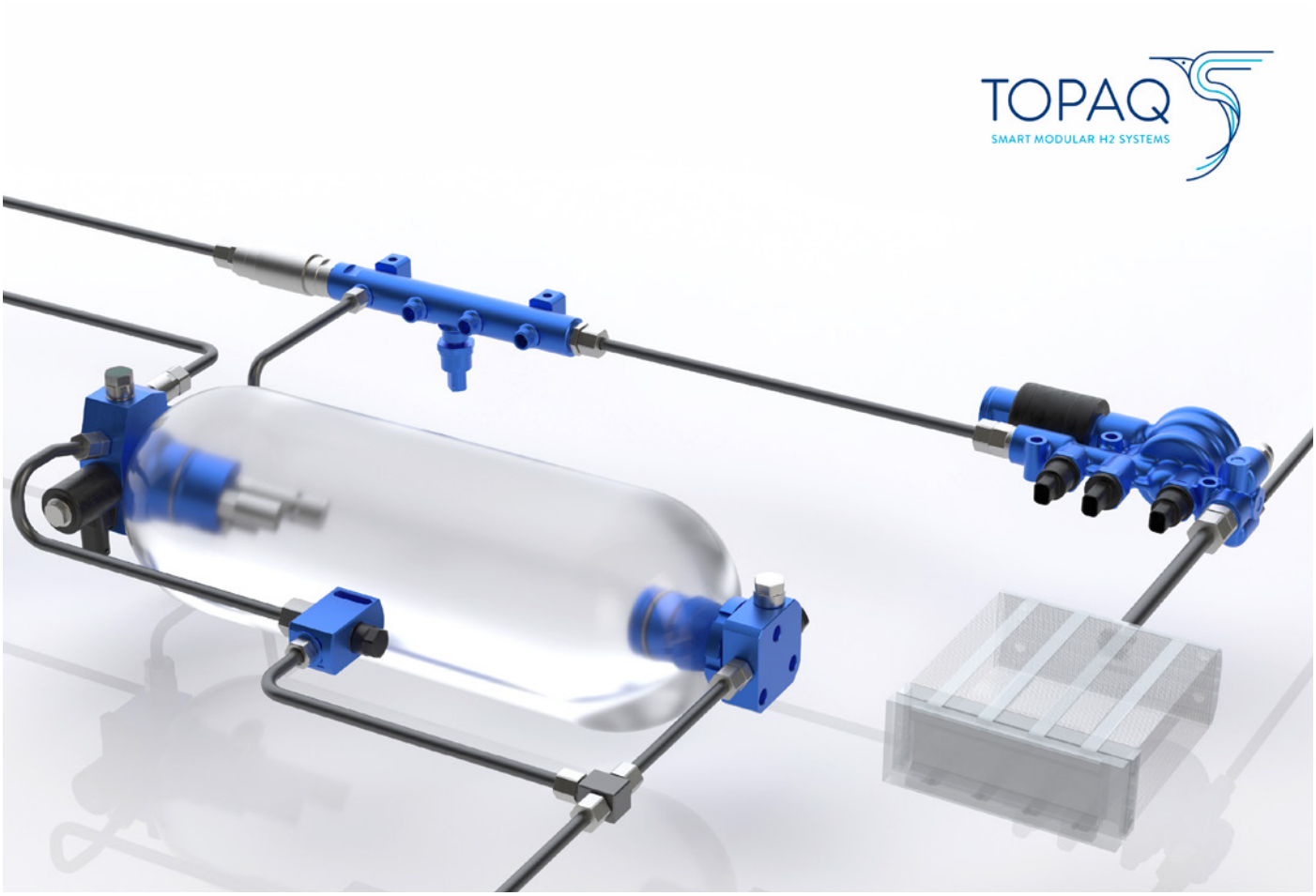
TOPAQ HYDROGEN SUPPLY SYSTEMS FROM A SINGLE SOURCE

These TOPAQ hydrogen supply systems from Poppe + Potthoff enable safe, reliable, and efficient routing of hydrogen from the tank to the fuel cell or hydrogen combustion engine. Using a holistic approach, the company designs all the core components of these systems by itself. Such components include On-Tank Valves (OTV), H2 pipes, Parallel Charging Units (PCU), High Pressure Regulation Units (HPRU), and Thermal Pressure Relief Devices (TPRD). While designing its systems, Poppe + Potthoff remains true to its principle of customer orientation and develops each of its systems precisely for the customers respective requirements. P+P thus offers modular and application-optimized TOPAQ system architectures – for use in both the mobile and industrial sectors. Thanks to these modular architectures, benefits that go beyond the pure product level are made possible.

A MATERIAL SPECIALLY DEVELOPED FOR HYDROGEN

Drawing on its traditional strengths in the fields of precision steel pipes, common rails, and pipes for diesel injection systems, Poppe + Potthoff has been able to use its material competence to develop a material specifically for pipes and rails in hydrogen applications: PPH2. Usually, components used in hydrogen applications are often manufactured from austenitic stainless steel. This solution, however, has disadvantages. For example, stainless steel has relatively low strength, so the components must be designed with greater wall thicknesses for higher pressure resistance. This increases their weight, with the higher material input leading to higher component costs. As an alternative material, PPH2 is an alloyed carbon steel with high mechanical properties, which are further enhanced by the innovative PPSH annealing treatment. These special properties allow the production of thinner-walled components (compared to stainless steel) and thus a reduction in weight while increasing the availability of hydrogen pipes and rails. PPH2 was already tested by TÜV Saarland/TÜV Rheinland in accordance with DIN EN ISO 11114 in 2021 and approved for use in hydrogen applications under EU Regulation (EC) No. 79/2009. With the successful testing according to ANSI/CSA CHMC 1-2014, a material compatibility test according to another set of regulations has been added. In a cooperation with the testing institute TÜV SÜD Chemie Service GmbH, Poppe + Potthoff was also able to have the material tested according to a newly developed testing methodology. The results of this test also confirm the successful outcome of the CHMC1 test. As a development partner for its customers, Poppe + Potthoff independently develops and produces components such as pipes or rails made of PPH2 for up to 700bar nominal pressure. Pipes, H2 rails (manifolds), and interfaces have successfully been certified in PPH2 by an independent testing institute according to EC79 and successfully tested according to the maximum requirements of HGV3.16.

PPH2 enables the production of thin-walled components, thus reducing material costs and CO2 emissions



Poppe + Potthoff develops and supplies all core components of the TOPAQ hydrogen supply system

TEST STANDS FOR HYDROGEN COMPONENTS

As a group of companies, Poppe + Potthoff brings together a wide range of competencies to form a network. In this way, the company offers its customers unique solutions in the H2 sector. One example of this is the in-house development and construction of test benches. These test stands can be used in research & development to constantly benchmark the manufacturing process and H2 component quality. Consequentially they are used to guarantee the safety of media-carrying components during their entire service life. Hence, components must undergo endurance tests under extreme pressure pulsations and temperature changes. P+P offers flexible solutions while simulating diverse conditions and environmental changes. Alongside pressure cycle test rigs, as well as burst- and leak test solutions, P+P also offers a state-of-the-art 1050 bar gas leak test system for hydrogen component development. The rig enables the use of nitrogen, helium, as well as a moulder gas hydrogen blend of 95/5. When using its test stands during development, the analysis of data gained during product testing allows for an optimization of hydrogen components and a shortening of development cycles.

As a development partner for sustainable technologies, Poppe + Potthoff's goal is to solve its customers' problems. This goal is achieved by networking competencies and partnering with young, innovative companies. In this way, Poppe + Potthoff creates an eco-system with which it supports its customers in the fields of sustainability and digitalization.

By Bastian Drexhage, Public Relations Manager at Poppe + Pothoff

TransHyDE-Project System Analysis

"Hydrogen Infrastructure – Facing the Challenges"

SIDE EVENT AT THE EUROPEAN HYDROGEN WEEK 2023

Hydrogen will make a crucial contribution to the decarbonization of European economies. In order to achieve the given goals, an ambitious ramp-up to establish hydrogen markets is necessary. On the one hand, hydrogen production capacities and import possibilities must be build up, and on the other hand, processes and technologies must be converted to hydrogen. Another requirement is the development of the necessary infrastructure. The TransHyDE-project System Analysis (one of ten projects within the TransHyDE technology platform, funded by the German Federal Ministry of Education and Research) is investigating, on the basis of various scenarios, how much hydrogen will be demanded in Europe until 2045, from which sources the demand could be satisfied and which hydrogen transport infrastructures will be needed. The main objective is to develop a roadmap that bundles the production potentials and requirements and presents possible expansion scenarios for a hydrogen infrastructure for the period up to 2045.

At this side event, we will present preliminary project results and invite you to discuss challenges and possible obstacles with us at internal and external expert presentations as well as a panel discussion.

Our side event consists of the following talk:

INTRODUCING THE TRANSHYDE-PROJECT SYSTEM ANALYSIS

The TransHyDE flagship project, which is funded by the German Federal Ministry of Education and Research, aims to develop a hydrogen transport infrastructure. It consists of four demonstrations projects and six research projects. One of them is the TransHyDE-Project System Analysis. Using two different approaches, TransHyDE-Sys investigates and derives future hydrogen infrastructures considering different transport options with a focus on hydrogen pipelines. In addition, TransHyDE-Sys brings results from all TransHyDE projects together an develops a roadmap for a reliable development of a European hydrogen economy.

FUTURE HYDROGEN DEMAND IN EUROPE AND IMPLICATIONS FOR INFRASTRUCTURE PLANNING

Climate-neutral hydrogen has the potential to significantly contribute to the decarbonization of energy demand sectors, such as industry, buildings, and transport. However, hydrogen is not the sole climate-neutral solution available and faces competition from other technologies, such as direct electrification, based on cost and efficiency. Consequently, there is a wide range of expectations regarding the future role of hydrogen, leading to significant uncertainty in infrastructure and energy system planning. In this presentation, we show our analysis of future hydrogen demands for Europe and Germany. Specifically, we focus on the rate of adoption of the individual technologies and the regional distribution across Europe, as these factors play a major role in determining the need for hydrogen transportation and production infrastructure.

MODELLING OF HYDROGEN TRANSPORT NETWORKS IN GERMANY AT THE CENTREPOINT OF EUROPE

Modelling of natural gas or hydrogen transportation systems requires that information from three different spheres has to brought together. In our project, we developed a complex toolchain of transport network simulation, which considers the scenario data layer, network topology layer and network simulation layer. On the basis of published project data in form of visual maps, we create different network topologies. In this presentation, we compare them with our TransHyDE-Sys scenarios and show our preliminary results.

ENTSO-G´S VIEW ON THE FUTURE DEVELOPMENT OF HYDROGEN INFRASTRUCTURE

In this side event, we will present our preliminary project results and have invited external speakers to give their views on future developments in energy infrastructure. In this presentation, ENTSO-G will share their perspective of future hydrogen infrastructures.

HYDROGEN STORAGES – CORNERSTONE FOR PROVIDING SECURITY OF SUPPLY IN THE HYDROGEN MARKET

Hydrogen storage units will play an important role in future energy systems. As part of the H2 infrastructure, they need to be considered at an early stage of the planning process. However, the geological potential in Europe is limited as not all natural gas storage facilities (caverns / pores) can be converted to hydrogen. In this presentation, we show the current status of the Bad Lauchstädt energy park project - a real laboratory for the energy transition. Here, the largest H2 storage facility with 50 million Nm^3 is being prepared and will be tested for H2 storage.

