THE HYDROGEN EUROPE QUARTERLY

A CHANGING POLITICAL LANDSCAPE Issue Q1 2024





Welcome!



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From the CEO

Welcome to the Q1 2024 edition of the Hydrogen Europe Quarterly magazine. Our first issue of 2024 looks ahead to a series of important elections in Europe and abroad, while examining how we can make 2024 "The Year of FIDs".

We are delighted to announce the online publication of the Q1 2024 issue of the Hydrogen Europe Quarterly magazine!

In 2024, a wide number of political elections are or will be taking place worldwide: many countries, plus the European Union, will be deciding on their leadership for the next years, representing over 2 billion people. Hence, the name of this edition, **A changing political landscape.**

This issue begins with an op-ed that explores the importance of the "positive narrative" that Europe has built in the wake of the Paris Agreement and asks questions about what is at stake for the energy transition with the current elections. Will climate change continue being a priority in the political agenda? Hopefully so: Hydrogen Europe has drafted a **Manifesto for the 2024 European elections,** aiming to guide the next legislative term's priorities around hydrogen, building on the progress that has been made so far.

But supportive legislation needs Final Investment Decisions (FIDs) that will bring hydrogen projects into life. How can we make 2024 the year of FIDs? is another question that needs answer. In conversations with Jose Miguel Bermudez Menendez, from IEA, we get a feeling of how the market outlook for hydrogen is at the moment, and get to hear the real, on the ground experiences from Amir Mansouri, Shell, and Philip Christiani, CIP.

Our prominent person interview is the European Commissioner for Climate Action, **Wopke Hoekstra**, currently the face of the Hydrogen Bank, which was launched at the European Hydrogen Week last November.



The corporate member spotlight in this issue is on **Chiyoda Corporation**, which is making huge progress with its LOHC technology that, it hopes, can contribute to Europe's hydrogen import solutions.

To coincide with the Belgian presidency of the European Council this semester, we had a conversation with the **Belgian Hydrogen Council**, with Belgium having put hydrogen high up on its list of priorities. Further South, the regional member spotlight this issue is on **Occitanie/Pyrénées-Méditerranée** (FR). Both spotlights demonstrate the rise of hydrogen in Europe and the important role that Belgium and France will play in the European hydrogen value chain.

Finally, as per every edition, our policy and intelligence updates touch upon the most pressing matters currently involving the sector. This issue covers the important topics of **standardisation**, **greenhouse gas emission accounting rules, and ETS allowances.** Meanwhile we shed a light on the potential of **offshore hydrogen** and **transatlantic trade** while, in a new series for the magazine, we begin a year-long analysis of the global race on hydrogen technologies.

We hope you will enjoy this issue and find it insightful for the year ahead in hydrogen.

Jorgo Chatzimarkakis CEO, Hydrogen Europe

Elections 2024:

Europe must stay true to its climate goals and political programs should reflect this



The 2015 Paris Climate Agreement was an historic achievement regardless of what has happened, or will happen, since. More than with the Kyoto Protocol, it really seemed like a global consensus had finally been achieved on climate change and a rough roadmap of how to mitigate its worst effects had been drawn up.

As a young Brussels-based paralegal working in renewable energy law, I attended several roundtables and conferences about the agreement. About what it meant and what it would lead to. Very quickly the limitations of such a far-reaching and inclusive treaty became apparent, not least the lack of any sort of proper enforcement mechanisms for achieving the ambitious Paris targets. How was it possible to stimulate the world's best inclinations with neither carrot nor stick, the existential consequences notwithstanding?

06

When this question was raised at one aforementioned roundtable, a Danish MEP acknowledged the lack of enforcement but stressed the importance of creating a "positive narrative" – believing in and encouraging humanity to do the right thing, now that we'd (mostly) all agreed what the right thing was.

The 2024 European Elections, the US presidential election, and the host of national elections in Europe and across the world, could put this positive narrative to the test. There is concern in some quarters that the energy transition could fall by the wayside in favour of nationalist agendas more focused on tax cuts, immigration, and military spending. But whatever happens it is crucial for us carry the mantle for the values we have, as Europeans, championed over the last decade. These include democracy and stability for our citizens regardless of who is chosen to control the wheel, and a duty to promote clean European industrial production.

The latter point is important, as sustainable industry is quality, economic growth - of which Europe needs more. There is a reason why we are competing with China and the US for clean technology. It's a job and wealth creator, as well as a transformational tool.

Hydrogen Europe recently published its own manifesto for the 2024 elections, which you can read in full within the pages of this magazine. It spells out clearly:

The coming mandate of the European Parliament and the next Commission will be the ones charged with reaching our 2030 targets and sustainably following up towards the 2040 timeframe. There is only one generation to go before 2050.

We who believe we can achieve a clean, sustainable, energy-secure Europe must take action, and not just on election day. Will it cost money? Certainly, but the cost of inaction is much greater, and will lead to more instability too. As Commissioner Wopke Hoekstra tells this magazine, it is up to us to balance the effect of inaction with the effect of action on people's livelihoods, comforts, and wallets. Hoekstra emphasises "a just transition, competitiveness, and a level-playing field" to win over voters.

For these concerns, fear of climate catastrophe is not, on its own, a vote-winner. Perpetuating this positive narrative, as we have managed to do with recent plans like the European Green Deal and REPowerEU proposal, means also focusing on the many advantages low-carbon technologies will bring.

From cleaner air, cleaner water, energy security, industrial transformation, and job creation, the benefits of a net zero society will be felt with each breath, each sip of water, and every time climbing fossil fuel prices do not plunge people into fuel poverty. Renewable energy, batteries, biofuels, and of course hydrogen and its derivatives will provide the pieces to the puzzle and help us demonstrate to the wider public what is clear to us: Sustainability is security. Decarbonisation is job creation. Net Zero is economic growth.

We have come this far in our climate action journey thanks to the courageous commitment of so many throughout European civil society – from NGOs to lawmakers and forward-looking entrepreneurs. What we need is a continuation of this European spirit, these democratic values, and our firm, world-beating commitment to reindustrialising Europe, global cooperation, and affordable green energy.

Amir Mansouri, Director of Shell's Holland Hydrogen 1 project, tells us in the next story that he is *"personally less concerned about political change, but more about current will to implement at pace [...] the direction of travel in the EU is clear.*" The current European Commission has gone to great lengths to ensure that this is the case. It is up to the next one, regardless of political creed, to not divert from this course. We must continue to invest heavily in building up our society for our net zero future, using and supporting all available technologies. And it is up to us, as stakeholders in the energy transition, to keep them on track.

By Peter Collins, Editor, Hydrogen Europe Quarterly

Financing, not floundering: How can we make 2024 the year of hydrogen FIDs?

The widely reported figure from the International Energy Agency (IEA) 'Global Hydrogen Review 2023' that only 4% of global hydrogen projects are reaching final investment decision (FID) has been the subject of much analysis and some consternation. Despite an impressive pipeline of projects, and some notable early success stories, obstacles and bottlenecks prevent true lift off for European hydrogen. To answer the question of how to improve this number, and make 2024 the year of FIDs, the Hydrogen Europe Quarterly spoke to Jose Miguel Menendez, Energy Technology Analyst, Hydrogen and Alternative Fuels at the International Energy Agency (IEA), Philip Christiani, Partner at Copenhagen Infrastructure Partners, and Amir Mansouri, Director of the Holland Hydrogen 1 project for Shell.

The question of FIDs looms large for European hydrogen stakeholders. Legislation has been passed, targets have been set, ambitions have been made clear, but the final step of advancing projects to construction is still somewhat elusive.

Complex supply chains in a new sector will always pose challenges, as will a lack of necessary infrastructure, increased cost of capital, and inflation. Some of these issues are to be expected, and some are global factors affecting all industries. What can be controlled is the regulatory environment but, despite huge progress on that front in the last two years, the job is still not done.

"There is no absolute regulatory certainty, and this creates a perception of high risk," Jose Miguel Menendez, Energy Technology Analyst, Hydrogen and Alternative Fuels at the International Energy Agency (IEA), tells the Hydrogen Europe Quarterly.

This results in an imbalanced approach to supporting projects and stimulating demand: **"On the demand side we are seeing a lack of action from policymakers. There's a complete disconnection between the level of action and the level of ambition,"** Menendez added.

The IEA Global Hydrogen Review 2023 also shows that Europe's slow development in hydrogen is allowing global competitors to overtake the bloc. In the report, it reveals that last year China made up more than 40% of electrolysis projects that have reached FID globally, having only accounted for less than 10% of global electrolyser capacity installed in 2020.

But the report is not all doom and gloom for European hydrogen. Quite the opposite in fact, as the report identifies hydrogen as a key sector in the energy transition.

"The main message from the IEA report is that interest in low emission hydrogen remains strong, not only in politicians but in industry too," said Menendez.

There are two reasons for optimism. The first is a simple point of arithmetic. While indeed only 4% of announced projects have taken an FID, in real terms this represents a doubling of capacity compared with the previous year, reaching nearly 2Mt. This rise has been masked a greater increase in the number of announced projects, but it still shows positive momentum building despite China taking the lion's share of it. Poor financial conditions like high inflation are finally plateauing, so this small but important success despite hard times is a good sign that the future is bright.

The second reason is that the way forward in Europe and the rest of the world is, while ambitious in scale, eminently achievable in scope. And some of what has already been put in place will soon be paying dividends.

"We will see more projects reaching FID in the coming years," Philip Christiani, Partner at Copenhagen Infrastructure Partners, said bullishly, adding that "I believe as soon as we see the effect of the hydrogen bank, we will see more projects coming into FID simply because of how the auction is defined, including a requirement to secure 60% offtake of the produced amount."

"The H₂ Bank has been created well – an auction system is better than offering a fixed number. From a taxpayer and a competitive perspective, it just makes sense," he added.

The pilot auction of the Hydrogen Bank was launched in November with an €800m budget and received over 132 bids totalling 8.5GW of electrolyser capacity. The amount of appetite for the auction shows how many companies are prepared to invest, if they can get the support they need.

The rest of the solution is multi-faceted, but it involves nothing previously unheard of, and there is plenty of precedent to follow. Focusing on the financing gap, with banks and institutions still reluctant in many cases to take the leap and with project developers working hard to put the economics in place, Christiani preached patience: **"I don't think the financial sector is getting to grips** *with hydrogen: there are probably still more unanswered questions than answers. It will still take time for the industry to mature, maybe 10 years before we have a consistent business model. But that's not any different from the development of offshore wind or other renewable technologies."*

CIP, while a relatively young outfit approaching its 12th year, has been involved in a host of major renewable energy and other infrastructure projects since its inception. One of its first funds is on its fifth raise, targeting \in 12 billion by Q3 2024, demonstrating the faith of investors in CIP's ability to make a success out of ambitious projects. Its Growth Market Fund 2, part of its focus on new markets including hydrogen, is targeting a hard cap of \in 3 billion, demonstrating in turn CIP's belief that hydrogen can succeed alongside other low-carbon technologies.

It is certainly not alone. Amir Mansouri is the director of Hydrogen Holland 1 (HH1), a Shell-owned 200MW electrolyser planned to be built by the Port of Rotterdam and powered by the part-Shellowned 759MW Hollandse Kust (Noord) offshore wind plant. Once operational, it is expected to become one of the largest renewable hydrogen plants in Europe. FID was taken back in July 2022.



© Shell

"In an environment in which we believe there is a forward leaning stance on energy transition and H_2 , we took a leap of faith in summer 2022. There's no doubt that hydrogen's potential is recognised by the EU in policy and legislation, and it is at heart of its climate strategy. But, with us being a first mover, the market is nascent and still highly uncertain. We didn't want to wait for market to be fully formed before taking this step," Mansouri recalled.

With all major contracts signed, construction is underway, and the project is taking shape. Offtake agreements are still being considered, with Shell taking a flexible approach (and offtaking the product for its own Shell Chemicals and Energy Park in Rotterdam). The project is a testament to Shell's belief in being able to decarbonise with hydrogen.

"I don't think we would have gone ahead with HH1 if it were another project. We did because of the faith we had in our abilities to mature in this business," said Mansouri.

Mansouri was pleased enough with the RED legislation targets, the commitment to decarbonisation in FuelEU Maritime, and the

creation of the Hydrogen Bank – despite not being eligible for the first round, though Shell hopes to be for the second – and highlighted the importance of IPCEI to getting the first major projects off the ground.

What is needed now is member states to implement the legislation and get their own support schemes up and running, action at the national level being *"where the rubber meets the road",* Mansouri explained. Increasing power prices and inflation aside, one area that must be dealt with quickly is the transposition of EU policy to national law.

"We've committed to HH1, and part of that commitment was based on counting on the government to implement these regulatory frameworks. The fact that it hasn't yet has created some instability," explained Mansouri.