TRANS4IN – ENERGY TRANSFORMATION IN THE BAVARIAN CHEMICAL TRIANGLE

The chemical industry is facing a fundamental transformation. As major hubs of consumption, chemical parks will be playing a key role in shaping the energy infrastructure of the future. Which transformation strategy are the actors themselves pursuing and how does this change the consumption profile of such a chemical park? As part of the TransHyDE lead project, the Trans4In project has summarised the individual company strategies in the chemical triangle around Burghausen and Burgkirchen and translated them into two regional scenarios the “hydrogen path” and the “electricity path”. This transparently shows the development of energy consumption and the resulting infrastructure requirements from the perspective of local stakeholders. In this presentation, we use the example of the Bavarian Chemical Triangle to show how the regional energy demand develops depending on the scenarios and what requirements are placed on future infrastructures.

By TransHyDE

A brief look at the Polish hydrogen R&D scene

"Achieving climate neutrality in the EU is very difficult without a significant role for hydrogen. A prerequisite for the development of this market segment is the existence of an adequate amounts of cheap energy that can be used in the electrolysis process" - *Mapping the Future of Green* Hydrogen analysis[1] by Polish **CAKE - Centre for Climate and Energy Analyses**, an EU-funded research project.

Already in 2021, the **POLISH HYDROGEN STRATEGY** clearly indicated commitment to invest in the hydrogen economy as a key factor in achieving climate neutrality. This includes the development of low-emission H2 production capacities, enhancing storage and development of transport infrastructure, and promoting its adoption through hydrogen valleys.

A key tool for the implementation of the Polish Hydrogen Strategy is the **SECTORIAL DEAL** that now gathers almost **240** organizations from the public sector, business, NGOs, research, and academia. One of its 5 objectives is extensive R&D, and this is where we – the **NATIONAL CENTER FOR RESEARCH AND DEVELOPMENT (NCBR)**, as the largest Polish funding agency, fit. Other, equally important objectives, focus on the support of investments to aid in the creation of local content, support for the development of skills and cooperation which are required to make hydrogen economy happen.

[1] https://climatecake.ios.edu.pl/aktualnosci/news-viiew/mapping-the-future-of-green-hydrogen/?lang=en

Polish experts know exactly how to handle hydrogen as the country is the **EUROPE'S 3RD** and the World's 5TH largest producer of the gas. In 2022, Poland produced 1.3 million tons of H_2.

In parallel, Polish researchers published 83 papers on hydrogen, electrolysers and fuel cells in 2019 (7TH place in EU) and applied for 79 patents (H_2 and fuel cells, 6TH place).[2] This R&D landscape is fueled by regional, national and EU funding as well as business-driven initiatives.

In this context, a selection of projects and organisations will be featured at the European Hydrogen Week.

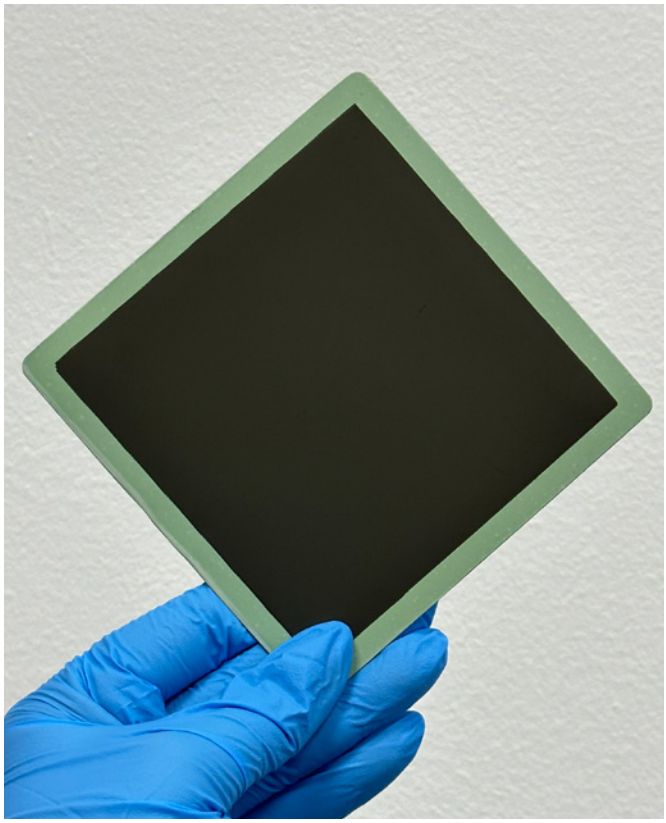
Polish researchers cover the entire value chain of hydrogen technologies, ranging from production technologies like the fabrication of **SOLID OXIDE CELLS (SOC) USING LOW-COST TECHNIQUES**, design and production of SOC stacks, construction and operation of fully-operational systems, including CHP and P2X units, but also hydrogen combustion, including design of burners for various applications. These are some of the works that the team of 60 reserchers at the Center for Hydrogen Technologies (CTH2) of the **INSTITUTE OF POWER ENGINEERING (IEN)** is focused on. IEn designed, built and tested the first rSOC-based installation (10 kW) integrated with the power plant (Hydrogin project) and under project VETNI designed and is currently constructing a 30 kW SOE system, which will be connected to a refinery. Currently, technology is scaled-up to multi-MW systems.

Another **HYDROGEN TECHNOLOGIES CENTER (HTC)** was recently set up at the **GDAŃSK UNIVERSITY OF TECHNOLOGY** where currently ca. 50 researchers focus on optimising chemical processes and materials engineering towards efficient energy conversion. They work on syngas production from waste streams, catalyst development for methanol/DME synthesis, electrical characterization of PEM fuel cells, materials development, and device characterization within the SOFC/SOEC technology. Endowed with local potential for the integration of wind, solar and hydrogen resources, HTC and the City of Gdańsk are well positioned to play a vital role in the future hydrogen economy in Poland.

[2] https://pie.net.pl/wp-content/uploads/2021/01/PIE-PP_Wodor.pdf

On a safety side, the **SILESIAN UNIVERSITY OF TECHNOLOGY** works on prototypes of room temperature hydrogen sensors (**HYDROSENS**/M-ERA.NET) that use conjugated polymers based on carbazole-derived repeat units as selective receptor layers. Their ability to operate at room temperatures makes them an energy-efficient and safe solution for application of H2 as a fuel.

Polish beneficiaries are engaged in many transport-related projects such as, for example, **STASHH** (H2020) that develops an open standard for heavy-duty fuel-cell modules with the objective of kickstarting the use of fuel cells and hydrogen in the heavy-duty mobility sector. Another project, **AMBER** (Horizon Europe), is developing a hybrid-electric fuel cell-based propulsion system for next-generation regional aircraft. There, the Polish Institute of Aviation – **LUKASIEWICZ RESEARCH NETWORK** - is a member of the consortium.



Solid Oxide Cell (SOC) manufactured at The Institute of Power Engineering.

The **AMBER HYDROGEN VALLEY**[3] by ORLEN S.A. is an R&I project example which aims to activate the long-lasting hydrogen economy in the Pomerania Region in Poland. It creates a whole hydrogen value chain, from its production, storage, and distribution to end-uses in mobility, industry and energy sectors with multi-actor involvement. In total Poland currently has **ELEVEN** hydrogen valley projects in the pipeline. Eight of these were initiated by The Industrial Development Agency JSC (ARP S.A.), which also manages the industrial parks and Special Economic Zones.

GREEN SKILLS FOR HYDROGEN[4] (ERASMUS+) or **H2 GLOBAL**[5] (COSME) constitute examples of Polish development of a green hydrogen value chain and skills in regions. Dedicated programs at various levels of education have been established. And in November 2023 Orlen S.A. selected a 2ND cohort of students to join their **H_2 ACADEMY**[6].

As the Polish National Contact Point for Horizon Europe we are proud to support participation of Polish beneficiaries in international R&I projects and we look forward to providing support for the future ones.

We invite you to join us during #EUH2week at the NCBR stand B43 (hall11).

By NCBR, Poland's National Center Research and Development

[3] https://h2v.eu/hydrogen-valleys/amber-hydrogen-valley

[4] https://greenskillsforhydrogen.eu/

[5] https://h2globalcluster.eu/

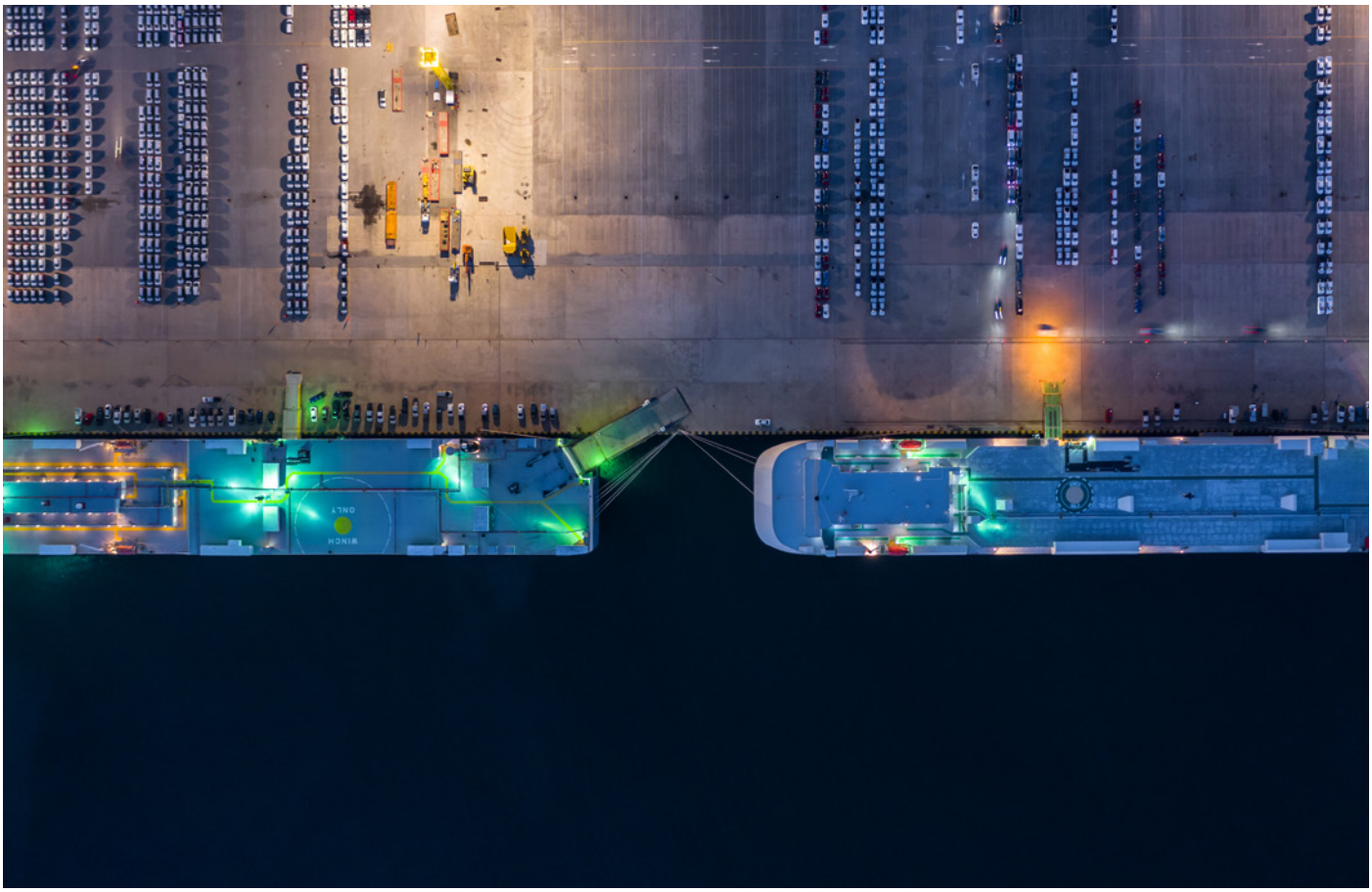
[6] https://akademiah2.pl/

Hydrogen and fuel cell solutions for Hydrogen Valleys

Faced with escalating climate change and increasing air pollution, many cities and regions have adopted ambitious plans to meet net zero targets by introducing clean technologies across several transport, energy and industrial sectors, while generating additional economic and employment opportunities.

One of the initiatives that is leading the transition towards zero emissions is the Hydrogen Valleys. Led by the Clean Hydrogen Partnership, Hydrogen Valleys is defined as a geographic area that clusters multiple sectors across the complete hydrogen value chain and thus has a huge potential in scaling up the local hydrogen economy.

However, a successful delivery of a Hydrogen Valley eco-system requires strong collaboration between multiple stakeholder groups. Therefore, a Hydrogen Valley calls for a dynamic and diverse industry network with expertise and skills within hydrogen supply and infrastructure, project development, service and maintenance, financing and the regulatory framework.



Ballard - A Proven Partner

Addressing the decarbonization challenge, Ballard Power Systems delivers fuel cell power for public and heavy-duty transport including buses, trains, trucks,

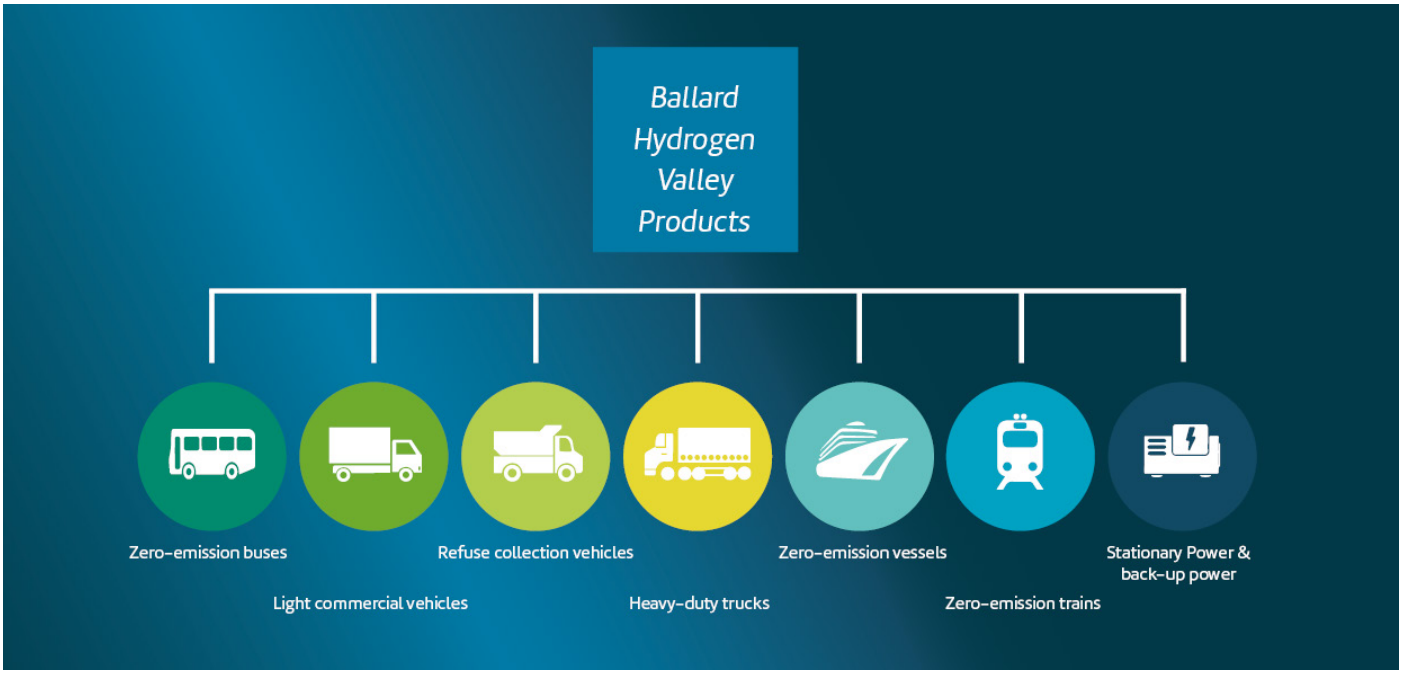
ferries and stationary power applications. Our strong European footprint includes established product development, manufacturing and service facilities in Denmark with supporting locations in Germany, UK and Norway, employing over 250 staff.

Ballard is involved in current and upcoming Hydrogen Valley projects offering proven experience in navigating the hydrogen landscape and bringing fuel cell expertise and experience to key sectors. This ensures long term, viable solutions that can realize the full green and economic potential of the Valleys and their communities.

Today, Ballard is the fuel cell partner in two key Valley projects, BalticSeaH2 and Crave H2, in Southern and Northern Europe. In these projects Ballard supports regions, cities, operators and government bodies in the application of hydrogen fuel cell technology.

Powering the green transition

Ballard's fuel cell products are designed to deliver superior performance at reduced operating cost, and its proven experience in hydrogen power offers implementation-ready solutions for a wide range of applications - Ballard's fuel cell modules are now powering vehicles and vessels worldwide.



Ballard's heavy-duty fuel cell technology is purpose-built to perform in demanding applications, and challenging conditions, and they are manufactured to meet stringent and specific industry standards across global market segments.

Recording over 150 million kilometers of on-road fleet experience for heavy-duty vehicles worldwide, hydrogen fuel cell busses powered by Ballard now operate in more than 25 cities across Europe."

Ballard provides comprehensive expertise and assistance to ensure successful synergies and collaboration for partners looking to transition to a zero-emission platform that can effectively decarbonize heavy-duty vehicles, fleets and infrastructure.

To learn more about how Ballard partners with Hydrogen Valleys to deliver zero-emission solutions, please visit: info.ballard.com/hydrogenvalley

By Ballard

Large-scale plant for industrial hydrogen projects

Demand for large-scale hydrogen projects from the industrial sector is increasing rapidly.

The MHP electrolyser (Modular Hydrogen Platform) from H-TEC SYSTEMS is suitable for large-scale industrial projects with a capacity of 10 MW or more.

To meet their 2030 greenhouse gas emission targets, companies from energy-intensive industries need to rapidly reduce their carbon footprint. One of the most promising technologies to achieve this is green hydrogen. With the Modular Hydrogen Platform (MHP), H-TEC SYSTEMS, specialist in PEM electrolysis plants, introduces a scalable system specifically designed for large-scale hydrogen projects of 10 MW or more and for the industrial production of green hydrogen. The MHP consists of standardized PEM electrolysis blocks with an electrolysis capacity of 10 MW each, which can be combined as required to form multi-megawatt plants with an electrolysis capacity of 100 MW and more.

APPLICATIONS FOR GREEN HYDROGEN ARE INCREASING

There are numerous practical examples of successful green hydrogen use, such as for heating the furnaces in steel, cement or glass production. In many industries, green hydrogen also serves as a climate-friendly raw material. When hydrogen (H2) and carbon monoxide (CO) are mixed, a high-quality synthesis gas is produced from which chemical constituents for chemicals, polymers or synthetic fuels can be manufactured. In the petrochemical industry, green hydrogen serves as a raw material for synthetic fuels ("power-to-liquid"). With the help of renewable energy and the addition of CO2, the hydrogen is converted into synthesis gas. In a further step, the gas is converted into hydrocarbons. These e-fuels can be used as a climate-neutral substitute for fossil fuels (diesel, petrol, paraffin, etc.) in commercial vehicles, aircraft, and ships.

ENABLING NEAR-SITE PRODUCTION PROCESSES

With the increasing number of application fields, a key question is where industrial companies can source hydrogen as climate-neutrally and economically as possible. In addition to external supply, where hydrogen is transported via pipelines, the existing gas grid infrastructure or by truck, on-site hydrogen production is considered particularly advantageous.

On-site hydrogen production and storage is a decisive step towards energy self-sufficiency. When produced with 100% renewable electricity, green hydrogen makes an important contribution to reducing CO2 emissions. European Union aims to reduce CO2 emissions by 95% by 2050. This goal cannot be achieved with "blue" or "gray" hydrogen produced with fossil fuels.

As a proven process and leading technology to produce green hydrogen, PEM electrolysis is well established and suitable for industrial use. The technology offers numerous advantages over other electrolysis processes. The production of green hydrogen by means of PEM electrolysis can be operated in dynamic partial load range, i.e. it can compensate for load fluctuations of renewable energies. PEM electrolysis plants are therefore ideal for balancing power peaks in the supply grid.

FUELING THE ENERGY TRANSITION

An MHP unit with an electrical output of 10MW produces approx. 4,600 kilograms of highly pure hydrogen per day. In the strategic conceptual design of the Modular Hydrogen Platform, particular focus was placed on efficiency and availability. H-TEC SYSTEMS is a leading manufacturer of PEM electrolysers for many years and, as a subsidiary of MAN Energy Solutions, also brings experience and know-how in the industrial-scale plant market. In addition, the manufacturer assures its customers high plant availability over the entire life cycle through comprehensive service offerings.

A MODULAR SOLUTION THAT SIMPLIFIES SCALE-UP

The highly standardized 10 MW blocks of MHP rely on the proven S450 stack technology of H-TEC SYSTEMS. The MHP electrolysers are designed for particularly easy indoor installation on pre-assembled skids. Each 10 MW block is equipped with integrated process water treatment and power supply. In addition, the system can be supplemented with fresh water and hydrogen treatment as well as process heat recovery or oxygen utilization as required.

Among the most important features of the modular platform is the high system efficiency of the MHP electrolysers of 77 percent at 30 bar pressure, significantly above the usual values. The modular design also ensures high reliability of the electrolysis plants. Independent controls at stack cascade level enable quick and easy replacement of individual stacks.

REDUNDANCY CONCEPT FOR HIGH RELIABILITY

In addition to efficiency, the system availability of an electrolyser plays a central role for industrial use. This is ensured by a special redundancy concept. During maintenance or inspections of the 10 MW unit, a defined part of the system can be shut down while the rest of the electrolyser continues to run. This concept allows the plants to reach almost full output even in the event of a fault. The interplay of high system efficiency, high availability and the proven maintenance concept guarantees stable operation and particularly low hydrogen production costs.

By H-Tec Systems

CONTACT: H-TEC SYSTEMS GmbH www.h-tec.com

Hydrogen storage is key for the required flexibility of a decarbonised energy system

© Hydrogen Europe

Why hydrogen storage?

The integration of hydrogen into the wider energy system cannot be understood without storage. Hydrogen is the key enabler of sector coupling, which consists in linking the power, transport, and industrial sectors to create an integrated, and unified system. Energy storage is going to play an essential role in providing the balancing and flexibility needs in this new integrated energy scheme that will be dominated by variable renewable energy sources.

Hydrogen storage has multiple functions as it can:

1 Support the transition of energy intensive industry: Hydrogen storage is crucial for the greening of industrial processes, ensuring a consistent and on-demand supply of clean hydrogen feedstock for various manufacturing operations such as in steel, ammonia, and chemical processes. Also, it can provide heating power to heat-intensive industries such as cement, iron, and aluminium industries, which require very high temperatures not easily achievable with electrification.

2 Strengthen renewable energy integration in the power sector and price stability: Storage plays a pivotal role in optimising the use of renewable power, both when it is in excess (through electrolysers, avoiding costly curtailments), and when it is insufficient, all the while providing generation adequacy to systems highly dependent on variable renewables. Green hydrogen, produced with cheaper and more abundant renewables in summer, can be stored and it can cover the increase in demand experienced in winter when there is less solar energy and electricity is more expensive – procuring more affordable prices and helping to balance the inter-seasonal variability of the power sector that is enhanced as more variable renewable energy sources (VRES) are deployed in the system.