So are the looming elections a cause for even more concern? Not for him.

"I am personally less concerned about political change, but more about the current will to implement at pace. I don't think

it's so much a question of any changing political landscape. The direction of travel in EU is clear," he concluded.

CIP's Christiani has also noted this alignment at the European level on the energy transition and, what's more, the maturing in thinking of lawmakers when it comes to important aspects of building up the hydrogen market.

"One of the things that has matured is the thinking on European hydrogen transmission system. Two or three years ago we weren't discussing transmission - today we are," Christiani explained. The facts support this assertion with Europe seeing the first FIDs on gas transmission systems being taken in Port of Rotterdam, Spanish TSOs putting in work on the Spanish network, and a draft of what the cross-Europe network will look like.

Christiani is keen to play a part in that. As mentioned earlier, CIP is putting its money where its mouth is on hydrogen, and we need look no further for evidence of this than the BrintØ 'Hydrogen Island'. In 2022, CIP set out plans to build an artificial island in the Danish North Sea dedicated to the large-scale production of green hydrogen from offshore wind. Once operational in 2030 the island will connect to ten wind farms of 1GW each, consolidate the power, and transmit it to Belgium, the UK, the Netherlands, Germany, and Denmark. Hydrogen will be produced on the island – between 500,000 tonnes and 1 million tonnes yearly - and distributed via hydrogen pipelines to industrial centres in these same countries.

"Regarding BrintØ, it makes financial sense to make an offshore island, reducing cost of windfarms with high transmission costs and associated interconnectors to manage the power between the Northern European countries," said Christiani, pointing out that after a certain distance the power losses from normal AC power cables become prohibitive – making BrintØ the efficient choice in the long run.

CIP's Hydrogen Island will require multiple offtakers to buy up the whole product and, while challenging in the short-term, the outlook is positive.

"We already have demand in industry where hydrogen made from unabated fossil fuels is already being used, it's just a matter of making them switch," the IEA's Menendez pointed out while adding that, alongside industry, shipping and aviation were all "no regret sectors" in which the legislative direction is clear, and the demand base already exists. HH1's placement in Rotterdam – Europe's largest port and within a stone's throw of the Northern European industrial centres – and BrintØ's position in the North Sea connecting these same centres to the offshore power production base, show the importance of location, location, location when it comes to early hydrogen projects.

In the meantime, all three interviews showed the sector's alignment in what can still be improved for the next wave of projects. As Christiani outlined it, there are four priorities for the next European Commission:

First, put another €30 billion into H₂ Bank. If we want to meet the targets, we should have €3 billion per year over the next 10 years.

Second, undo the red tape around auctions and permitting of onshore wind, offshore wind and solar. We can meet our wind and solar target to decarbonize the European energy system if legislation and permitting is sped up.

Third, Europe must define what the supply chain will look like for major components: Turbines, transmission, solar PV, etc...,

Fourth, Europe must establish the necessary H₂ and power transmission systems.

We may still yet find the same bottlenecks holding up projects in 2023. But what the IEA report shows, and what the progress of HH1 and BrintØ reinforce, is that the important trends are pointing upwards, and the building blocks are being put into place. How to make 2024 the year of FIDs is still up for debate, but making the 2020s the decade of hydrogen has never looked more likely.

PROMINENT HYDROGEN PEOPLE: Wopke Hoekstra

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 European Commissioner for Climate Action Wopke Hoekstra, with the former Dutch cabinet minister sharing his thoughts on the importance of climate action and European security.

Commissioner Hoekstra, how would you assess the progress Europe has made in 2023 in reaching our climate targets and, in particular, the progress made in exploiting the potential of hydrogen to help us achieve those targets?

The past years have been incredibly challenging for Europe, but EU's climate ambition is firm and steady, to reach climate neutrality by 2050. That is also what the Climate Action Progress Report 2023 concluded last year.

We have made progress on emission reductions, renewable energy deployment, and investing in clean mobility. And we have done this while growing our economy and investing in the clean technologies of the future. That is exactly were the potential of hydrogen comes into play. Hydrogen is going to be a key technology for decarbonising Europe's industry and helping to deliver on our future climate targets and the European Green Deal.

Last year in November, the first EU-wide auction for renewable hydrogen production was launched and sent out a clear signal that Europe is the place to invest in renewable hydrogen production, and in hydrogen-based industries. This will help incentivise the necessary final investment decisions which can bring renewable hydrogen projects to fruition in Europe. We are doing this for and with our companies.

And in fact, an impressive pipeline of projects is participating in the auction: it has attracted 132 bids from projects located in 17 European countries. By doing so, we also develop a solid hydrogen market in the EU that will make us more competitive, offer new growth opportunities to industry, and provide quality jobs for European companies and citizens.



What is the geopolitical value of a thriving clean hydrogen sector?

Building a hydrogen economy is a key mission for Europe, and therefore also for the European Union. War is literally at our doorsteps. Russia's horrible full-scale invasion of Ukraine already made Europe realise that we needed to cut our dependence on Russian fossil fuels. There are many other conflicts, the geopolitical situation is particularly grim at the moment.

In that type of world, in the world we live in, and we will continue to be living in for a while, Europe should not depend on fossil fuels imports.

Climate policy is increasingly becoming security policy as well. And hydrogen is at that very nexus. I am a believer in the hydrogen economy for our energy security. Developing a solid hydrogen market in the EU will make us more competitive, offer new growth opportunities to industry, and provide quality jobs for European companies and citizens. We also put the right rules in place to create a strong and competitive hydrogen market.

2024 will be defined by key elections at the European and Member State level, as well as internationally. Could the global push for net zero soon face disruption?

As I just said, the geopolitical situation is of course tremendously complicated. But if you think about COP28, the chances of making it a success were actually pretty slim. And yet at the same time, we did manage to pull this off. Because with COP28, we spoke with one voice and pushed for climate ambitions globally. Together with the 200 countries that gathered in Dubai, all having their different interests and objectives, we managed to build towards a successful outcome and deliver a package of agreements that will help to put the world back on track for the goals of the Paris agreement.

All countries agreed to transition away from fossil fuels and accelerate action to do so in this critical decade before 2030. And Parties have committed to tripling global renewable energy capacity and doubling the rate of energy efficiency improvements before 2030. Together, these elements will give a very powerful boost to solar, to wind industries, as well as other renewable energy technologies such as hydrogen.

In my view, COP28 was proof that we can deliver internationally towards net-zero. And in the next couple of years, the EU must push and will push for the implementation of these actions. Europe will continue to lead the way in global climate ambition. This Commission has put Europe on the forefront of the energy transition race. However, climate change is not a vote-winning issue according to most voter surveys. What would you say to a voter who is not convinced that the EU's climate policies have helped them?

The case for climate action is beyond doubt and requires planning now. We can all agree that acting on climate change is essential for the future generations. We see in all EU Member States what climate change is doing: floods, droughts, etc. The planet is heating up and affecting all of our lives. Another aspect of climate change is the cost.

The vast majority of our citizens feel and see the effects of climate change and are clear that we need to continue with climate action. And yet at the same time, there are also significant worries about what this does in terms of effects to our lives. To what extent it effects people's wallets, to what extent it affects people's livelihoods and jobs. It is up to us to make sure we balance these two aspects, climate action and, even more than before, a just transition, competitiveness, and a level-playing field.

We need to make sure that this transition can be lived through by each and every one in all our Member States. And if we manage to do that, we will also do a very important step in terms of energy independence and in terms of strengthening our strategic autonomy.

Are you personally more worried or more optimistic for the next European parliament?

Elections are always interesting times. It is a moment when citizens take stock of what happened in the past years and decide on what kind of representation they wish to have for the years to come.

The outcome of the elections is totally in the hands of the citizens. And as it should be. What I am worried about nevertheless are three elements: participation, disinformation, and misuse of AI.

It is important that citizens come to vote as most of the decisions taken in the Parliament have a direct impact on their lives. And equally important, they need to have access to trustworthy and reliable information. Without that, democracy cannot function.

Hydrogen Europe Manifesto FOR THE 2024 EUROPEAN ELECTIONS

Across the world, our life chances - any individual's opportunities to improve their quality of life - are being threatened. Conflict and climate change threaten the life chances of many people. Supporting technologies and concepts that can mitigate or solve the current problems is a top priority.

Hydrogen is one such technology.

Hydrogen is the smallest molecule in the universe but has huge potential to change our world. The way in which we manufacture goods, move people, power our energy needs, and grow crops can be made cleaner and more sustainable. Hydrogen can bring strong industrial development globally and can save jobs in Europe that would otherwise be lost.

The EU has embarked on the important mission to decarbonise its economy and develop a sustainable, emission-free model of society. With the Green Deal, the Union has produced the tools that can shape a climate-friendly future. We are not alone on this path. The United States, China, the Arabian Peninsula,

India, Brazil, Australia, Namibia and many more countries all strive to be champions of decarbonisation. While their adopted timelines are longer than ours, we should not doubt their determination to achieve their goals. Global competition and our own European ambition to achieve climate neutrality by 2050 mean that we must do a lot better, and do it faster, after the European elections in 2024. The coming mandate of the European Parliament and the next Commission will be the ones charged with reaching our 2030 and sustainably following up towards the 2040 timeframe. There is only one generation to go before 2050. The impetus set by the European Parliament elected in June 2024, and the Commission it will support, will determine whether we achieve not only our climate goals, but also whether we can set global trends and standards for decarbonisation.

Hydrogen is one of the vectors of this necessary change contributing with 15-20% of the final energy demand by 2050 (as recently presented by the European

Commission in the 2040 Climate strategy). It can transform industries and drastically reduce their CO₂ emissions. It can revolutionise air, maritime and road transportation. It can store variable renewable electricity and bring stability andflexibility to an electricity grid transporting ever increasing quantities of energy. And it can help with heating and cooling buildings without carbon emissions.

Hydrogen is not a miracle molecule – but it can do what electricity can't and it is therefore complementary to a renewables-based energy system. Electricity and hydrogen are both urgent and vital prerequisites for the achievement of climate goals, for the retention of Europe's industrial base and competitiveness, and for European energy security. Without both in large quantities, there will be no transition away from fossil fuels

and dependencies on third countries. Yet with both of them, Europe can position itself as the global lead, doing good not only for climate and economic sustainability, but also for European research, industrial development, and jobs.

Europe has tremendous potential for hydrogen, regarding both its production and use. For our own production, and for imports, we need to adopt regulations which fit into global trends. Our regulations must correspond to the needs of European industry and provide planning security to off-takers.

Policy positions decided and implemented during the next legislature of the European Parliament will make this vision of a just future for all a reality – or not. This is why we want to contribute to the electoral debate with a few important suggestions. We believe those suggestions contain elements vital to the success of a green transformation. We want Europe to inspire and lead this transformation.

Our manifesto outlines 16 key actions and policy recommendations the new Commission and European Parliament should support to ensure the objectives laid out in the Green Deal are met on time with a thriving European industrial base creating jobs and growth for Europeans. To achieve this, Hydrogen Europe calls upon European policy makers to speed up the deployment of hydrogen via:

EUROPE HAS TREMENDOUS POTENTIAL FOR HYDROGEN

AN EU INDUSTRIAL POLICY FOR A COMPETITIVE, RESILIENT, AND SUSTAINABLE EUROPE

Develop a strong manufacturing base in Europe for hydrogen technologies, their components and materials addressing critical dependencies, with the support of new funding opportunities to derisk investments and coherent market access approaches.

Foster the competitiveness of the European hydrogen producers in a globally interconnected world, by accelerating the deployment of renewable energy sources, by creating a level playing field through sustainability requirements, the CBAM, common certification and standards.

Frame the EU industrial policy actions of the new legislative term in a concrete and ambitious **EU Clean Industrial Plan** that promotes a business case for energyintensive and critical industries and establishes indicators for clean techs and theirvalue chains.

Assign an EC Vice-President exclusively responsible for Industrial Policy, in charge of the new EU Clean Industrial Plan and able to coordinate the actionsneeded to consolidate EU competitiveness. The Parliament should create an intergroup to follow up on the EU Clean Industrial Plan.

Strengthen a **competitive workforce that creates jobs in Europe through an H2 academy** focusing on skills the hydrogen sector needs. This can be ensured by providing adequate public support and coordination of EU initiatives (Ex: Net Zero Industry Academies and skills projects in the hydrogen sector financed by the Clean H2 Partnership and Erasmus +).





A THRIVING EUROPEAN MARKET FOR CLEAN HYDROGEN

Accelerate development of a hydrogen market through the Innovation Fund and the Hydrogen Bank with auctions that support investment decisions by reducing risk and covering the price gap between production cost and the price that consumers can afford in a global competitive marke

Create an investment friendly regulatory framework for all clean hydrogen production technologies that are aligned with the 2050 Climate Neutral strategy of the EU. The European commission should swiftly adopt a definition of low-carbon hydrogen that encompasses all production pathways - as long as they meet strict emissions criteria. And it should review the definition of RFNBO by 2026, making it a lot more pragmatic.