3 Enhance energy security in the power sector: A robust hydrogen storage system provides a safety buffer against lack of VRES production and supply disruptions due to weather patterns, e.g., extreme weather events such as very cold waves, unforeseen unforeseen outages, natural disasters, trade conflicts, and other external events, thereby mitigating the risks of price volatility.

“A robust hydrogen storage system provides a safety buffer against lack of VRES production and supply disruptions due to weather patterns

How can we store hydrogen?

Hydrogen can be stored in multiple ways, each of them presenting advantages and disadvantages. As pressurised gas or liquid form, on the surface of or within solid and liquid materials. It can be turned into various carriers to be then converted back into hydrogen. The options are multiple, and each choice entails trade-offs between some of the key technical parameters as well as the objective at hand, all of those options greatly covered and explored by scientific literature.

For long-term season storage at large scale, hydrogen can be stored in geological (underground) formations such as salt caverns, aquifers, depleted gas fields and rock caverns. As of today, storing hydrogen in salt caverns is the most effective, proven method and the one with the highest technology readiness level (TRL). Its feasibility has been showcased in the US (Texas) and UK (Teeside) where hydrogen feedstocks of 50–100 million m3 (125–250 GWh) have been safely stored since the 1970s. Salt caverns used as hydrogen storage provide versatile operation, undergoing multiple cycles annually, termed as fast-cycling operation. Currently, the hydrogen industry is working on better understanding the resilience of salt caverns under fast cycling conditions since hydrogen from electrolysis, as well as the future power system will require greater flexibility. Still, salt caverns are not proportionally distributed across Europe, with high concentration in Northwestern Europe and in the North Sea. They also require the necessary pipeline infrastructure to connect to demand centres. Therefore, **THE COORDINATION ON BUILDING HYDROGEN GENERATION, TRANSPORT INFRASTRUCTURE AND STORAGE SOLUTIONS IS OF PARAMOUNT IMPORTANCE.**

How much storage do we need?

Out of the 3 main applications presented above, the support to the energy intensive industry is the one that requires hydrogen storage in the short term. Many of these industries need a steady supply of hydrogen since they are working on a 24/7 basis. In addition, their operation requires a stored buffer, not only to provide enough green hydrogen when there is lack of supply, but also to stabilise prices and reduce the risks of lack of supply. Meeting the hourly correlation requirement of the Renewable Energy Directive will significantly increase storage needs and thus the industry would benefit greatly from access to common large storage infrastructure.

However, the flexibility needs from the power sector will require the largest amount of stored energy. A recent study commissioned by the European Commission concluded that these flexibility demand will double in 2030 from 2021 levels[1], indicating the huge need to focus investments in this area.

Flexibility needs can be categorised based on the timeframe. They are hourly, daily, monthly, and inter-seasonal. Monthly flexibility is needed to cope with inter seasonal variations and the reduced availability of wind and solar during long periods. Such meteorological events, known in Germany as “dunkelflaute”, are periods of low wind and solar production for over 24 consecutive hours, combined with low temperatures. There is an average of 50 – 100 hours of “dunkelflaute” conditions in Northern countries happening every December, January, and February, and in some cases, they can last up to 8 days.

Even though there is a substantial loss of efficiency in the conversion from RES to hydrogen and then from hydrogen to electricity again (the so-called “round trip efficiency loss”), **IF WE WANT TO AVOID FIRING UP GAS AND COAL PLANTS IN PERIODS WHEN VRES ARE MISSING, HAVING A STRATEGICAL HYDROGEN RESERVE IN THOSE AREAS WITHOUT HYDROPOWER COULD OFFER A VALUABLE TRADE-OFF.** Loss of efficiency would be compensated by avoided GHG emissions and air pollution stemming from the conventional fossil fuelled baseload. This is even truer if the additionality principle is respected and energy surpluses from curtailments are used and stored for this purpose.

Monthly flexibility needs have been estimated to grow by a factor of 3 by 2050. For instance, while Germany sees the largest absolute number, France undergoes the most significant increase in those needs - between 2030 and 2050, with an added flexibility demand of 53 TWh. In total, about 500 TWh of energy will have to be stored to meet monthly flexibility needs. Part of that monthly flexibility will be covered by hydropower. Yet hydropower is not accessible everywhere and climate change is already affecting its availability. Many countries will then depend on access to a common hydrogen network and large underground storage facilities to cover their flexibility needs in the power sector and avoid their reliance on fossil fuels to compensate for the lack of renewable energy supply.

[1] The EU flexibility requirements in 2021 were estimated at 11% of the total electricity demand, while they will grow to 24% in 2030 and to 30% in 2050. Source: Flexibility requirements and the role of storage in future European power systems, November 2022, JRC , European Commission https://publications.jrc.ec.europa.eu/repository/handle/JRC130519.

Are we on track?

No. Whichever way you look at it, the difference between the estimated hydrogen storage needs and the planned projects is mind-blowing. Some studies have calculated a need to have around 70TWh of hydrogen storage by 2030, but these studies were carried out before REPowerEU so the hydrogen storage target could potentially even be larger. Even with it being a very optimistic target, the reality is that only 6 TWh of projects are planned in Europe for 2030. It is unlikely they will all get the necessary funding and approval process in place to be commissioned within the next 7 years.

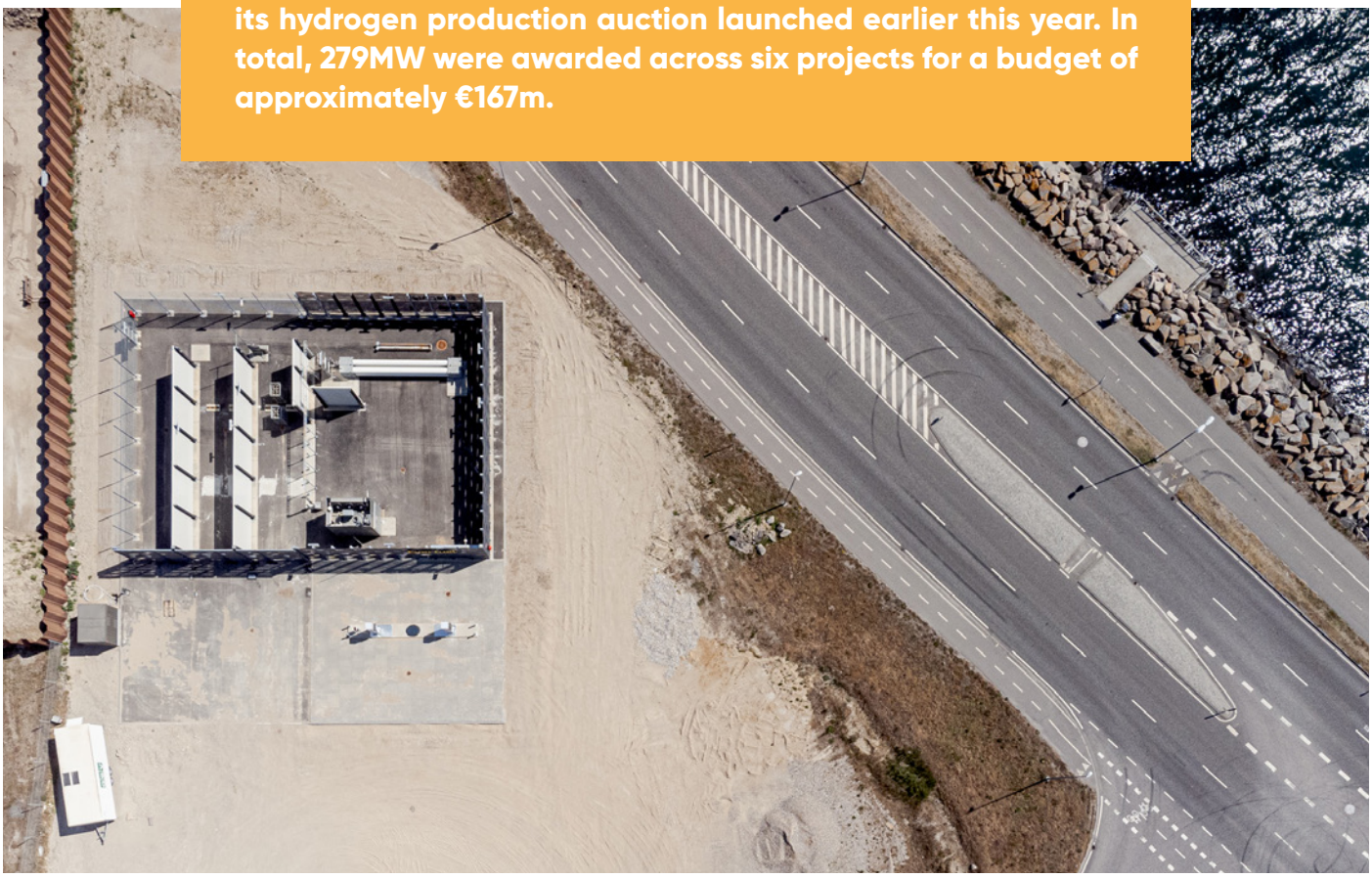
This is why we need to drive the focus of policy makers, industry and investors into this area. A lot more of projects must be developed - and quickly. Otherwise, Europe's security of supply, RES targets compliance and price stability could be potentially compromised. Strong support should come from EU and national funding sources, but most importantly, we must accelerate the build out of hydrogen pipelines so that demand, generation, and storage site can be effectively interconnected. To optimize the process of energy system integration, it is crucial to utilise all available energy vectors, diversify green technologies and energy sources, and strategically develop infrastructure by both leveraging existing assets and planning for necessary expansions and interconnections. This must indeed translate into the right of dimensioning of hydrogen storage along with the strategic coordinated planning of various energy infrastructures.

If you are interested in this topic, watch out for Hydrogen Europe's upcoming report on the topic of infrastructure, where storage features as a one of the 3 key infrastructure pillars, along with transport and import. If you would like to get involved and contribute to the conversation, join Hydrogen Europe's Energy & Infrastructure Working Group!

By Daniel Fraile, Chief Policy Officer and Isabel Alcalde, Officer, Energy & Infrastructure Policy, Hydrogen Europe.

Danish hydrogen auction offers lessons to rest of Europe

Last week the Danish government announced the winners of its hydrogen production auction launched earlier this year. In total, 279MW were awarded across six projects for a budget of approximately €167m.



The auction was offering a premium for 10 years for a maximum (ceiling price) of €2 per kg in order to produced Renewable Fuels of non-biological origins (RFNBOs, as defined by the Renewable Energy Directive). But projects were able to compete with much smaller levels of support. All the winning bids were below the €1.2/kg threshold, with the most competitive project asking for a premium of just €0.15/kg. The Danish energy agency received a lot of interest for this auction, with over 675MW of projects participating in the auction.

With the European Hydrogen Bank's first auction coming up in November, many will be speculating what prices and premium we might see. The hydrogen bank is offering €800m among at least three projects with a celling price of €4.5/kg. The Danish market provides hope that the European bank will deliver projects well below the celling price.

But how could developers in Denmark manage to be so competitive? There are three reasons to be positive here.

First, it is important to understand the date by which those projects must be commissioned, 2027. By that year, both bidding zones in Denmark are expected to have over 90% renewable electricity share in the grid, meaning that hydrogen producers are not subjected to temporal correlation nor additionality (as per the rules under the Renewable Energy Directive). Hydrogen producers will be allowed to produce RFNBOS over 90% of the year and will be able to prove compliance just with electricity guarantees of origin. This is a key aspect for the production of competitive renewable hydrogen. Other regions in Europe such as north Sweden and Norway already benefit from these conditions.

Second, Energinet is planning to build the West Danish backbone, which will connect Denmark's Bidding Zone 1 (DK1) with Germany before 2028. And this is exactly where the winning projects will be located. This allows hydrogen producers to access a larger pool of hydrogen offtakers in Germany who are also expecting a connection to the backbone around the same date. This shows the importance of having good visibility and certainty on future infrastructure.

Third, there are no special limitations with regards to state-aid (contrary to the Hydrogen Bank). The Danish hydrogen producing projects will be able to sell their hydrogen to offtakers in Germany regardless of whether these companies are also receiving state support to enable their use of renewable hydrogen (in the form of IPCEIs, Innovation Fund or other schemes). This can be done as long as there are no double subsidies for the same investment items. This drastically simplifies the setting of projects and the identification of future offtakers.

Denmark has taken advantage of its geography and its success in cleaning up its grid to offer hydrogen producers a competitive and attractive proposition. This well structured auction should light the path ahead for other European member states as they work to build up their hydrogen infrastructure.

By Daniel Fraile, Chief Policy Officer, Hydrogen Europe

Matching supply and demand to ramp up the hydrogen market

Supporting the hydrogen market: a first focus on production

Meeting the investment needs of Europe's developing hydrogen sector is a critical imperative for the region's transition to a sustainable and low-carbon energy landscape. The growth of clean hydrogen production projects is advancing rapidly, yet only 4% of the total potential output has progressed to final investment decision (FID), due to a high green premium, the lack of infrastructure and demand uncertainty.

To tackle this challenge, the United States and Europe have recently accelerated their efforts to promote clean hydrogen production. Considerable public funding is being committed through initiatives such as the US Hydrogen Production Tax Credit under the Inflation Reduction Act (US IRA), where producers receive a tax credit up to $3 dollars per kilo of hydrogen produced based on projects' lifecycle greenhouse gas (GHG) emission intensity. In March, the European Commission launched the European Hydrogen Bank domestic pillar, which will support production with a fixed premium up to €4,5 per kilogram of hydrogen, covering the cost gap between renewable and fossil-fuel-based hydrogen over a period of ten years. Funding will be provided through the first €800 million pilot competitive auction under the revised Innovation Fund, on 23 November.

At Member State level, the landscape of supply-side schemes involves different approaches on implementation and flexibility. The Netherlands has been managing the Stimulation of Sustainable Energy Production and Climate Transition (now SDE++) program since 2018, a scheme covering the difference between the cost of CO2 reducing technologies and the market value of the generated product. For 2023, the €8 billion SDE++ will ringfence a minimum of €750 million to produce "molecules" such as renewable hydrogen, advanced renewable fuels and biomethane. In Denmark, the government launched a €170 million scheme in 2023 to support the upscaling of the production of renewable hydrogen and derivatives, such as renewables-based ammonia, methanol, and e-kerosene, using PtX technologies. Support will be provided through a fixed premium, determined through a competitive bidding process. In early September, France launched the public consultation for its €4.2 billion scheme supporting hydrogen production, focusing not solely on renewable but also clean hydrogen. The auction scheme should use contracts for difference or a similar mechanism to cover some or the whole price gap between fossil fuel hydrogen and clean hydrogen production, for a duration of ten years.

GIVEN THE URGENT NEED FOR DECARBONISATION AND THE EXTENSIVE INVESTMENT CYCLE OF HYDROGEN PROJECTS, THE MOST RECENT SUPPORT SCHEMES HAVE BEEN DESIGNED TO BE SIMPLER, TARGETED AND SWIFTLY IMPLEMENTED TO ACCELERATE DEPLOYMENT OF CLEAN HYDROGEN AT SCALE.

The chicken and egg challenge: the critical need to support demand

The recently approved RED III targets for renewable hydrogen consumption in industry (42%) and transport (1%) by 2030 are expected to stimulate demand for the molecule and derivatives in the next years, and to increase focus on demand-side policy instruments.

The biggest challenge for hydrogen projects to reach FID is establishing durable, creditworthy offtake agreements. Indeed, the rapid reduction in clean energy technology costs can discourage off takers from committing to long-term contracts with developers, hindering contract formation between buyers and sellers. This maintains high investment risk on large scale production projects, ultimately inhibiting cost reduction. Demand visibility is hence critical to sufficiently mitigate risks for private finance institutions, especially project finance providers. Meanwhile, designing efficient demand-side support schemes is not without its challenges. Hydrogen producers are worried that offering subsidies to off takers might not be the most efficient approach. They fear that the demand for hydrogen from these buyers could decrease, or that they might opt for alternative decarbonisation methods, reducing the impact of public support to scale the clean hydrogen market. Additionally, ensuring demand side auctions competitiveness where market demand is concentrated to a few existing uses is complex.

New approaches to demand side support

Germany is leading two main schemes which will support demand for hydrogen in the country. First, in June, the German government launched a double digit billion euros CCfD package to decarbonise energy-intensive industries. Projects using cleaner hydrogen as a feedstock or as a transformative production process will be supported by so-called “climate protection agreements” for a period of 15 years to cover their additional investment and operational costs. Secondly, the German H2Global program, a leading instrument supporting hydrogen imports to Europe, is currently implementing its first €900 million auction on green ammonia, green methanol and SAFs. Part of a total €4.5 billion commitment from BMWK, H2Global is tackling the above-mentioned contract formation challenge by offering ten years supply contracts to producers while granting flexibility to buyers through one-year sales agreements.

Finally, France is also developing non-budgetary tools such as sub-mandates (i.e., RNFBO and derivatives targets for specific end-uses) to give predictability to industry and investors, as well as taxes functioning as incentive for end-use sectors to increase their demand for hydrogen.

Innovative systemic approaches to support supply and demand in a coordinated way

Coordinating supply and demand-side schemes is essential to ensure that support is complementary and efficient. The EU and the US are currently finalising their strategies to jointly stimulate supply and demand, each with its own approach.

The US approach: clean hydrogen hubs

More recently, the US announced a $7 billion package to support 7 Regional Clean Hydrogen Hubs (H2Hubs) selected across the country, as part of a broader $8 billion Hydrogen Hub Program funded under the Bipartisan Infrastructure Law (BIL). The Clean Hydrogen Hubs are expected to create hydrogen ecosystems connecting producers, consumers, and local infrastructure to accelerate reaching end-use sectors such as for instance steel, cement, and transport, although the BIL includes requirements on end-use diversity as well. Flexibility has been applied on the hydrogen production routes, with several hubs covering more than one production technology. Indeed, five hubs cover renewable hydrogen, four CCUS and two nuclear powered production.

The remaining $1 billion in funding will support a foreseen demand-side initiative, with measures under consideration being pay-for-difference contracts supporting projects based on market price these can achieve, fixed support to projects stacking on top of source revenue sources, market-maker tools to reconnect purchaser and seller expectations, or support to feasibility studies on potential off takers near the H2Hubs. Through the Clean Hydrogen Hubs approach, the US therefore seeks to address the need for bankable demand for hydrogen and provide a signal for market certainty, thereby improving the financeable structure of projects for these to reach FID.

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The EU approach: IPCEI framework and the centralised Hydrogen Bank model, comprehensive tools for market ramp up

In Europe, the Important Projects of Common European Interest (IPCEI) framework allowed Member States to support spearheading projects and applications for production and usage of hydrogen and derivatives. The IPCEI Hy2Tech wave, approved in July 2022, covers hydrogen production, fuel cells, storage, transport, and distribution, as well as the development of hydrogen products for end users, especially the mobility sector. It was followed in September 2022 by the approved Hy2Use wave, supporting large-scale electrolysers and transport infrastructure for production, storage, and transport, alongside technologies to integrate hydrogen into hard-to-abate industrial processes such as steel, cement, and glass. However, IPCEI frameworks need to tackle several shortfalls, including the restriction to R&D and infrastructure support, a lack of transparency in the selection and wave design process and the delay in Member States disbursing the grants.

At EU level, the Commission is relying on the Hydrogen Bank to become the main instrument to set up a fully functional clean hydrogen market and value chain. If the domestic leg, as mentioned previously, is set and ready to deploy production support, the announced international leg model is still uncertain. The H2Global mechanism has been highlighted as a potential tool to inspire this second leg.

Nevertheless, as discussed in this article, a Hydrogen Bank comprehensive approach, focusing on a more flexible production-consumption complementary schemes strategy could maximise its impact. The Bank's second pillar should therefore promote demand-side auctions, while including both imports and intra-EU trade, further supporting the creation of a European hydrogen market. Finally, demand-side auctions under the Bank should address the need to support infrastructure to transport and store hydrogen which is critically needed for long-term offtake agreements.

The Bank's "demand" leg could therefore widen H2Global's scope from derivatives to hydrogen, covering high-priority industrial sectors with binding obligations under REDIII. Non-binding auctions could serve to set infrastructure needs around strategical geographical locations. By connecting both intra and extra-EU oversupply with EU overdemand areas, collecting price indications by both suppliers and consumers would help define a price index for effective future off taker schemes. Thereafter, a second binding auction could be launched based on these parameters, providing clarity for grid development.

Simple and quickly executed supply schemes are now in place for clean hydrogen production. In the meantime, public focus is shifting gradually towards demand, in the view of identifying price signals and accelerating the adoption of decarbonisation technologies. Ramping up the hydrogen market significantly requires a coordinated stimulus to supply and demand. In this regard, the US and the EU have adopted distinct approaches. The US leans on strategic hubs to demonstrate large-scale projects, while the EU will use a centralised tool in the form of the Hydrogen Bank to facilitate the connection between supply and demand centres.

By Marie Espitalier-Noël, Manager, Funding & Market, Hydrogen Europe

Clean Hydrogen Monitor 2023

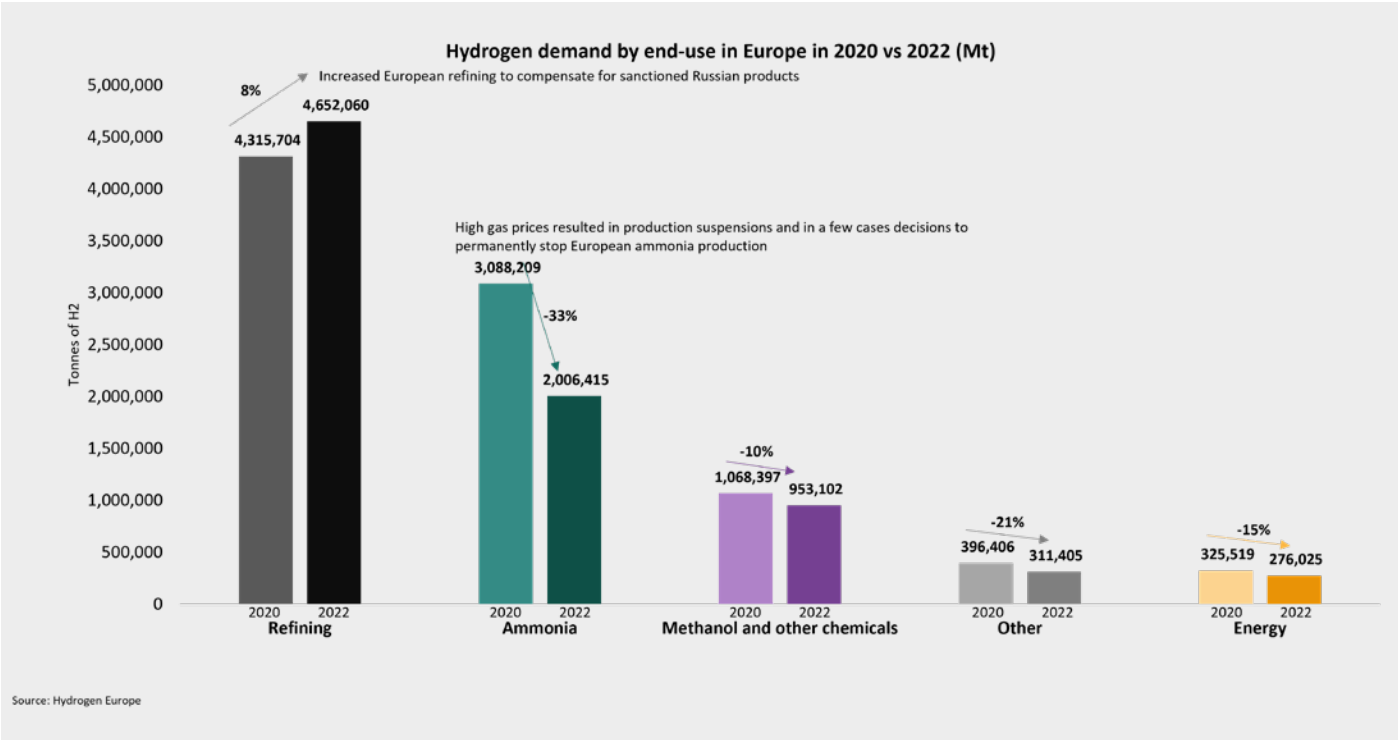
The Clean Hydrogen Monitor is published by Hydrogen Europe every year and presents quantitative and qualitative indicators that track the state of play of the emergence of the clean hydrogen market in Europe.