Accelerate deployment of renewables enabling large production of reliable and competitive hydrogen and derivatives in Europe, laying the pathway towards 2040 climate framework.

Foster global certification schemes for a fair trade of clean hydrogen globally, enabling the mutual recognition of different pathways (RFNBOs, low carbon fuels) across geographies.

Ensure rapid and the most optimal implementation of REDIII H2 targets at national level, in particular in energy intensive industry, steel, chemicals, ammonia sector and refineries.

Create a level playing field for hydrogen technologies in mobility applications through EU legislation and specific windows of Innovation fund (e.g. more support for e-fuels in aviation).





A PAN-EUROPEAN INFRA-STRUCTURE THAT PROVIDES RESILIENCE AND FLEXIBILITY TO THE ENERGY SYSTEM

The European Commission should establish a European Hydrogen Grid Strategy, setting clear goals, accelerating the roll-out of PCI (Projects of Common Interest), and contributing to the removal of existing barriers and unlocking EU funding.

The EU should help create the European Network of Hydrogen Network Operators (ENNOH) as soon as possible to lead the development of the Hydrogen Network Development plan, coordinate national efforts and closely cooperate with theelectricity and natural gas infrastructure operators.

The EU should develop a comprehensive storage strategy. Such a strategy ought to identify the flexibility needs for short and long-term periods, ensure complementarystorage solutions (such as batteries, hydro pump power, and underground hydrogen storage) are all developed on time and at the volumes required. An EU target for underground hydrogen storage should be set along with a clear legislative framework.

The EU should move from setting binding targets to fast deployment of hydrogen fuelling infrastructure and zero emission fleets.

The EU should work on an Integrated Offshore infrastructure Plan that complements the benefits of both power grids and hydrogen pipelines (also offshore) to accelerate and increase the contribution of offshore renewable energy sources.



Member Spotlight: Chiyoda Corporation





Chiyoda, the Yokohama-based global engineering, procurement, and construction (EPC) company, has a long track record of meeting global corporate and social responsibility (CSR) standards. In May 2005, it became the first engineering company in the world to be included in the FTSE4Good Index Series of socially responsible companies. The objective of achieving harmony between energy and the environment is set out in the first sentence of its corporate philosophy. With its experience in refineries, chemical and LNG (Liquefied Natural Gas) plants, Chiyoda knows first-hand the challenge and necessity of decarbonising our energy systems. It also possesses the tools and vision to do so.

Japan is a country with a large and prominent industrial base, with high demand for cleaner energy sources. But with limited renewable energy potential to meet such high demand and it now being difficult to rely heavily on nuclear power following the 2011

Fukushima disaster, it will require alternative solutions to meet its energy transition objectives.

"To decarbonise, Japan will have to import green energy, *like hydrogen and ammonia,"* said Osamu lkeda, Managing Director at Chiyoda Corporation Netherlands. And with this fact in mind Chiyoda has set its sights on figuring out the best way to "accelerate the hydrogen supply chain for imports." While many companies have identified ammonia, methanol, or liquid hydrogen as their means of transporting hydrogen and derivatives, LOHC is an intriguing option for the long-distance transport of these crucial green and clean molecules.

Chiyoda had a key technology breakthrough with its SPERA Hydrogen[™], a dehydrogenation catalyst and process to extract hydrogen from the hydrogen bonded liquid methylcyclohexane (MCH). Toluene (TOL), a common petroleum product used for example as addictive for gasoline, or solvent for paints and lacquers, is fixed with hydrogen through hydrogenation converting it into MCH, used normally as a solvent as the white correction fluids, which is easy to store and transport in large volumes in conventional petroleum tankers as it is a stable liquid at ambient temperature and pressure. MCH can be stored in standard petroleum tanks in large volumes for long periods and, when necessary, hydrogen is efficiently extracted back from MCH through the dehydrogenation process and the toluene is recycled as by-product and reused a raw material for other cycles, closing the loop of the hydrogen chain.

Chiyoda actually performed its first demonstration of this system, in 2013, with the pilot plant in its own R&D premises running. The over 10,000 hours of testing between 2013 and 2014 and the success of the first international hydrogen supply chain demonstration project

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Our technology is ready.

existing containers between Brunei Darussalam and Japan in 2020, and thereafter the transportation of hydrogen on the same route through existing chemical tankers in 2022, convinced the company that the technology is in fact the optimal solution when considering the all-important criteria of maturity, scalability, compatibility, cost and HSE-safety.

transporting hydrogen by

"In the short-term, the market must consider using readymade tech, and work to enhance security and flexibility in the energy sector. But we also need to consider the scalability and compatibility of each technology, and LOHC fits with all these criteria, and its levels of safety are also very important," explained lkeda.

Chiyoda's SPERA Hydrogen[™] technology creates a stable liquid at ambient temperature and pressure, thereby making it easy to handle, and benefits from the fact that the required infrastructure can be repurposed from existing oil & gas pipelines and storage equipment, lowering project costs. Chiyoda says SPERA Hydrogen[™] can mitigate the overall risk of storing and transporting hydrogen.

The company sees a strong use case for its technology in the global supply chain, delivering much needed hydrogen to regional demand centers across the world.

Following the successful demonstrations between Brunei Darussalam and Japan, Chiyoda is now working on a project in Singapore. In October 2022, Sembcorp, Mitsubishi, and Chiyoda signed a memorandum of understanding (MoU) to commercialise a low-carbon hydrogen supply chain to Singapore, using Chiyoda's Spera Hydrogen[™] technology. When operational in the late 2020's, it is set to be Asia's largest low-carbon hydrogen import project, with a capacity of approximately 60 kilotonnes per year. .

In Europe, Chiyoda is part of the consortium behind the LOHC for Hydrogen Transport from Scotland (LHyTS) project, which aims to establish a hydrogen export route from Scotland to the Port of Rotterdam via the MCH LOHC. A feasibility study was completed in conjunction with the Scottish government and the consortium is now working to go to the next pre-FEED phase with a view to building up to a semi-commercial level in the late 2020's and a full-scale launch in early 2030.

"We think that with our LOHC MCH system, we can support key players to help Europe reach its decarbonisation targets. This is our ambition," said lkeda.

Each hydrogen transport method has its pros and cons, and as a result develop different use cases. Ikeda does not expect LOHC MCH to be the only solution when ammonia, methanol, and liquid hydrogen are all potentially suitable. But what is important is a technology neutral approach that can crowd in all viable technologies to create a diverse and complementary hydrogen transport network.

"It's important for the EU to consider all derivatives and carriers that can be deployed. All technologies should be on the table with support mechanisms incorporated fast to support hydrogen implementation also for transport and storage," said lkeda. In Japan, decarbonisation – and the role of hydrogen in that endeavour – is an important discussion, and the country is working hard to develop its own support schemes, *"taking lessons from Europe on how to develop the market",* says lkeda.

In Europe, too, there is a push to build up its LOHC capacity. In February this year the European Commission greenlit Hy2Infra, the third "wave" of Important Projects of Common European Interest (IPCEI) – the first call exclusively focused on hydrogen infrastructure. The 32 projects cover hydrogen storage, electrolyser production, transmission and distribution, and the handling of 6,000 tonnes per year of LOHC. This reflects a commitment to LOHC as one import solution, which aligns with Chiyoda's strategy for Europe.

Chiyoda has conducted a series of robust studies, pilot, and demonstration projects to put itself at the forefront of the LOHC market, both at home and abroad. It is actively seeking international partners with which to accelerate the global hydrogen trade.

"Our technology is ready," concludes Ikeda.



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Regional Association Spotlight: Occitanie

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 **Nadia Pellefigue**, Vice-President of the Occitanie/ Pyrénées-Méditerranée Region in charge of International Relations, Europe, Higher Education and Research. With a perfect storm of optimal conditions for hydrogen development in the southern French region, it is positioning itself for a leading role.





We took the initiative early and have become, I think, the foremost region for industrials interested in hydrogen.



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In southwestern France, the region of Occitanie, nestled between the Mediterranean Sea and the Pyrenees mountains, finds itself presented with an excellent opportunity to benefit from a thriving hydrogen sector. With strong renewable energy potential, and a substantial industrial base needing, and wanting, to decarbonise quickly, the equation is simpler than in many regions. Occitanie can produce and use hydrogen within the region, and this is before considering its broader strategic location: it borders another exciting hydrogen economy in Spain and is in the vicinity of Western Europe's industrial centres.

But no one need tell this to the regional administration, which has been setting the groundwork since as far back as 2007.

"There were already research structures in place on hydrogen, to which we then brought financial support and network building," explains Nadia Pellefigue, Vice-President of the Occitanie Region in charge of International Relations, Europe, Higher Education and Research.



"This continued in a more focused manner between 2010 and 2014 to structure the hydrogen ecosystem and integrate the question of hydrogen into regional innovation strategies across multiple sectors," she continued.

This progressed into an in-depth study to assess the viability of hydrogen as its own strategic sector for the region. It concluded the obvious: that there was massive renewable energy potential sufficient to make affordable green hydrogen at scale, and a large base of ambitious companies seeking ways to eliminate emissions, like AirBus, Thales Group, Alstom, Schlumberger, Lhyfe, Siemens, Renault, and Continental – all "keen to take the risk with us" said Pellefigue, and all able to use hydrogen solutions in their sectors.

The cherry on top was the assessment that Occitanie region had the best research potential too, even boasting the largest concentration of laboratories in the country, with a deeper focus on hydrogen. Occitanie's hydrogen strategy in 2019 was launched with a €150 million budget until 2030.

"We took the initiative early and have become, I think, the foremost region for industrials interested in hydrogen," said Pellefigue.

Some of the region's notable on-going projects encapsulate this trifecta of advantages. Technocampus Hydrogène Occitanie is a \notin 40m hybrid research-and-hydrogen-use project slated for

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delivery in 2025. With a 2MW electrolyser and total surface area of 9,000m², this centre dedicated to research, testing, technological innovation, and teaching will be the largest of its kind in France, with the ambition of being the largest in Europe, bringing together manufacturers and researchers in an "unprecedented collaboration". Memoranda of Understanding have already been signed with Airbus and Safran, with more discussions on-going. The research will primarily focus on hydrogen mobility applications across road, rail, air, and maritime transport.

In the maritime space specifically, the region boasts three major ports which Pellefigue and the regional administration wish to help "leap into the future". In 2021 the region decided to replace its ageing old dredger, a machine used for the excavation of material from a water environment, optimise its dredging activities, and reduce its environmental impact. A new "Hydromer" dredger, featuring electric propulsion, will run on hydrogen from September 2025. The €29m project received €25.75m from Occitanie, €2.25m from the national government, and €1m from ADEME the French agency for ecological transition, demonstrating the support it is receiving from the regional and national governments. The new dredger is expected to save one million tonnes of CO₂ annually. It will begin operating in March.

Another major project is the Corridor H_2 Occitanie, a Europewide initiative to develop a series of hydrogen production and distribution capacities for mobility applications from the Iberian Peninsula to Northern Europe, coupled with the deployment of numerous hydrogen-powered heavy-duty vehicles. Representing a total investment of €110m, including €40m from Occitanie region via the Connecting Europe Facility (CEF), as well as support from the European Investment Bank for €14.5m. By end of 2023, the region provided a subsidy to 7 companies for the acquisition of 25 hydrogen-powered trucks . By the end of 2024 the region will also have 15 inter-urban regional buses using the network of production and distribution infrastructure.

The region itself is also a buyer of hydrogen solutions, having purchased rolling stock from Alstom for train routes to Toulouse, "leading by example", explains Pellefigue.

The region is, importantly, thinking long-term on hydrogen. And that means focusing on the less attention-grabbing but equally important issue of skills.

"For me, it is necessary to support the improvement of competences in hydrogen. If it is to be a solution for tomorrow, we need men and women with the skills to work in the sector. But right now this skill base is not being developed. We have to act on this!" said Pellefigue.

Six months ago, the GENHYO project, financed by a national call for proposals (Compétences et Métiers d'Avenir – France 2030), was launched, to include hydrogen in the school curriculum across all relevant subjects to avoid, in Pellefigue's words, only having high level researchers and not the all-important base of manufacturers, chemists, and engineers with a focus on hydrogen.

"We need people who aren't working on hydrogen now to consider career changes," she added.

The region is receiving support from the national government in this endeavour, and others, but things can always be improved. While the financial assistance on these projects has been welcome, the region hopes the national government will be able to participate more in future schemes. At the policy level of both France and the EU, Pellefigue would like to see a concrete plan to end of the sale of combustion engine vehicles, thereby incentivising the timelier switch to zero-emission transport options, and increased support for hydrogen in aviation and maritime transport.