The Clean Hydrogen Monitor is published by Hydrogen Europe every year and presents quantitative and qualitative indicators that track the state of play of the emergence of the clean hydrogen market in Europe. The 2023 edition provides an updated assessment of current hydrogen production capacity and demand, addresses European policy developments, evaluates the funding and financing landscape, estimates production costs, sheds light on announced clean hydrogen production and consumption projects, and for the first time provides an assessment of hydrogen in selected mobility applications.

Clean hydrogen and its derivatives are indispensable to decarbonising our economies and reaching Net Zero by 2050. To achieve the continent's ambitious climate targets, Europe's clean hydrogen market needs to emerge to replace current fossil hydrogen consumption in refining, ammonia, methanol, chemicals, and supply new end-uses including steel, mobility, industrial heating, power generation, and seasonal storage. The flurry of announcements and debates around clean hydrogen in the last five years has been mostly driven by policy discussions ranging from the European Hydrogen Strategy through to binding legislation such as the Renewable Energy Directive and sector specific demand targets. **WITH THE REGULATORY FRAMEWORK ALMOST COMPLETED, THE EMPHASIS IS NOW ON IMPLEMENTATION OF PROJECTS ACROSS THE SUPPLY CHAIN, MAINTAINING A COMPETITIVE TECHNOLOGICAL ADVANTAGE, AND THE ASSOCIATED CHALLENGES.**

Current hydrogen market

When it comes to the current hydrogen market, the European hydrogen production capacity remained stable for the reporting year 2022 at around 11.5 Mt. Power-to-hydrogen/water electrolytic capacity rose by 23% to 228 MWel by September 2023 compared to December 2022. It now represents 0.3% of the total operational European production capacity up from 0.15% three years ago. While 23% is a high growth rate for mature industries, Europe would need a 150% annual growth rate to reach 140 GWel of installed electrolysers needed to produce the 10 Mt envisaged by REPowerEU. Due to lack of official hydrogen statistics, Hydrogen Europe tracks the approximate hydrogen consumption which amounted to 8.2 Mt in 2022 compared to 8.7 Mt in 2020. While hydrogen consumption in refining increased by 8% to compensate for sanctioned imports of Russian oil products, the total decrease was caused by production suspensions in ammonia and various chemical sectors due to high gas prices.



Policy

While the current hydrogen market is dominated by fossil fuels, European decarbonisation policies are driving the emergence of a clean hydrogen market. Two years after the publication of the Fit for 55 package, some of the key policy drivers for clean hydrogen production and consumption are finally in place.

The long-awaited Renewable Energy Directive (RED) sets obligations for hydrogen consumption in transport and industry, while providing the definition of renewable fuels of non-biological origin (RFNBO). FuelEU Maritime and ReFuelEU Aviation offer a clear direction for decarbonising these sectors with a key role for hydrogen and synthetic fuels. The Alternative Fuels Infrastructure Regulation (AFIR) will ensure the rollout of hydrogen refuelling stations across Europe to accommodate the increase in zero-emission vehicles. The legislation underpinning the transport and storage of hydrogen, Hydrogen and Decarbonised Gas Package, is about to be finalised and will clarify the low-carbon hydrogen definition.

While there are outstanding policy files relevant for the hydrogen sector related to standardization, certification, industrial policy, raw materials, and others, the policy framework is almost complete. That is providing the necessary clarity for the market to begin moving from announcements to final investment decisions (FIDs).

Funding

With many emerging clean technologies and industries competing against incumbents, the clean hydrogen sector also needs support to mature and scale to eventually compete on its own. In Europe, around EUR 1.8 trillion must be mobilised, amounting to EUR 40 to 80 billion in annual investments until 2050, with higher investments through the 2030s to make clean hydrogen a reality. The EU answered this challenge with a myriad of funding instruments: Clean Hydrogen Partnership for R&D investments, Innovation Fund for the deployment of first-of-a-kind industrial projects, and the Hydrogen Bank as a market making tool aiming to support renewable hydrogen producers with a fixed premium, as well as the Important Project of Common European Interest (IPCEI) programme, among others.

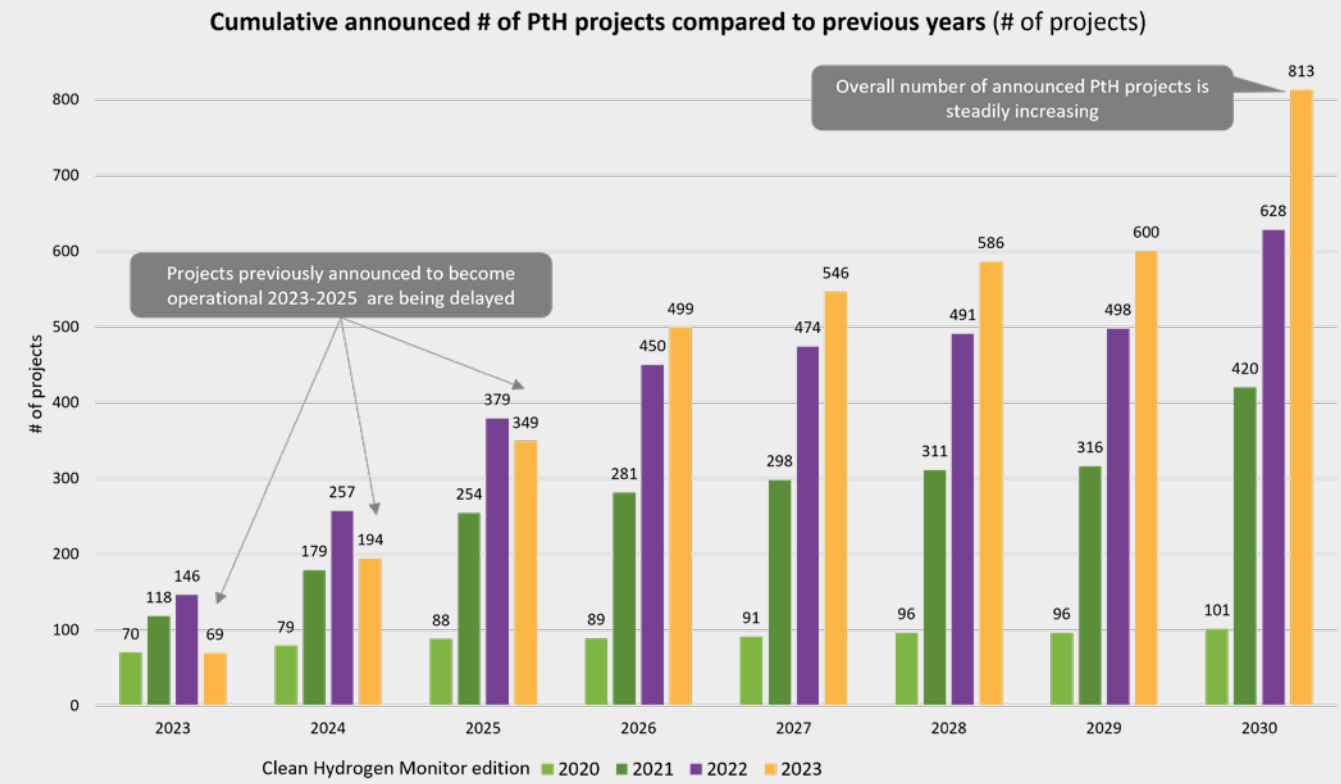
Despite the different funding streams, a substantial funding gap remains, underscoring the pivotal role of private finance. Currently, corporate finance, predominantly in the form of equity investments, is the primary financing method for the sector. However, to scale up the hydrogen economy effectively, equity must be complemented with debt through project finance. Over the past few years, banks and debt finance providers have been formulating hydrogen strategies to enhance their understanding of the sector. While banks and debt finance providers have been familiarizing themselves with the sector, non-recourse financing is still not common.

To fully unlock the sector's economic and decarbonisation potential, the development and timely implementation of innovative and centralized market-making instruments will be imperative to mitigate risk and attract the whole private finance value chain.

Announced clean hydrogen production and consumption project pipelines

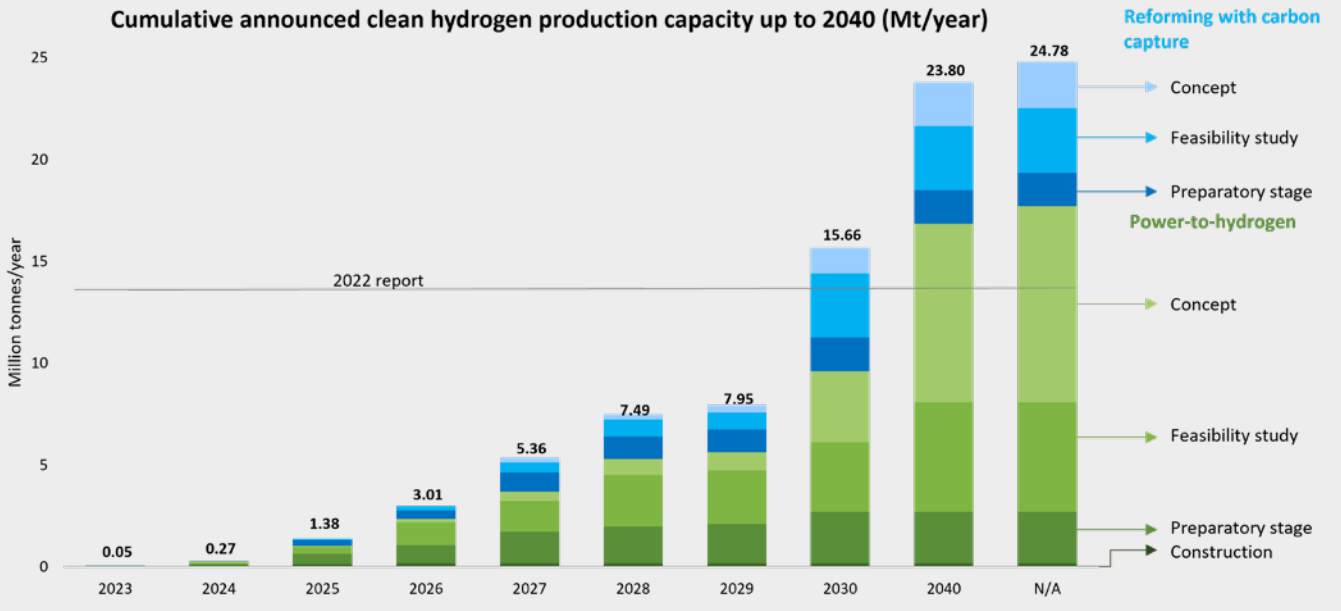
The funding support remains one of the key levers for hydrogen production projects reaching maturity and final investment decisions. The number of power-to-hydrogen (PtH) projects planned to be operational by 2030 increased from 628 in 2022 to 813 in 2023 across all stages of development from concepts to projects under construction. The graph below shows conclusions from previous years about the cumulative number of PtH projects that have been announced to be completed by respective years. The trend of increasing project announcements is a positive development, but similarly to previous years, projects continue being delayed.

While 2022 Clean Hydrogen Monitor data reported 257 projects with plans to come online in 2024, this year's version reports only 196 after accounting for revised timelines. The real number that will have come online by the end of 2024 will, most likely be lower. The main reasons behind project delays include regulatory uncertainty and lack of funding. Additionally, producers also often cite lack of off takers due to the cost gap of renewable vs fossil hydrogen, component delivery issues, project development delays due to first-of-a-kind nature of projects, standardisation and certification uncertainty, and slow development on hydrogen transmission and storage.



Notes: Data does not represent a forecast, but announced production project pipeline
Sources: Hydrogen Europe

Despite the delays in the short to medium term, the clean hydrogen production project pipeline is strong and if all planned production projects for 2030 were realized, there could be 15.6 million tonnes of hydrogen made by electrolysis and by reforming natural gas with CCS. However, only 4.4 Mt of that planned capacity is currently in a more advanced development stage and only ~0.2 Mt represented by 1.7 GWel of PtH capacity passed FID and is under construction. That is a positive development compared to the 380 MWel that were under construction by September 2022.

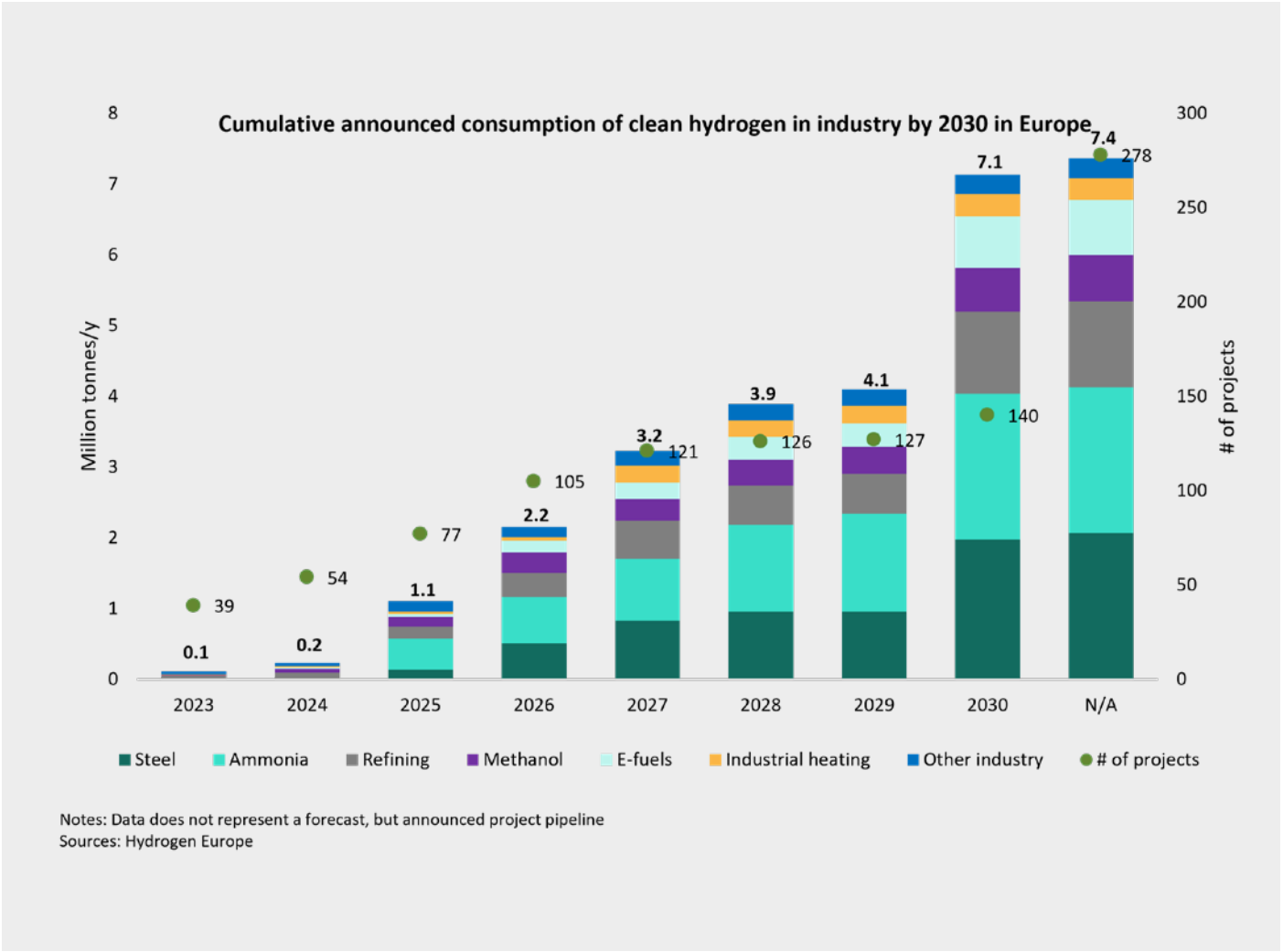


Notes: Data does not represent a forecast, but announced project pipeline
Sources: Hydrogen Europe

7.1 Mt/y of new clean hydrogen consumption has been announced by industrial off takers in Europe until 2030 which is an overall increase of 1.3 Mt/y compared to last year. This demonstrates that, despite many challenges, the outlook for the use of clean hydrogen in industry is positive. The largest volumes have been announced in the ammonia and steel sectors with around 2 Mt/y of clean hydrogen demand each.

84% of the announced clean consumption is expected to be produced via electrolysis with the remaining 16% coming from reforming of natural gas with CCS/U. 41% of total announced consumption is planned to come online in 2030, which is an indication that a significant number of projects are being developed in response to the Renewable Energy Directive targets concerning the consumption of renewable hydrogen by 2030 – especially affecting ammonia producers and refineries.

The steel sector is also under increasing pressure to decarbonise with the decreasing free allocation of allowances due to planned CBAM implementation. The fact that the announced clean hydrogen consumption projects in industry are less than half of the announced clean hydrogen production volumes is representative of one of the issues that producers currently face with finding willing off takers.



Notes: Data does not represent a forecast, but announced project pipeline
Sources: Hydrogen Europe

Hydrogen mobility

The hydrogen mobility market is steadily increasing, with original equipment manufacturers (OEMs) constantly researching ways to further develop hydrogen powertrains (both fuel cells and hydrogen internal combustion engines). Heavy-duty sectors show the fastest uptake of hydrogen powertrains – only 2022 shows major increase in trucks (55 in 2022, compared to 14 in 2021), buses (206 in 2022, compared to 165 in 2021), while the maritime sector is still in its infancy (4 operational hydrogen-powered ships in 2022, with 28 on order by 2028). However, hydrogen mobility faces several challenges including the development of standards and deployment of refuelling infrastructure, competitive pricing at the hydrogen refuelling station level, and certain support for hydrogen vehicles until the technology scales up to become price competitive on the market.

Transmission and storage

With the emergence of the clean hydrogen market, both developers and national governments are realising that there are limits to local production and consumption of clean hydrogen and are emphasising the development of hydrogen infrastructure. From the transmission perspective, Belgium and the Netherlands are the most advanced countries because of their respective plans, adopted legislation, and having begun construction of their national hydrogen networks. On hydrogen storage which will be needed both for seasonal energy storage as well as on a smaller scale for individual consumers to optimise their production and consumption profiles, Hydrogen Europe tracks 28 hydrogen storage projects in Europe larger than 30 GWh in salt caverns, aquifers, depleted fields, and lined rock caverns. The countries with most large-scale hydrogen storage projects in development, albeit in early stages, are Germany, France, and Spain.

The clean hydrogen industry has gone a long way since the publication of the European Hydrogen Strategy in 2020. The regulatory framework has been almost completed; regulatory demand for renewable hydrogen (RFNBO) in industry and transport has been set; there are billions of euros available for clean hydrogen projects from European and national funding schemes; and countries have begun developing their national hydrogen networks. As a response, production projects are maturing with 4.4 Mt being at least in FEED stage and planning to come online by 2030. While some struggle to find off takers, the first movers focus on green ammonia, green steel, refining, methanol, and sustainable aviation fuels. It is important to focus on scaling and maturing these projects as many are first industrial deployments of that size; private finance; and continuous support to bridge the gap between production costs and off takers' willingness to pay. **IF SUCCESSFUL, EUROPE WILL BECOME A STRONG CLEAN HYDROGEN PLAYER IN A NET ZERO WORLD.**

Events Overview

1. 13th DII DESERT ENERGY LEADERSHIP SUMMIT

27th – 29th November 2023, W Dubai – The Palm, Dubai

IN PERSON | Organised by Dii Desert Energy

dii-desertenergy.org/13th-dii-desert-energy-leadership-summit

EVENT DESCRIPTION:

Since 2010 Dii Desert Energy's annual Leadership Summits have paved the way for climate neutral, lowest cost and secure energy from the MENA Deserts. This year this unique international event returns to Dubai to showcase the region's leading role as an innovator, an emerging 'Green Powerhouse' and, hence, a key contributor to global GHG reduction.

Under the theme **'TIME FOR CLIMATE ACTION – FROM ANNOUNCEMENTS TO TANGIBLE PROJECTS'**, this edition is hosted ahead of COP28, with a prominent pre-COP reception, to discuss strategies and projects to speed up the journey towards 'no harmful emissions', whilst achieving energy security and lowest costs in MENA and beyond.

The Summit gathers partners along the emission-free value chain, led by the 'doers of projects', from key developers, utilities and investors, making the Dii Summit a unique high-level meeting in the market with the common objective of kicking-off the creation of a market for zero emission energy. With record breaking renewable energy project tariffs and project capacities in MENA, the Summit helps energy markets and energy traders to reduce and avoid 'greenhouse' effects based on market principles and a pragmatic approach.

The summit forms part of Dii's wider roadmap of accelerating the energy transition in the Arab world by connecting regions, people and continents sharing Dii's mission 'No Emissions!'

For more information, please visit the event website https://dii-desertenergy.org/13th-dii-desert-energy-leadership-summit/

2. COP28

30 November –
12th December 2023,
DUBAI – UAE

ONLINE

www.cop28.com

EVENT DESCRIPTION:

The United Nations Climate Change Conferences are yearly conferences held in the framework of the United Nations Framework Convention on Climate Change (UNFCCC). They serve as the formal meeting of the UNFCCC parties (Conference of the Parties, COP) to negotiate and agree action on how to tackle climate change, limit emissions and halt global warming. The United Nations Climate Change Conferences are the world's highest decision-making body on climate issues and one of the largest international meetings in the world.

The host of the 28th United Nations Climate Change Conference, or Conference of the Parties (COP28) will be the UAE (United Arab Emirates). COP28 UAE will provide a milestone opportunity for the world to come together, course correct, and drive progress to keep 1.5C within reach - so we can meet the goals and ambitions of the Paris Agreement.

For more information, please visit https://www.cop28.com/

3. MI CHM & Hydrogen Europe panel on Infrastructure Funds

4th December 2023

ONLINE

hydrogeneurope.eu/events

EVENT DESCRIPTION:

Mission Innovation's Clean Hydrogen Mission, the European Commission and Hydrogen Europe are organising together on 04.12.2023 a 2 hours panel from 13:00 until 15:00 CET to discuss dedicated to infrastructure investments.