And in a familiar refrain, the focus needs to be on cost reduction initiatives. The price of the diesel dredger being replaced by the hydrogen model is approximately \notin 2 per kilogram, but the cost of green hydrogen is still much higher than that. The region has accepted contracts for as high as \notin 9/kg on the condition that they drop to \notin 5.5/kg by 2026.

Overall, the mission for Occitanie is clear: *"to facilitate the use of hydrogen by our industrials in the years to come. If they make that choice, we need to be ready,"* concludes Pellefigue.





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National Association Spotlight: WaterstofNet & Belgium Hydrogen Council

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 **Stefan Van Laer**, Manager Policy and International Relations at WaterstofNet & the Belgian Hydrogen Council, about Belgium's role in a hydrogen-inclusive energy transition.

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Someone said to me at one point that today you need a PhD in subsidy schemes to apply for a hydrogen subsidy. If you're not working on it every day you won't get it.

•• BELGIAN Hydrogen Council Belgium, the capital and crossroads of Europe, may never be a worldleading producer of large quantities of green hydrogen. But its large industrial base, advanced port infrastructure and proximity to some of Europe's major production and demand centres mean it will have three major roles in the European hydrogen economy: as end-user and distributor of hydrogen and its carriers and derivatives, and as a technology leader in the wider value chain.

WaterstofNet was founded in 2009, by Adwin Martens, who brought with him nearly two decades experience in energy efficiency in industry, combined production of heat and power (CHP), fuel cells, and hydrogen. Martens is currently the chief strategy officer for the organisation, now well established and active in the conversation on European hydrogen. But back in 2009, the concept of hydrogen was a complete unknown – at least in international discourse.



© Belgium Hydrogen Council

"Back then hydrogen was dead and buried for a lot of people, except for Adwin," said Stefan Van Laer, Manager Policy and International Relations at WaterstofNet.

WaterstofNet's more important activities today is the coordination of the "Waterstof Industrie Cluster" (Hydrogen Industry Cluster), an industrial partnership uniting companies, governments, and institutions to collaborate on hydrogen. WaterstofNet has been coordinating the cluster since September 2016, with support from the Flemish Agency for Innovation and Entrepreneurship. After the subsidy process ended in 2019, the cluster continued on its own, growing from an initial 20 companies to more than 180 across the entire hydrogen value chain in Belgium and the Netherlands.

WaterstofNet also acts as a 'knowledge platform', organising

numerous "Hydrogen Academies" to, as van Laer describes it, "dive into hydrogen from A to Z, the basics and the specifics, created for and by our cluster members". For the past four years, this was hosted in Antwerp with an entirely Belgian focus. But this year the organisation will put on its first English-language Hydrogen Academy in Brussels and the Netherlands, demonstrating its outward focus an desire to spread the word beyond its borders.

Another focus for the association is on projects, specifically mobility-oriented schemes like the construction of hydrogen refuelling stations (HRS), and procurement of hydrogen-powered road vehicles like buses and trucks.

An umbrella group, Belgian Hydrogen Council (BHC), was launched last year to unite the regional H₂Hub Wallonia and WaterstofNet. Its

focus is on policy advice to the federal and regional governments and promoting Belgium's hydrogen industry, supporting the Cluster's mission to foster the development of projects. BHC is also active on the European stage to promote Belgium's hydrogen interests. Recently, the Belgian Hydrogen Council exhibited at the 2023 European Hydrogen Week.

Belgium strengths in the hydrogen economy are clear, explains van Laer. First, the country will be a prominent importer of hydrogen and its derivatives.

"We import three times more natural gas than we need, and those two thirds extra are moved on to other countries namely Germany," Van Laer said.

The infrastructure is therefore in place for the import of cleaner fuels. The Port of Antwerp-Bruges needs no introduction as Europe's second largest seaport, after the nearby Port of Rotterdam, but Belgium also boasts the NorthSea Port between Ghent and Zeelend as well as the Port of Oostende, known for its capabilities in the maintenance of offshore wind turbines.

"We can be a hydrogen hub in Europe with our central

location," Van Laer enthused, pointing to the country's diminutive size as another advantage: with only 150 kilometres of pipelines, these ports can be connected to potential offtakers in Belgium itself but also in the Netherlands and Germany and beyond. Fluxys, a member of WaterstofNet, is currently building a stretch of pipelines and Air Liquide operates its own private network – one of the world's largest. It is envisioned that the necessary pipelines will connect Antwerp and Ghent to Liège by 2026, while the German connection is expected to be opened by 2028.

Second, Belgium will be a major end-user of hydrogen: "Obviously, you can bring in as many green molecules as you want, but if you don't have the offtakers, why even bother?" asked Van Laer, rhetorically. Indeed, the presence of a large offtake base in and around Belgium is a big advantage for the country. In Ghent, ArcelorMittal's integrated steel mill – one of the largest in Europe – is working to replace one of its blast furnaces to work with hydrogen by 2027. Antwerp boasts the second largest petrochemical cluster in the world after Houston, USA, which already consumed 400,000 tonnes of grey hydrogen per year. Given that under the Renewable Energy Directive (RED3), EU industry must procure at least 42% of its hydrogen from renewable fuels of non-biological origin (RFNBOS) by 2030, there will be plenty of demand for green hydrogen from these petrochemical sites. And all this before considering the longerterm opportunities in heavy duty road transport, shipping, and aviation, which are also in need of decarbonisation and looking to hydrogen as a solution.

Finally, the third consideration is the presence of what van Laer called *"technology champions"* – electrolyser manufacturers like Cummins, John Cockerill, and Exion Hydrogen that all have a presence in Belgium and will help to accelerate the uptake of electrolytic hydrogen. These will be supported by the likes of AGFA, which produces membranes, Borit, which produces bipolar plates, and Bekaert, which produces porous transport layers – all essential components to the production of electrolysers.

While the lack of large renewable resources combined with the stringent rules on additionality, temporality and geography will make it difficult for Belgium to produce its own affordable green hydrogen at scale, some of the Hydrogen Industry Cluster's member companies are finding ways to work around these limitations and build up some pioneering domestic production.

"The Belgian government is not in favour of large-scale hydrogen production in Belgium, and they have a point, but we do see the value of producing some of it domestically even if it never reaches gigawatt scale," said van Laer, pointing to the value of showcasing its domestic expertise for export and increasing flexibility in its energy network.

We can be a hydrogen hub in Europe with our central location.

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Belgium's role in the hydrogen market is, therefore, well understood and the country is well-placed to exploit its advantages and become an importer, distributor, and user of hydrogen in the European market as well as a technology exporter.

So, what is left to do? Here, we see an alignment with other European member states, despite its distinct conditions. A lack of final investment decisions, a concern over insufficient support – the European Hydrogen Bank budget is too small, Van Laer says – and a tendency to overcomplicate regulations all contribute to slower progress than needed.

For Van Laer, the solution is to keep it simple: "Someone said to me at one point that today you need a PhD in subsidy schemes to apply for a hydrogen subsidy. If you're not working on it every day you won't get it," he explained.

But with the continued work and efforts from Europe's national and regional associations, like WaterstofNet and the Belgian Hydrogen Council, there is every chance that we can continue to improve the model and bring forth the era of clean hydrogen in Europe.



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Kite Hydrogen Ships: Groundbreaking new Green H₂ Production Technology

Are you interested in seizing guaranteed green H₂ contingents at low cost?

Are you interested in finding a key selling market for your H₂ production technology?



Graphic 1: Energy Ships could soon cruise our oceans, in permanent wind zones, with the sole purpose: to bring back green hydrogen to our harbour terminals. Fully ecological with no disturbance to eco systems, not "in my backyard", geopolitically independent with lowest regulations in no-mans' land. Picture: OCEANERGY AG.

This is how a large chunk of the future of green hydrogen production could look like. Energy Ships, operating in permanent wind zones on the open ocean.

The groundbreaking innovation: Such Energy Ships can produce base-load green electricity from wind. 24/7 and 100% throughout a normal day. This world's first with wind can power electrolysers non-stop. Paying into their capacity utilization, efficiency, and lifetime. Ultimately into their economic operation and therefore economic hydrogen production.

There are no scalability issues on the ocean. Access to low-cost green hydrogen, large-scale, will of course help our entire industry and fundamentally all of our projects.

Logistics are built and priced into such Energy Ships. This is in stark contrast to desert projects, which are mostly far away from Europe. Long transport of H₂ is expensive, liquefaction or transformation to e-fuels is required, ultimately coming at a cost of \in 3-4 per kg H₂, in addition to production cost.

The KITE HYDROGEN SHIP project has come a long way. For its core, the K1 Kite Propulsion system, OCEANERGY tests prototypes on land at their proprietary kite test field in Cape Town, at the "Cape of Storms". These flight tests started in 2020 and have resulted in already four generations of their high-tech machinery.

After much experimentation in the field of Airborne Kites, by a number of companies in the last two decades, today we know

that with this specific Kite Propulsion system they have created a winning architecture. In particular, the system has virtually overcome all limitations to scalability. This is its most outstanding feature, because it allows to finally overcome the barrier to commercialization of kite technology.

The next phase will be a small prototype ship, 20 meter long. It will bring the entire technology on the ocean. In particular it will overcome intermittency in green power production. The small ship will bring the final proof. Graphic 2 shows the predictions, what will happen, gained from 120,000 simulated harvesting tours in last years' actual wind data. Energy Ships' mobility, with smart navigation, results in a drastic increase in capacity utilization. The generators operate almost all the time at their rated output power (Y-axis). And so will the electrolysers.

Other advantages of Airborne Kites augment these effects of mobility. Kites harvest at a very high altitude and can adjust their flight altitude adaptively. With this they can always find the right flight level with the best wind. It is quite fascinating that when you master this technology, wind power density can further quadruple. The moving platform, with its apparent wind effects, adds extra to these advantages. It can even increase power by another factor. As compared to a fixed-base mast-bound system, we get an astounding 32 times more wind energy harvest per year and square meters. It more than compensates the increased operating costs of such Energy Ships, which need to account for a crew and for kite recycling costs.



Graphic 2. The generators of mobile Energy Ships operate almost all the time at their rated power. The difference to a static wind power harvesting system is strongly evident, resulting in about 4x energy (MWh). Data: OCEANERGY AG.

"But then, personnel on board will work continuously on maintenance and minor repairs, and monitoring of the sensitive hydrogen production facilities. This pays into the lifetime and smooth operation of such Energy Ships" explains Wolfram Reiners, CEO.

If you ask yourself, how Energy Ships compare to more "traditional" clean hydrogen production technologies, here is a summary. OCEANERGY offers right now the opportunity for investment from our members. If you require a commitment of vast amounts of low-cost green hydrogen, this may be for you, as the company will dedicate such contingents to investors, perpetually. Other investors, which can achieve further synergetic value, next to mere ROI, may be companies who offer products which can be deployed on these ships, and which may then find a guaranteed customer.

For smaller investments, with an estimated multiplication of the invested capital of 10x over 7 years, there is the opportunity via a public funding exchange.

Hydrogen Europe Members can find the public funding exchange here, so called "Crowdfunding". There is also a 3-minutes video, explaining the Energy Ships Technology:

oceanergy.com/invest/



TRADE & FUNDING UPDATES

Fostering a stronger transatlantic hydrogen and clean energy partnership

In December 2023 the US treasury proposed the conditions under which hydrogen should be eligible for Inflation Reduction Act tax credits, resembling the support scheme under the EU but with notable differences. Diverging regulatory approaches to hydrogen will limit the competitive, transatlantic market necessary to massively deploy clean molecules and fulfil the European Union's import goals. The next Trade and Technology Council in Belgium is a good opportunity to address issues in the transatlantic hydrogen space and enlarge the Clean Transatlantic Marketplace, accelerating hydrogen deployment and realising hydrogen's contribution to climate mitigation, economic competitiveness, and energy security.

The Inflation Reduction Act of the United States substantially supports the deployment of clean hydrogen.

The IRA is set to raise a total of US\$739 billion and spend US\$433 billion, of which nearly US\$400 billion will be directed at energy security and climate policies. Primarily through tax credits, the Act will catalyse investments into increasing clean electricity production, onshoring the manufacturing of key energy transition components currently heavily controlled by China and accelerating the deployment of essential clean energy technologies such as clean hydrogen. For hydrogen specifically, the clean hydrogen production tax credit, also known as 45V tax credit, provides US\$3/kg for hydrogen with less than 0.45kg of CO2e per kg of H₂. Coupled with clean electricity tax credits, which amount to 2.6 cents per kilowatt-hour (kWh) or 30% of the initial investment, producers can get up to US\$4.50/kg of H₂, substantially driving down the levelized costs of hydrogen and accelerating the creation of a market for the clean molecule.

After a long-awaited time, the US has now proposed the conditions under which hydrogen is eligible for tax credits, mirroring but with notable differences compared to the EU Delegated Act in RED II.

In December 2023, the draft guidance determining which clean hydrogen would be eligible for US tax credits was published. In essence, the 45V tax credit guidance requires additionality, time matching (temporality), and geographical correlation conditions, three main building blocks that are also tacked in the EU Delegated Act for qualification as Renewable Fuels of Non-Biological Origin (RFNBOs). While some argue that the 45V Proposed Regulations are "stricter" than the RFNBO rules, this is an over-simplification: they each contain requirements that could be considered stricter than the other in certain areas.

Because of differences in approach, qualifying for the 45V Credit does not automatically qualify a facility as producing RFNBO compliant renewable hydrogen.

First, both the US and the EU mandate that the hydrogen facility's clean power source must have begun commercial operations within 3 years of the hydrogen facility coming online, although the EU exempts hydrogen plants put in place before 2028 from additionality until 2038. Second, both approaches ultimately mandate that power generation must occur at the same frequency as the hydrogen production it is feeding into in an hourly basis, although the US starts with annual correlation before moving to hourly in 2028, while the EU starts with monthly correlation and transitions to hourly in 2030. Third, both the 45V and the EU Delegated Act mandate that the clean power must be sourced within the same region as the hydrogen facility, although approaches differ on the definition of such regions. They also differ on the need for interconnection between power sources and the hydrogen facilities, with 45V allowing for Electricity Attribute Certificates, which grants producers more flexibility, while the EU requires PPAs with no intermediaries. Other key differences exist: the US allows for the use of subsidized clean electricity for clean hydrogen production and has a technology neutral approach to clean electricity, significantly diverging from the EU framework. The Greenhouse Gas (GHG) emissions rate calculation is also different (4kg CO2e/kg H₂ in the US versus 70% reduction in the EU, around 3.38kg/CO2e) and the scope of the calculation is more stringent in the EU (well-to-wheel) than the US (well-to-gate).

Addressing different regulatory approaches to clean hydrogen between the EU and the US will be essential to create the competitive, transatlantic markets needed to massively deploy clean molecules.

Large, harmonized hydrogen markets are needed to deploy hydrogen at scale, lower its cost curves and, most importantly, realize its climate, economic and security benefits, including fulfilling EU's diversification and hydrogen import goals. Given its differing approaches, the EU and the US need to work together to refine and harmonize their frameworks to allow for the scale up of clean hydrogen. For additionality, the US can consider including grandfathering clauses in line with the EU. In terms of temporal matching, and with both the EU and the US pushing for hourly matching, transatlantic partners should reconsider their approaches by thoroughly studying the effects of mandating hourly correlation requirements in such a short timeframe, their impacts on the levelized cost of hydrogen, and the environmental effects of opting for monthly or annual correlation instead given strict additionality rules.

Today, many studies already show hourly correlation can increase hydrogen costs by 20–30% and is not necessarily needed to ensure a positive impact on GHG emissions, with monthly correlation already achieving up to a 90% GHG emissions reduction.

Strict hourly correlation in the short term can thus increase costs, delay industrial decarbonisation, and lower EU and US clean technology and climate leadership for very little climate gains. In terms of geographical correlation, partners will need to agree on the definition of zones and the EU to decide on whether the 14 proposed zones under the 45V equate to biddings zone under the EU framework and, if not, what sub-zones would. Other elements should be discussed in the transatlantic context and considered in the EU, from the acceptability of electricity attribute certificates and virtual PPAs, to the adequacy of subsidised clean electricity for clean hydrogen production and the harmonisation of carbon intensity accounting approaches. For trade in low carbon hydrogen specifically, it will also be fundamental to address common definitions and accounting methods, including for the biogenic CO2 used in hydrogen derivatives, as well as the potential effects of the Carbon Border Adjustment Mechanism (CBAM) Until many of these issues are tackled and certification streamlined, US projects looking to export green molecules to the EU will find it difficult to reach final investment decisions.

The next Trade and Technology Council (TTC) in Brussels is a good opportunity to address issues in the transatlantic hydrogen sector and enlarge the Clean Transatlantic Marketplace.

While the climate and energy space of TTC has so far focused pre-eminently on carbon border adjustments, green steel, and other low carbon goods, the next TTC meeting can and should be focused on streamlining the conversation on tangible issues affecting the emergence of a true transatlantic marketplace for new clean energy technologies likeclean hydrogen. Ensuring the harmonisation and the interoperability of hydrogen regulatory frameworks and streamlining market access for electrolysers in the EU and the US is not only feasible but also has the power to substantially support the quick deployment and the positive climate, security, and economic contributions of hydrogen. This is even the more so critical given elections in both sides of the Atlantic, which are not only likely to delay the publication of the final hydrogen rules in the US, and potentially derail them completely if there is a change in administration, but also change the general approach to climate policy in the EU, including by pushing for an earlier review of the renewable hydrogen regulatory framework.

A targeted conversation on the need to harmonize hydrogen frameworks in the transatlantic space today is an opportunity to prepare the ground for greater convergence of rules in the short term, reinvigorating the climate and energy space of the TTC. Hydrogen can thus become the kickstarter for the TTC platform to become more ambitious on essential discussions not only for hydrogen but for clean energy at large, reconciling green industrial strategies in the transatlantic context and advancing discussions on essential issues from critical raw materials, to demand creation, joint investments in the global south and green subsidies, among others.

> By Pau Ruiz Guix, Officer, Trade, Hydrogen Europe

TRADE & FUNDING UPDATES

Global race on hydrogen technologies



© Justin Jin for Hydrogen Europe



Possibly the most popular subject of comparison between different geographies, electrolysis is one of the cornerstones of hydrogen production, enabling the conversion of renewable electricity into hydrogen through the splitting of water molecules. This process is crucial for establishing a sustainable hydrogen value chain, as the hydrogen is produced without carbon emissions.

The two main types of electrolysis currently manufactured and operated are the well-established Alkaline (ALK) and the rather recently matured Proton Exchange Membrane (PEM) Electrolysis. Among projects currently under construction in Europe, a cumulative 1.2 GWel have opted for alkaline technology, in contrast to 0.4 GWel for PEM. For projects aiming for operation by 2030 the announcements are very balanced with 6.8 GWel to utilise ALK technology and 6.7 GWel to utilise PEM technology.¹

Less mature electrolysis technologies include Solid Oxide (SO), Anion Exchange Membrane (AEM) and Proton Conducting Ceramics (PCC) electrolysis. The latter is still being researched and developed in the laboratories at the moment, whereas SO and AEM will likely start to compete for a serious market share within this decade.

To reach cost competitive and economically viable prices for green hydrogen, efforts around electrolysers are concentrated on enhancing their efficiency, reliability, longevity, scalability, lowering use of costly materials and developing automated manufacturing.

Europe has been the historical first mover in this industry with many electrolyser manufacturers founded on the continent. In recent years China and the United States have begun to invest heavily in research and development

(R&D) to optimise their electrolysis technologies striving for market dominance.



Fuel cells are at the forefront of the hydrogen revolution, powering diverse applications ranging from portable devices over transportation to industrial processes. Fuel cells generate electricity through the electrochemical reaction between hydrogen and oxygen, producing only water as a byproduct. Their high efficiency and versatility makes them a clean and efficient energy solution and key technology of the hydrogen sector. Fuel cells also provide an alternative for the well-established internal combustion engine (ICE).

The dominant type of fuel cell is based on Proton Exchange Membrane (PEM) technology which operate at a fairly low temperature, typically between 50°C - 100 °C, enabling fast ramp up times and fast respond times to changes in power demand which make them good candidates for mobile and portable applications. Solid Oxide (SO) fuel cells are currently at a lower technical readiness level (TRL) but should become a great complement to PEM fuel cells, particularly fit for higher temperature environments (~600 – 1,000°C). Additionally, SO fuel cells can cope with higher fuel impurities or even different fuel inputs like natural gas or biogas.

The development needs for the different types of fuel cells vary, depending on their unique attributes, but general efforts around the development of fuel cells involve improving durability and lifetime, increasing efficiency, improving flexibility in terms of alternative fuels/ impurities, and scaling up and moving to mass-manufacturing.


Efficient storage and transportation of hydrogen via pipelines or tube trailers are critical challenges that require advanced compression technology. The significance of compression technology lies in overcoming hydrogen's low energy density, making it practical for various applications in storage and transport. Key technologies do not only include compressors, but also the tanks that efficiently store the compressed hydrogen onboard vehicles, enabling them to achieve sufficient range and performance.

Various applications within the hydrogen sector require purposebuilt hydrogen compressors, tanks, and tube trailers. In the mobility sector, hydrogen is commonly pressurised to ranges between 350 and 700+ bar for refuelling high-pressure storage tanks whereas pipeline injection happens at up to 100 bars. Additionally, hydrogen refuelling stations experience intermittent usage, subjecting compressors to stop-start loads.

There is a need for compressors designed specifically to offer improved reliability and increased efficiency compared to current models as well as scaling up the technologies to cope with future demand. Global competition is not only about creating the highest performing compression methods but also about reducing the cost of densifying hydrogen as well as the expensive advanced materials currently employed for compressed storage and transportation.

ADVANCED MATERIALS: CATALYSING PROGRESS IN HYDROGEN TECHNOLOGIES

The pursuit of advanced materials is a common thread in the technological ambitions of different geographies aiming to lead the hydrogen revolution. Global key players are investing in researching and developing materials crucial for the efficiency and durability of hydrogen technologies. Amongst others, these materials include catalysts and membranes for fuel cells and electrolysers, different nanostructured materials and components for high-pressure storage as mentioned previously – the essentials for hydrogen technologies in optimising the electrochemical processes involved in hydrogen production, conversion, and storage.

03

Advanced materials play a transformative role in overcoming efficiency barriers, reducing costs, potentially replacing critical raw materials (CRM), e.g. platinum group metals (PGM), and extending the lifespan of hydrogen technologies. Breakthroughs in materials science are accelerating the commercialisation of hydrogen solutions, making them more economically viable and appealing for widespread adoption.



Hydrogen carriers are essential for addressing the challenges associated with storing and transporting hydrogen, including its low energy density. Hydrogen carriers encompass various technologies and materials that enable the storage and transportation of hydrogen in a safe and practical manner. These carriers may include liquid organic and inorganic hydrogen carriers, metal hydrides, or solidstate materials capable of absorbing and releasing hydrogen.

Hydrogen carriers play a crucial role in overcoming the limitations of direct hydrogen storage methods, offering solutions that enhance the energy density, safety, and practicality of hydrogen utilisation. Advancements in hydrogen carrier technologies are key enablers of scalability and versatility in hydrogen solutions across industries, facilitating the widespread adoption and integration of hydrogen into the wider energy value chain.

Hydrogen carriers may be employed to transport hydrogen in vast amounts over great distances between different continents.

This means that the carriers of choice will not only dictate the production pathways in the producing location, but also the "cracking" infrastructure at the destination. Cracking refers to the process of splitting the hydrogen carrier in hydrogen and the atoms, molecules, and materials it was combined with. The choice of large-scale hydrogen carriers will therefore have big implications on the global supply chain.

As the hydrogen sector takes shape, the competition among different geographies intensifies in the pursuit of technological leadership. The battlegrounds of electrolysis, fuel cells, compression technology, advanced materials, and hydrogen carriers represent key arenas where innovation and breakthroughs will define the future. The race is not merely about securing a technological lead but also moving the trajectory of the energy landscape for generations to come. In the following editions of the Hydrogen Europe Quarterly, we will take a more in-depth look at these many ongoing races.

By Dominik Richter, Senior Officer, Trade, Hydrogen Europe

TRADE & FUNDING UPDATES

Harnessing Hydrogen: The Key to Clean Energy Through Standardization

Standardization plays a crucial role in the development of the hydrogen industry, it is essential for innovation, safety and integration into global markets. As hydrogen emerges as a clean energy source, the establishment of standards is paramount to guide its development and ensure compatibility with existing systems. International and national bodies such as ISO and CEN, or the European Clean Hydrogen Alliance's (ECHA) standardization working group, are central to this effort. Their work ensures that hydrogen technologies meet the safety, efficiency and interoperability standards that are essential for global acceptance and innovation. This article aims to highlights the importance of standardization in promoting sustainable growth, safety and technological advancement in the hydrogen sector, and underlines its importance beyond mere technical specifications but also touch upon geopolitical and technological promotion aspects.