In the quest to achieve the global decarbonisation targets, a substantial investment ranging between $6 trillion and $12 trillion by 2050 is required for generating and transporting low-carbon hydrogen. This colossal endeavour demands a collaborative effort involving public funds, corporate investments, and infrastructure backers to tap into this massive investment potential.

Notably, infrastructure investment has emerged as a standout choice in the realm of alternative investments. This popularity stems from its remarkable ability to withstand inflation and the ups and downs of demand. Infrastructure investors bring a valuable advantage by offering cost-effective funding to the sector, facilitating access to affordable debt and equity.

Highlighting the year 2022, infrastructure fundraising surged by an impressive 50% compared to the previous year. However, studies seem to show that dry powder, or non-invested committed capital has reached record levels too, raising a critical question: do we have enough viable projects to invest in?

This leads us to a crucial challenge: crafting strategies that reduce the perceived risks of infrastructure projects, thereby making them more appealing to potential investors. The discussion hinges on identifying de-risking models capable of transforming these projects into enticing investment opportunities. How can we reshape the investors' expectations and align them with the true risk landscape of ongoing opportunities?

4. #H2Talk: POST COP28: WHAT'S NEXT FOR INTERNATIONAL HYDROGEN PARTNERSHIPS?

14th December 2023

ONLINE

hydrogeneurope.eu/events

EVENT DESCRIPTION:

COP28 will host the first Global Stock-take of the Paris Agreement and is set to address the next climate ambitions covering a wide range of issues, including the phase out of fossil fuels, the deployment of renewables and the improvement of energy efficiency, keeping also in view the financial mechanisms to support developing countries in the energy transition as part of the COP sustainability agenda.

Will the conclusions of the climate conference, its side discussions and announcements positively impact the deployment of hydrogen on a global scale? Three days after the closing of COP28, our webinar will discuss the results of the conference with the European Commission, several international organisations, partner countries and industry stakeholders, and measure whether COP has fulfilled expectations and opened perspectives towards new countries' engagements, international partnerships and investments on hydrogen, marking thereby a before and an after COP28.

To register, please visit https://hydrogeneurope.eu/events/

European Hydrogen Week

20–24 November 2023
Brussels, Belgium

www.euhydrogenweek.eu

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Hydrogen Europe

Clean Hydrogen Partnership

The Programme

High-Level Policy Conference Hall 11, Main Auditorium		B2B Forum Hall 7, B2B Auditorium
DAY 1 **MONDAY, 20.11.2023 OPENING DAY**		
Session 1: Hydrogen and the global challenges ahead	14:00 – 15:00	**Session 1:** Regulation, code & standards: A guidebook into hydrogen trade
Session 2: Storing clean hydrogen in Europe	16:00 - 17:00	**Session 2:** Financing the global hydrogen ecosystem
DAY 2 **TUESDAY, 21.11.2023**		
Session 3: The Hydrogen Bank	10:00 - 11:00	**Session 3:** Clean Hydrogen Monitor 2023
Session 4: Scaling up electrolysers manufacturing	12:00 - 13:00	**Session 4:** Sector coupling and hydrogen storage: the role of hydrogen in future energy systems
Session 5: Ensuring a resilient EU hydrogen supply chain through the Green Deal Industrial Plan	14:00 - 15:00	**Session 5:** Deployment of the hydrogen ecosystem: a view from EPCs
Session 6: The role of hydrogen in decarbonising road transport	16:00 - 17:00	**Session 6:** Start up pitches from the H2UB HYDROVERSE
DAY 3 **WEDNESDAY 22.11.2023**		
Session 7: Hydrogen backbone: the necessary link	10:00 - 11:00	**Session 7:** Hydrogen for maritime
Session 8: The hydrogen import challenge: the strategic role of EU ports	12:00 - 13:00	**Session 8:** Hydrogen for aviation
Session 9: A partnership driving forward EU research and innovation in hydrogen technologies	14:00 - 15:00	**Session 9:** Liquified hydrogen: the untapped potential?
Session 10: Boosting the hydrogen economy – How synergies support increasing the funding impact	16:00 - 17:00	**Session 10:** Hydrogen derivatives and carriers
DAY 4 **THURSDAY 23.11.2023**		
Session 11: Rolling-out and scaling-up Hydrogen Valleys in Europe	10:00 - 11:00	**Session 11:** Start-up pitched from the H2UB HYDROVERSE
Session 12: Skills to power-up, empower and repower: the new workforce needed for the hydrogen economy	12:00 - 13:00	**Session 12:** Hydrogen production pathways
	14:00 - 15:00	**Session 13:** Hydrogen for buildings and industrial heat
Session 13: Clean Hydrogen Partnership independent scientific advisory workshop part 1 – global technology trends, outlook		
	16:00 - 17:00	**END:** NO B2B Forum session
Session 14: Clean Hydrogen Partnership Independent scientific advisory workshop part 2 – technology		

DAY 5
FRIDAY, 24.11.2023
Webinar: On the road to cop28: reducing time to decarbonisation with clean hydrogen

A warm welcome to all our new Hydrogen Europe members

Nacionalno združenje za razvoj vodika Slovenije (The National Hydrogen Association of Slovenia)

The National Hydrogen Association of Slovenia is a new association, which strives to promote and encourage thedevelopment of hydrogen technologies. We want Slovenia to achieve more ambitious plans in this area. The association is a key platform for connecting important players who engage in activities related to hydrogen technologies.

CONTACT
info@h2-si.com

Permascand AB

Permascand is a technology-driven global provider of electrochemical solutions - headquartered in Sweden.
Permascand has provided the full range of services from catalytic coatings and electrodes up to complete electrochemical cells and aftermarket services for a variety of industries – involving chlor-alkali, hydrochloric acid and water electrolysis - for more than 50 years. It was founded 1971 as part of AkzoNobel. Majority shareholder is Norvestor VI L.P and IPO was launched in 2021.
For Permascand supporting the energy transition means a natural evolution of its core business. Accordingly, Permascand offers proprietary coatings, customer-tailored electrodes and cells for hydrogen production and lithium extraction - delivering customized solutions world-wide.

CONTACT
info@permascand.com

REGIONE UMBRIA

Umbria is a region of central Italy known as “The green heart of Italy” and aims to become an increasingly green region producing green energy, in particular renewable hydrogen within brownfield sites. This action is part of a decree by the Italian Ministry of the Environment and Energy Security for the creation of the Italian Hydrogen Valleys.

CONTACT
urp@regione.umbria.it

Türkiye Şişe ve Cam Fabrikaları A.Ş.

Sisecam is a major global player in the fields of glass and chemicals. Sisecam is the only global company operating in all core areas of glass production – including flat glass, glassware, glass packaging, and glass fiber. Currently, Sisecam ranks among the world's top two manufacturers of glassware and the top five producers of glass packaging and flat glass. Sisecam is one of the three largest soda ash producers in the world and the world leader in chromium chemicals.

CONTACT
innovation@sisecam.com

Encevo S.A.

Encevo is a leading and sustainable energy player in Luxembourg and the Greater Region. Encevo Group has a broad geographical footprint serving clients in Luxembourg, Germany, France, Belgium and the Netherlands. It is present all along the energy value chain, from production, storage, supply, transport to trading, distribution and services.

GENIKAI TOURISTIKAI EPICHEIRISEIS SOLMAR TOURS ANONYMI ETAIREIA (SOLMAR)

SOLMAR TOURS S.A. with the distinctive title UNION S.A., was established in Heraklion, Crete in 1978 and operates exclusively in tourist road transportation in Crete with long-term strategic partnerships with the largest tour operators worldwide [TUI, Jet2, etc.] and undertakes 115.000 coach journeys transporting 2.000.000 passengers annually [2022 base year].

Company is one of the top coaching tour companies in Greece, with a fleet of 120 coaches and mini buses. The age of the fleet is 80% under five years [Euro 6] and 20% under ten years [Euro 5].

Ecoinnovazione S.r.l.

Ecoinnovazione (www.ecoinnovazione.eu) is a research and consultancy company spin-off of ENEA (www.enea.it). It applies knowledge, methods and tools developed throughout many years of international research in the field of Life Cycle Assessment, Ecodesign, Sustainability and Circular Economy. It provides tailored solutions finalised to a winning circular economy and sustainability strategy.

CONTACT
eco@ecoinnovazione.it

FEST GmBH

FEST electrifies, automates and digitizes manufacturing processes in industry and production. Their water-electrolysis technology and hydrogen infrastructures offer pioneering projects for companies and the public sector including complex solutions for industrial plant construction as fully integrated Industry 4.0 projects. FEST has been established for many years as an experienced partner for process automation in the industry. In addition to expertise and experience, it is the drive for innovation and technical perfection that keeps the company and its people moving forward.

CONTACT
kontakt@fest-group.de

H2Site

H2site efficiently produces onsite and renewable H2 for small and medium companies. They focus on industry and mobility, using our membrane reactors able to work with different feedstocks such as ammonia, methanol, gas mixtures. H2SITE is formed by professionals with long experience and diverse backgrounds. Some even have been in the project from the beginning. They combine relevant scientific and technological experience with business development, manufacturing and startup growth.

CONTACT
info@h2site.eu

Norway Fortescue Future Industries AS

Fortescue is a global metals and green energy company, recognized for its culture, innovation, and industry-leading development of infrastructure, mining assets, and green energy initiatives. It operates with two divisions – Metals and Energy. Fortescue Energy is comprised of Fortescue Future Industries (FFI) and WAE Technologies. C9FFI is committed to producing green hydrogen, containing zero carbon, from renewable electricity.

Regione Emilia-Romagna

The Emilia-Romagna Region (ERR) takes on European targets until 2030 and until 2050 in the field of climate and energy as key development drivers for the regional environment. Additionally, ERR supports the creation of a hydrogen ecosystem: to develop local hydrogen uses; to demonstrate the systemic role of Hydrogen; to start the real green energy transition and to create new opportunities and new jobs.

CONTACT
sviluppolavoro@regione.emilia.romagna.it

Woodside Energy Ltd

Woodside Energy is a global energy company, founded in Australia, providing the energy the world needs to heat and cool homes, keep lights on and support industry. We are investing in the new energy products and lower carbon services our customers need as they decarbonize, such as hydrogen and ammonia.

Saarländische Wasserstoffagentur GmbH

The Saarland Hydrogen Agency aims to develop and implement the hydrogen strategy of the Saarland in consultation with business, academia and political bodies. Among other priorities we strive to assist the growth of industrial partners, to connect all relevant actors in the field of hydrogen in the Saarland and to liaise with the relevant players in the wider region, as well as state and European level.

CONTACT
mathieu@sakowin.com

STRING

STRING is a political organisation representing 15 regions and cities across Northern Europe. Concentrating on regional development, green growth, and sustainable infrastructure projects, among others our hydrogen refuelling stations, STRING aims to create a cohesive green megaregionand accelerate the green transition in Northern Europe.

CONTACT
contact@stringmegaregion.org

Job market

1. Vice President of Manufacturing

BOSS Energy Consulting

Full Time

Remote, Germany, Bavaria

DETAILS

2. Sales Manager – Electrolysers

BOSS Energy Consulting

Full Time

USA

DETAILS

3. Project Officer –Technology Monitoring and Assessment of Hydrogen Environmental impacts

European Commission - Joint Research Centre

Full Time

Petten - NL

DETAILS

4. Hydrogen Safety Engineering Technologist

Fondazione Bruno Kessler

Full Time

Italy, Trento

DETAILS

Find more jobs at hydrogeneurope.eu/job-openings

Not yet a member?

Join us with the attached QR code

Hydrogen Europe

#05

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