The Foundation of Harmonization: Progress through Standardization

But to better understand the importance of standards let us delve into the development of industrial standards, the history and its central role to global industrialization. Beginning with the Engineering Standards Committee (ESC) in London in 1901, which later became the British Standards Institution (BSI), efforts were made to improve product quality and compatibility while reducing costs. This initiative led to the creation of similar bodies around the world, such as DIN in Germany (1917), ANSI in the USA and the French Commission Permanente de Standardization (both 1918). The International Organization for Standardization (ISO) was then founded in 1947 by 25 national standards bodies to manage the development of voluntary international standards.

The creation of these organizations during or after the First World War was a response to efficiency crises caused by the lack of standardization, rooted also in the malfunctioning of machine guns due to non-standardized parts. This affected not only the machinery, but also the morale and safety of the soldiers, highlighting the need for standardized components.

National Standards Bodies (NSBs) play a crucial role in developing standards today, that ensure quality, safety and efficiency across all industries, including for the hydrogen sector. Their work facilitates innovation and international cooperation, making standards not just guidelines but catalysts for progress.

The Hydrogen Sector's Standardization Imperative

Standardization is particularly essential in the hydrogen sector to meet the challenges of safety, sustainability and integration into the energy matrix. It plays a multifaceted role in guiding the development of the sector, ensuring safety and facilitating interoperability with existing energy infrastructures. Standards provide:

GROWTH FACILITATION: Standards ensure the quality of hydrogen technologies, boosting confidence among investors, policymakers, and consumers, thereby spurring industry growth.

SAFETY ASSURANCE: Given hydrogen's high flammability, standardization in safety protocols is essential for public safety and accident prevention.

INTEROPERABILITY AND INTEGRATION: Ensures compatibility with sectors like transportation and energy, easing integration challenges.

INNOVATION SUPPORT: By providing a foundational framework, standards encourage technological advancements while ensuring safety and compatibility.

GLOBAL MARKET ACCESS: Facilitates international trade, essential for the sector's global sustainability and acceptance.

QUALITY AND MAINTENANCE: Guides inspections and maintenance for long-term efficiency and reliability of hydrogen technologies.

ENVIRONMENTAL CONSIDERATIONS: Promotes sustainable production and use of hydrogen.

REGULATORY ALIGNMENT: Helps the sector adhere to regulations, mitigating legal and operational risks.

CONSUMER CONFIDENCE AND MARKET ADOPTION: Standardization builds consumer trust in hydrogen technologies' safety, reliability, and environmental friendliness, enhancing market adoption.

In essence, standardization is foundational for the hydrogen sector's successful growth, innovation, and integration into the global energy landscape.

Success Through Standardization in the Hydrogen Economy

Hence, standardization is crucial to the global transition to clean energy, in which hydrogen plays a key role, as an energy vector. Led by organizations such as ISO and CEN, standardization is addressing the challenges of hydrogen technologies, promoting interoperability, safety and market acceptance. This section highlights five exemplary case studies that illustrate the impact of standardization on the hydrogen energy sector.

HYDROGEN FUEL INFRASTRUCTURE: The ISO/TC 197 committee's work focuses on hydrogen technologies, including hydrogen fueling stations, such as EN ISO 14687, which ensures fuel quality at hydrogen fueling stations, supporting diverse vehicle models and operational safety.

HYDROGEN STORAGE AND TRANSPORTATION: Standards like ISO 16111 by ISO/TC 197 for gas storage devices have led to the development of safe, high-pressure containers, showcasing the scalability of hydrogen storage solutions.

INTEGRATION WITH RENEWABLE ENERGY: The ISO/TC 197 facilitates hydrogen production through electrolysis within renewable energy systems, adhering to standards like ISO 22734. This enhances grid stability and supports the integration of renewable energies by providing grid services such as frequency regulation and load balancing.

SAFETY IN INDUSTRIAL APPLICATIONS: ISO 45001 provides a framework for health and safety in hydrogen facilities, promoting worker safety and risk minimization.

QUALITY ASSURANCE IN MANUFACTURING: The implementation of ISO 9001 in the manufacturing of hydrogen technologies ensures product reliability and quality control, as seen in the rigorous processes of a German manufacturer.

Additionally, cross-sector collaboration, guided by standards like ISO 17268, exemplifies the seamless integration of hydrogen

technologies with the automotive industry, ensuring vehicle compatibility with infrastructure.

These case studies highlight the essential role of ISO and national standardization bodies in solving the hydrogen sector's challenges, enabling the harmonious growth and deployment of hydrogen technologies across industries and regions.



Understanding Standardization and Committee Participation

Standards committees, such as those of ISO or national standards bodies, are made up of experts from different fields who work together to create and update international standards. These committees cover specific sectors or topics and work to draft, review and revise standards to ensure they support innovation, safety and efficiency. To join as an expert, you will usually need to be nominated by a member organization or industry association.

Interested individuals can contact their national standards body or **contact Hydrogen Europe** and we will help you with finding your into the right committee. Participation allows professionals to influence industry standards, network and contribute to global best practice and technological advancement.

In the hydrogen industry, active participation in standardization at European and international level is crucial. A wide range of stakeholders are involved in this process, including government agencies, industry and environmental organizations. Their involvement ensures that the standards developed take account of all interests and promote practical, sustainable regulations that encourage innovation. The hydrogen sector's active involvement in standardization is essential; without it, there is a risk that the standards developed won't fully reflect the sector's unique needs and potential, potentially stifling growth and competitiveness. By having a seat at the table, the hydrogen industry can ensure that standards reflect its technological advances, challenges and competitive advantages. This collaborative approach to standardization not only safeguards the interests of the industry, but also helps to create fair and inclusive standards that support the sustainable expansion of the hydrogen economy, which is particularly important in the context of Europe's energy transition.



Global Giants: The Battle for Dominance in (Hydrogen) Standards

Internationally, the stakes are higher as the hydrogen industry's global implications for energy, environment, and economy draw in a wide array of interests. Advanced hydrogen technology nations seek competitive advantages through standards, while developing countries strive for inclusive standards to join the hydrogen economy. This scenario has created geopolitical tensions, particularly evident in China's strategic efforts to influence global standards via initiatives like the 'China Standards 2035', aiming to establish global technology standards, including for hydrogen. This sets the stage for strategic competition over technological dominance in standardization between China, the US, the EU, and other global economies.

In China, GB standards¹⁵, which are either mandatory (GB) or voluntary (GB/T), play a crucial role. Mandatory standards are compulsory within the Chinese market, akin to regulatory requirements, whereas voluntary standards, though not legally binding, greatly influence industry compliance. Understanding and adhering to these standards is critical for both domestic and international businesses entering the Chinese market, emphasizing the importance of GB standards in China's global technology standards strategy.

The rivalry in hydrogen sector standardization, especially between Europe and China, underscores the geopolitical importance of setting global technological norms. While Europe has traditionally led in international standard development through organizations like ISO and International Electrotechnical Commission (IEC), China's increased involvement challenges this dominance with its financial and participatory influence. Europe's response emphasizes maintaining global standards that are free from political influence, aiming to preserve the voluntary, industry-led nature of standardization processes. Concerns over China's potential to dominate hydrogen standards, possibly leading to global licensing disputes and disadvantaging European industries, have prompted the European Commission to actively coordinate regulation and standardization efforts, also via the <u>High-level</u> <u>Forum</u>¹⁶. With one of its aims to protect Europe's leadership in the clean energy transition against growing influences.



In response, Europe's standardization strategy emphasizes the importance of insulating global standards from political influence and aims to maintain the voluntary, industry-led nature of standardization processes. Europe is wary of China's potential to dictate hydrogen standards, which could lead to global licensing disputes and undermine European industry. The European Commission is actively coordinating regulatory and standardization efforts to ensure Europe's leadership in the clean energy transition, despite China's growing influence.

16 / https://single-market-economy.ec.europa.eu/single-market/european-standards/standardisation-policy/high-level-forum-european-standardisation_en

^{15 /} The acronym "GB" stands for "Guobiao", which translates to "national standard" in English.

The Industry's Voice:

Shaping the Future of Hydrogen Standardization

In this context, the role of the International Organization for Standardization (ISO) and the European Committee for Standardization (CEN) as impartial facilitators of the standardization process, striving for transparency, inclusiveness and a balance between technical precision and the various political and economic interests at play, is crucial. Effective lobbying and advocacy, taking into account the different stakeholder perspectives, is essential to develop standards that are both technically sound and socially and environmentally responsible.

The hydrogen sector faces unique challenges in terms of safety, environmental impact and technological feasibility, requiring a collaborative approach to standardization to support a sustainable hydrogen ecosystem. Active participation in standardization is key to influencing the future of the hydrogen industry. Despite the difficulties of managing diverse interests and ensuring ethical advocacy, these efforts represent an opportunity for stakeholders to come together to build a sustainable, efficient and globally integrated hydrogen economy. Success depends on transparent and constructive advocacy with the aim of creating standards that are fair, forward-looking and beneficial to all stakeholders.

Come and join us and get involved in the Committees!

By Maximilian Kuhn, Advisor, Hydrogen Europe



Innovations in hydrogen from biomass through gasification used for obtaining value-added products: From protein for feed & food to bioplastics



Hydrogen can be obtained via different pathways, e.g. steammethane reforming or electrolysis (splitting water with electricity). The latter has become popular as power-to-gas using excess renewable energy. The biological route is currently being explored as an alternative, where microorganisms yield H₂, while there are numerous other "colours" of hydrogen¹.

An innovative way for hydrogen production is through synthesis gas (syngas), a mixture of H₂ and CO which has traditionally been obtained from coal. Syngas is also accessible through biomass. Biomass gasification is an emerging technology for combined heat and power (CHP), as it can yield a higher electrical efficiency than traditional biomass combustion.

The synthesis gas from biomass gasification is then subjected to a water-gas shift reaction to increase its H_2 content. When the formed CO_2 is sequestered, carbon-negative hydrogen can be obtained.

Syngas, used at scale, can produce petrochemicals via the Fischer Tropsch process, involving catalysts, high temperatures and high pressures. An alternative to using syngas, besides through combustion, is with gas fermentation, where the $H_2/CO_2/CO$ mixture is converted into products of interest by biocatalysts - microorganisms which feed upon the gases.

The advantages of bacteria over catalysts are their robustness against contaminants and their ability to synthesize complex compounds in a cost-effective manner. Classic fermentation uses carbohydrates (starch, sugar) as carbon and energy source. This raises concerns for high-volume products, comparable to first generation biofuels, where scale-up will lead to competition over feed and food production.

Gas fermentation is a vibrant field of interest, where gaseous feedstocks (methane, syngas and various industrial waste gases such as blast furnace gas) are fed into bioreactors. These bioreactors increase the conversion rate of feedstock compared with classic fermenters. They struggle with the low solubility of the gases

compared to carbohydrates, leading to lower cell densities in fermentation and higher downstream processing efforts for biomass extraction and purification. These disadvantages are offset by the wide and low-cost availability of the raw materials from which syngas can be made.

A particular point worth mentioning here is the feedstock flexibility and the possibility to use side and waste streams of biomass for gasification. CH4 and CO contain sufficient energy for a fermentation process, and the use of CO_2 requires H₂ for energy supply to the deployed microorganisms. The addition of hydrogen allows even CO_2 streams to be recycled, such as CO_2 from a cement plant or another carbon-intense industry, or CO_2 from direct air capture (DAC), preferably from an enriched gas such as ventilation air in a building. Hydrogen through gas fermentation allows for the decarbonisation of several high-volume industries. Biomass gasification has been demonstrated at scales from a few 100 kW to ~20 MW, with the Swedish GoBiGas project aiming at 100 MW².

Biomass gasification for hydrogen production

In biomass gasification, a dry raw material is required, with no more than 10% water content. An integrated plant would use the process waste heat to dry the input material. Some challenges to overcome are the formation of tar and the operability of the gasification plant, where 8000 full load hour and more per year can be reached. Approximately 4% of the input material (wood chips) is converted into biochar, which can also be monetized.

Methane can also be obtained from biobased hydrogen through a methanation step, like with CO_2 in the Sabatier process, where both H_2 and CO_2 are available, such as electrical renewable energy next to a biogas plant. Syngas itself only contains a few % of CH4. The CH4 can also be subjected to gas fermentation, in an aerobic process where methanotropic bacteria produce materials of interest.

^{1 /} Jimena Incer-Valverde, Amira Korayem, George Tsatsaronis, Tatiana Morosuk, "Colors" of hydrogen: Definitions and carbon intensity, Energy Conversion and Management, Volume 291, 2023, 117294, ISSN 0196-8904, https://doi.org/10.1016/j.enconman.2023.117294.

^{2 /} https://www.goteborgenergi.se/Files/Webb20/Kategoriserad%20information/Forskningsprojekt/The%20GoBiGas%20Project%20-%20Demonstration%20of%20 the%20Production%20of%20Biomethane%20from%20Biomass%20v%20230507_6_0.pdf

 ^{3 /} Kyle A. Alvarado, Juan B. García Martínez, Michael M. Brown, Xenia Christodoulou, Scot Bryson, David C. Denkenberger, Food production in space from CO2 using microbial electrosynthesis, Bioelectrochemistry, Volume 149, 2023, 108320
4 / García Martínez Juan B., Pearce Joshua M., Throup James, Cates Jacob, Lackner Maximilian, Denkenberger David C., Methane Single Cell Protein: Potential to

^{4 /} Garcia Martinez Juan B., Pearce Joshua M., Throup James, Cates Jacob, Lackner Maximilian, Denkenberger David C., Methane Single Cell Protein: Potential to Secure a Global Protein Supply Against Catastrophic Food Shocks, Frontiers in Bioengineering and Biotechnology 10, 2022, DOI=10.3389/fbioe.2022.906704

Materials from hydrogen – enabled by gas fermentation

We must not overlook the impact of materials and food production on climate change. Although non-energy and non-agricultural materials constitute only a small subset of all raw materials and natural resources in the EU, they account for almost 20% of all greenhouse gas emissions in the EU⁵. Hence, carbon-neutral or even carbon-negative products are of high interest.

SINGLE CELL PROTEINS

Microbial protein, also known as single cell protein (SCP), holds great promise as alternative protein. Back in the 1970, SCP, made from methanol and methane, was brought to market but lost out to cheap imported soy. SCP is now seeing a revival for the feed industry, targeting the replacement of fish meal in aquacultures and chicken rearing, and also in the food sector. Among all "cellular agriculture" approaches, SCP holds great promise, at it is a scalable technology that was also considered as a possible solution to a global food catastrophe^{4,7}. Bacteria grow much faster than fungi (yeasts) and algae, so bacterial protein meal (BPM) has the strongest potential for scalability and low costs. The protein demand per person is estimated at 60-70g per day, which translates into a market of ~200 million tons/year. Hydrogen could become a key enabler of this industry.

BIOPLASTICS

Under nutrient stress, several microorganisms were found to synthesize a carbon storage compound - polyhydroxyalkanaotes (PHA) – which can subsequently be extracted and put to use as a bioplastics material. Gas fermentation allows the production of PHA without the use of primary agricultural resources. While the classic production route of the material needs 2.8 kg sugar/kg of PHB, gas fermentation can yield 1kg of PHB from approximately 2kg of methane. Companies working on PHA from methane are, for instance, US-based Mango Materials and Austrian CIRCE Biotechnologie. PHB production from syngas was demonstrated by Flüchter et al.⁸. The plastics industry has an annual production volume of 400 million tons, of which bioplastics like PHA can technically replace up to 90%. Hydrogen can be at the core of the polymer industry – while bioplastics today only have 2% market share, they are growing fast.

Other compounds are accessible from H₂ through gas fermentation, such as fuels. Lanzatech has emerged as one of the market leaders in syngas fermentation, targeting the biofuels industry and lately going for sustainable aviation fuel (SAF)9. While biomass gasification has been developed for energy production - power and heat -, the concept of polygeneration creates additional and possibly higher value by converting the syngas into useful products. Such a process, be it a thermochemical one like Fischer Tropsch synthesis or a biological one like gas fermentation, offers additional revenue potential to operators of the (biomass) gasification plants, and for other producers of hydrogen. Gas fermentation can convert hydrogen into useful products, and recycle CO2, to make carbonneutral and carbon-negative products. Anthropogenic emissions that contribute to climate change not only stem from transportation - our food systems contribute approx. ¼ of the man-made greenhouse gases, and materials at large are responsible for almost half of our greenhouse gas emissions. By using hydrogen in gas fermentation, these industries can be transformed, and hydrogen can hence be at the center of the entire pursuit for sustainability, not only as (transportation) fuel.

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7 / Juan B. García Martínez, Joseph Egbejimba, James Throup, Silvio Matassa, Joshua M. Pearce, David C. Denkenberger, Potential of microbial protein from hydrogen for preventing mass starvation in catastrophic scenarios, Sustainable Production and Consumption, Volume 25, 2021, Pages 234-247, https://doi.org/10.1016/j.spc.2020.08.011

8 / Flüchter S, Follonier S, Schiel-Bengelsdorf B, Bengelsdorf FR, Zinn M, Dürre P. Anaerobic Production of Poly(3-hydroxybutyrate) and Its Precursor 3-Hydroxybutyrate from Synthesis Gas by Autotrophic Clostridia. Biomacromolecules. 2019 Sep 9;20(9):3271-3282. doi: 10.1021/acs.biomac.9b00342. Epub 2019 May 15. PMID: 31066546.

^{5 /} EEA, https://www.eea.europa.eu/publications/improving-the-climate-impact-of 6 / https://solarfoods.com/solar-foods-receives-novel-food-regulatory-approval/

^{9 /} https://www.lanzajet.com/



Wood chips as feedstock for gasification to obtain biobased synthesis gas



A fixed bed gasifier (300 kWetectric, 500kWitterna), consuming approx. 180 kg/h of wood chips. Picture provided by GRESCO Power Solutions (Austria).



POLICY & MARKET UPDATES

Greenhouse gas accounting rules must be done right to secure a global hydrogen market





Having an open and transparent debate on this topic is especially important as we are already seeing divergences between the approach adopted by the EU in the RED Delegated Acts and the rules proposed by the 2022 US Inflation Reduction Act (IRA) relating to clean hydrogen production credits. While there is still a debate on which one is stricter, the main issues are the differences (i.e. bidding zones, virtual PPAs, use of subsidised electricity) that make it difficult to qualify for the US credits and RFNBO definition at the same time, consequently making it challenging for the global hydrogen market to emerge.

The differences between the EU and US rules and the new ISO standard, published at COP28 in December 2023 – i.e. ISO/TS 19870:2023 Methodology for determining the greenhouse gas emissions associated with the production, conditioning and transport of hydrogen to consumption gate, make the environment even more complex to navigate for investors. And things are strained further by the fact that the EU has only now started its work on a delegated act on GHG allocation rules for low-carbon hydrogen. For the latter, the impact of the rules can be as profound as for renewable hydrogen.

This is well demonstrated by the example of natural gas reforming with carbon capture and storage (CCS). Even while assuming a high CO_2 capture rate of 94%, the treatment of upstream emissions related to natural gas supply can be the decisive factor in determining whether the produced hydrogen qualifies as low-carbon or not. In the current RED Delegated Act, the default value for natural gas is 9.7 gCO₂/MJ, which is based largely on emissions for natural gas delivered by pipelines from Russia.

Such an emission factor however would not be appropriate for gas delivered from the Netherlands or Norway, where a longstanding ban on routine flaring, carbon taxation as well as the common use of fully welded pipelines and relatively shorter distances to main markets, combined with the use of low carbon hydropower electricity at onshore facilities result in a significantly lower upstream carbon intensity. On the other hand, LNG imported from outside of the EU as feedstock would be characterised by an even higher emission intensity – making it next to impossible to produce taxonomy aligned hydrogen ($3.0 \text{ tCO}_2/\text{tH}_2$), even with a very high CO₂ capture rate (94%).



Well-to-gate emissions for hydrogen from NG reforming with CCS depending on the NG source

Source: own estimations, assuming ATR+CCS with a 94% CO₂ capture rate and based on natural gas carbon footprint from DBI "Carbon Footprint Natural Gas 1.1", 2021, EC RED DA and the GREET 2023 model.

Given the importance of upstream natural gas emissions, the approach taken by the 45V regulation is more flexible, allowing for a case-by-case evaluation, whereas the EU RED DA puts forward a single default value to be used by all projects.

The above analysis is just a small sample of differences and the impact they can have on the final carbon footprint of hydrogen as a fuel. There are many other methodological options with regards to the approach towards the use of existing nuclear energy power plants for water electrolysis, the CO₂ allocation method for by-product hydrogen production processes or the recognition of the carbon removal potential of waste-to-hydrogen technologies, which can all have a similarly profound impact, highlighting why, in order to facilitate international trade of hydrogen, it is critically important not only to get the GHG accounting methodologies right, but also ensure consistency between rules applied in different regions.

The latter is especially crucial for countries without access to abundant and cheap renewable energy, where alternative hydrogen production pathways might prove to be a necessity to facilitate the development of a local low-carbon hydrogen market. These technologies can supply hydrogen at a very competitive cost level, below €3.0/kg, while also providing additional benefits, like production of co-products valuable for the energy transition (carbon/ graphite from waste or gas pyrolysis), productive management of non-recyclable waste streams, net-carbon removal (in case of biowaste-to-hydrogen) and many others.

It is therefore critically important that the European Commission, when preparing the low-carbon Delegated Act, does not slow down the development of these technologies and ensures a level playing field between renewable and low carbon hydrogen pathways.

By Grzegorz Pawelec, Director, Regulatory & Market Intelligence, Hydrogen Europe







POLICY & MARKET UPDATES

ETS free allowances: limited but useful support for clean hydrogen production

The EU Emission Trading System (ETS) is the EU's main tool to reduce greenhouse gas (GHG) emissions and reach climate targets. Established in 2005, the 11,000 installations covered by the ETS have an obligation to buy emission allowances: each allowance gives its holder the right to emit 1 tonne of GHG. Consequently, emission allowances are auctioned to operators of the covered installations. The annual number of allowances is capped with a linear reduction factor reducing this cap over the years. This evolution will eventually bring covered emissions to zero (by around 2040 according to the new linear reduction factors) and will exert an increasing price pressure on available allowances. Under this "cap & trade system", emitters can trade their allowances with each other, creating a secondary market. If the demand for allowances doesn't decrease fast enough, the supply of allowances will grow smaller compared to demand, increasing their price. The average price of allowances in the EU ETS in 2022 and 2023 was around 80 EUR/tCO₂, a far higher level compared to a few years back.

The higher the carbon price, the higher the risk of carbon leakage. For Europe, this is the risk that a carbon-intensive industry shifts its activities from the EU to a third country where the carbon price is lower or where there is no carbon tax at all.

To avoid such situations, allowances allocated free of charge ("free allowances") have so far been given to sectors deemed to be at risk of carbon leakage (assessed on the double intensity in terms of trade and carbon emissions for each sector). Hydrogen production is covered by the ETS. Until its revisions in 2023, the system only covered steam methane reforming and partial oxidation plants,





with daily capacity exceeding 25 tonnes of production. Because the production of hydrogen is exposed to global competition, it can also potentially be affected by carbon leakage, and so is eligible for free allowances.

Until now, the number of free allowances was based on historical production levels in the sector, the product's specific benchmark (based on the 10% least carbon intensive installations in the sector, so-called "best performers"), and a factor for exchangeability of fuels and electricity, among others. The exchangeability factor makes the allocation of free allowances based on direct emissions only while the determination of the benchmark values is based on both direct and indirect emissions. This means that, until last year, technologies that do not have any direct emissions (i.e. electrolytic hydrogen) could not receive free allowances.

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The revision of the EU ETS Directive enlarged the coverage to all means of hydrogen production, which paved the way for the eligibility of clean hydrogen to free allowances. It also decreased the coverage threshold from 25 to 5 Tonnes of daily production capacity, extending the eligibility of even more installations. In turn, the delegated regulation setting rules for the allocation of free allowances (the FAR) was adapted in 2023 to align it with the reviewed EU ETS. Two main changes on the hydrogen benchmark and the concept of exchangeability took place.



The hydrogen benchmark was redefined in a way that is independent of the production process, an essential step in providing fairness for all technologies.



The concept of exchangeability of fuel and electricity was removed, impacting both the determination of the amount of free allocation and the calculation of benchmark values. Impacts on the former are that zero-direct emissions hydrogen production can benefit from free allowances too. Impacts on the latter are that the number of free allowances will be based on direct emissions only. Thus, support to compensate for indirect emissions is compatible and alreadyexisting State Aid for indirect cost compensation can continuously be allowed.

The last-highlighted change is a key one, making sure State Aid can still be provided by Member States to compensate hydrogen producers that consume electricity that is more expensive due to carbon pricing. The rules should be revised by DG COMP in the next months.



Free allowances are unconditional if installations are above the production threshold, in the same style as the US Inflation Reduction Act's (IRA) Production Tax Credit (PTC). As such, they represent an attractive option for OPEX support.

Nonetheless, three elements should be kept in mind. Firstly, we estimate that, depending on benchmark levels and carbon prices, free allowances would represent support of between €0.20 and €0.80/kg of clean H₂ produced – which is not negligible, but lower than the US IRA's PTC (\$0.60 - \$3/kg) and not enough to close the cost gap between conventional and clean hydrogen production. Thus, instruments such as the Hydrogen Bank and other support mechanisms are highly needed.

Secondly, given the sector's coverage by the Carbon Border Adjustment Mechanism (CBAM), the eligibility of free allowances to hydrogen production is temporary: allocated free allowances for hydrogen will gradually drop, before their complete phasing out in 2034.

Thirdly, hydrogen produced for ammonia production is not eligible to free allowances to respect the principle of no double allocation. Ammonia production will receive free allowances based on the ammonia benchmark. The hydrogen and ammonia producers will have to agree on how they plan to share any profits derived from the resale of free allowances.

After a short period of public feedback, the FAR has been sent to the Council and the Parliament on 30 January 2024 for a scrutiny period of 2 months where co-legislators can reject the act, as per the approval procedure for delegated acts. Hydrogen Europe welcomes the FAR and calls for its adoption as soon as possible.

By Bastien Bonnet-Cantalloube, Senior Officer, Industry & Sustainability, Hydrogen Europe



POLICY & MARKET UPDATES

Common offshore and H₂ infrastructure planning: challenge and necessity

Offshore hydrogen is a relatively new modality for hydrogen generation, which consists of producing hydrogen in an offshore environment, capturing the electricity produce by offshore wind turbines or, possibly, ocean or tidal energy. This solution can take advantage of economies of scale, facilitate access to more powerful and stable sources of renewable energy sources (RES), and enables offshore renewable energy to grow massively as it could remove its dependency on high voltage infrastructure. Although it is in an early stage of development, it's a promising production method which Europe should pursue.

There are three configurations to produce H_2 in an offshore environment:



Offshore distributed electrolysis

Offshore wind farms, or in some potential cases individual turbines, equipped with their own electrolysers. The hydrogen produced is then collected through multiple small pipelines, which converge into a main transmission pipeline for transportation to the shore. This approach is advantageous when there is a relatively small number of offshore wind assets in proximity, or when they are spread out over large distances.



This configuration involves connecting (electrically) all wind assets to a single offshore platform with a large electrolyser, with the hydrogen then being transported onshore via a large transmission pipeline. This method is beneficial in areas with a high concentration of nearby wind generation, as it allows for a higher capacity factor of the electrolyser and achieves some economies of scale.

Onshore hydrogen production with offshore

electricity

In this case, electricity is first transmitted to the shore through cables and hydrogen is produced there. This does not involve any new technology development as onshore electrolysers are proven and well understood. Deploying largescale electrolysers by the coast, near the landing cables, will enable a faster expansion of offshore wind capacity as it overcomes the need of having to reinforce the already saturated onshore grid.



Source: Hydrogen Europe¹⁰

Why do we need offshore H₂ production?

With the increase of H2 demand driven by the 2022 RePowerEU¹¹, Europe plans to produce 10 Mt of domestic H2 by an increase to 33 Mt by 2040¹², as envisaged by the 2040 Climate Targets. Reaching this target will require vast amounts of additional renewable power sources that will have to develop in parallel to renewable deployment for electrification: According to the Commission, stepping up our renewable hydrogen ambition would require around 500 TWh¹³ of additional power generation in 2030 that would also have to comply with the principle of Additionality laid out in RFNBO Delegated Act¹⁴. How does offshore H2 help tackle this problem? By easing the land availability and environmental pressures onshore and seizing offshore renewable potential. Offshore wind projects are also generally much larger than their onshore counterparts.

Furthermore, onshore grids are more congested every year: a quarter of Germany's offshore wind production was curtailed in first guarter of 2023¹⁵ due to underinvestment in the grid, a bottleneck that is unlikely to be solved before 2027. All this energy (or a large share of it) could be used to produce renewable hydrogen. With Europe setting its sights on connecting an ambitious amount of 111 GW of offshore wind by 2030 as agreed in the Wind Charter Treaty¹⁶, and almost 400 GW for 2040 according to the Offshore Network Developing Plan¹⁷, grid congestions are expected to increase as the onshore grid and landing points capacity are unlikely to develop as fast as offshore renewable capacity. Integrating H2 production to offshore facilities can help accommodate better integration of offshore renewable energy production.

As a result, expanding H₂ production beyond our shores (in any of the three abovementioned configurations) is a promising solution to these obstacles.

Moreover, the offshore environment presents numerous advantages for H2 production such as:

ENHANCED H2 PRODUCTION - floating wind farms can be situated further out at sea, tapping into stronger wind resources, which leads to more consistent wind availability and, consequently, improved productivity and higher utilisation of both the turbine and electrolyser.

GREATER COST-EFFICIENCY OF TRANSPORT INFRASTRUC-**TURE** H2 pipelines can transport up to 4 times¹⁸ more energy than high voltage Direct current (HVDC) cables and are much more affordable according to the US Department of Energy¹⁹. Besides the cost advantage, expanding offshore hydrogen infrastructure opens a vast opportunity to use existing oil & gas infrastructure; the cost of repurposing existing infrastructure is around 1/3²⁰ of the cost of developing new hydrogen pipelines.

A MANAGEABLE APPROACH WHEN IT COMES TO IMPACTS **ON MARINE ACTIVITIES.** Offshore hydrogen infrastructure could be located farther away from shore, reducing competition with activities such as shipping, fishing and military activities.

As a result, from a systemic point of view, offshore H2 production could address the structural issue of congestion, thus reducing costs of energy transportation and consequently easing the permitting bottlenecks Europe is facing. Moreover, it could help speed up VRES integration and allow for projects to develop faster, while interfering less with other marine activities.

- 13 / Questions and Answers on the EU Delegated Acts on Renewable Hydrogen, accessible here.
- 14 / Commission Delegated Regulation on RFNBO criteria, accessible here.
- 15 / Clean Energy Wire, accessible here.
- 16 / Wind Charter Treaty, accessible here.

19 / Cost of long-distance energy transmission by different carriers, accessible here.

^{11 /} European Comission, REPowerEU, accessible here.

^{12 /} European Commission, "Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society", accessible here. 12 / 100 Mtoe in Scenario 3 of 2040 targets.

^{17 /} ENTSO-e, ONDP, accessible here,

^{18 /} Analysis of costs and capacity for energy transport through different energy carriers (Department of Energy of the U.S.), accessible here.

^{20 /} ORE Catapult, accessible here.

Leading the way towards scaling up of offshore H₂ production

There are several innovation and demonstration projects working on offshore hydrogen solutions across Europe. One of the most notorious ones is the operating offshore electrolyser in Nantes, France, deployed by Lhyfe. This project, since its commissioning in 2023, is demonstrating that hydrogen can be produced safely and reliably in harsh offshore environments. Meanwhile in China, scientists showed they were able to successfully produce hydrogen from seawater by using a membrane-based seawater electrolyser²¹.

Beyond R&D, some countries are already working on the investment framework to develop the technology at larger scale, enabling to reach pre-commercial stage.

For instance, Germany plans 1GW of wind-powered green H₂ production at sea, with a pipeline to shore with a dedicated area in their Maritime Spatial Planning called SEN-1. By 2035, this infrastructure is anticipated to channel up to 1M tonnes of hydrogen yearly to Germany, with potential links to a forthcoming hydrogen pipeline connecting Norway and Germany²², The Netherlands has also chosen the site of the world's largest Offshore Wind-to-Hydrogen project, representing 500 MW of electrolyser capacity²³. Their operational target is for 2031, with an existing offshore wind farm and repurposing a nearby natural gas pipeline for transport of green H₂ to the shore. A pilot project of the plan with an electrolysis capacity of 50-100 MW will test and modify the technology so that the large-scale project is realised efficiently.

However, these are rather scattered initiatives that merit a strong united strategy across the EU.

That must translate into regulatory flexibility for initial demonstrators and pre-commercial projects. For larger-scale projects, the implementation of dedicated market mechanisms such as auctions specifically designed for offshore hydrogen production, is essential.

21 / More information accessible here.

22 / Aquaductus, accessible <u>here</u>. 23 / The Netherlands Chooses Site for World's Largest Offshore Wind-to-Hydrogen Project, accessible <u>here</u>. But more importantly, realizing this vision requires robust coordination in grid planning. The EU commitment to connect 111 GW of offshore wind by 2030 is extremely bold, and yet remains within our reach.

To succeed, however, Europe must look beyond the traditional methods of infrastructure planning: In one hand, offshore H₂ infrastructure could be integrated in the European Offshore Network Developing Plan (ENTSO-e just published in January the first ever ONDP). On the other hand, the European Network of Network Operators for Hydrogen (ENNOH) – to be set up by 2025 – will be charged with developing a dedicated hydrogen ten-year network development plan.

These two plans cannot be developed in silos if we want to embrace a more holistic and systemic approach to deployment of our critical grids and pipelines. Ultimately, that means striving towards an integrated TYNDP, covering electricity, gas and hydrogen infrastructures. Only by pushing for offshore hydrogen and enhancing grid integration will Europe be able to fully harness the maximum of its clean energy potential and achieve its ambitious climate and energy goals.

By Isabel Alcalde, Officer, Energy & Infrastructure Policy, Hydrogen Europe



Clean Hydrogen Partnership updates



The 2024 Call of the Clean Hydrogen Partnership has been published in January 2024 and is currently open for applications, with deadline to apply on 17 April.

A total of 113.5M€ is available for funding technology development. A total of 20 topics are published, covering the whole value chain: envelopes of 25M€ for Production, 27M€ for Storage & Distribution, 19M€ for Transport, 10M€ for Heat & Power, 5M€ for Cross-cutting issues and 29M€ for Hydrogen Valleys. In addition, an envelope of up to 60M€ from RePowerEU is available to fund additional valleys, leading to a total of up to 89M€ funding for Hydrogen Valleys this year.

In parallel, Hydrogen Europe members are already working on the co-definition of the Call 2025, together with the European Commission. A budget of about 90M€ is expected, with an addition of up to 80M€ from RePowerEU dedicated to Hydrogen Valleys.

For Hydrogen Europe members, the Innovation team, under the leadership of Michael Diderich, is available to offer guidance and support for any questions or concerns you may have.

The Hydrogen Europe Secretariat urges all Industry Corporate members to log in to the dedicated membership platform and explore the customized services tailored specifically for them.

All 2024 topics are available on the **Funding & Tenders portal** of the European Commission.



Repartition of AWP24 budget across Pillars & Actions



Innovative proton conducting ceramic electrolysis cells and stacks for intermediate temperature hydrogen production

Steam electrolysis using proton conducting ceramic electrolysis cells (PCCEL) is a promising technology that operates at intermediate temperatures. It achieves high electrical stack efficiency and low degradation rate. By developing a high-performance PCCEL design with reduced reliance on critical raw materials, the goal of this topic is to achieve an innovative, low-cost cell and stack concept for more efficient and durable hydrogen production.

- EU FUNDING: 3M€
- **TECHNOLOGY READINESS LEVEL TARGET:** 4
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-01-01

Advanced anion exchange membrane electrolysers for low-cost hydrogen production for high power rang applications

Anion Exchange Membrane-water Electrolysis (AEMEL) is a costeffective hydrogen production technology, eliminating the need for platinum-group electrocatalysts. Europe leads AEMEL research, focusing on stable materials, PFAS-free membranes, and suitable electrocatalysts. The goal of this topic is to develop AEMEL stacks capable of producing pressurized hydrogen at 50 bar, meeting the 2030 targets of the SRIA for e.g. current density, alkaline concentration, critical raw materials, electricity consumption.

- **EU FUNDING:** 4M€
- TECHNOLOGY READINESS LEVEL TARGET: 5
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-01-02

Development of innovative technologies for direct seawater electrolysis

Direct electrolysis of seawater can leverage on the global abundance of this resource without the need for desalination. Yet, it presents several important challenges and novel solutions are sought to enable the production of hydrogen from seawater directly. A proof of concept of an innovative technology is expected, it should enable direct electrochemical seawater splitting as well as brine use for energy efficient hydrogen production contributing to the overall objectives of the Clean Hydrogen Partnership.

- EU FUNDING: 4M€
- TECHNOLOGY READINESS LEVEL TARGET: 4
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-01-03

Development and implementation of online monitoring and diagnostic tools for electrolysers

With the expected GW-scale hydrogen production through water electrolysis within the next decade, there is a need for the development of tools for monitoring and diagnostics to optimise operation and detect fault conditions at an early stage. This will ensure longer lifetime, hence decreasing cost of ownership of electrolytic hydrogen production assets operated under fluctuating conditions, integrated into an energy system dominated by renewable energies.

- EU FUNDING: 4M€
- TECHNOLOGY READINESS LEVEL TARGET: 6
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-01-04

Hydrogen production and integration in energy intensive or specialty chemical industries in a circular approach to maximise total process efficiency and substance utilisation

Energy Intensive and Specialty Chemical Industries consumes about a quarter of energy in Europe and significantly emits GHG. Most processes are powered with fossil fuels, and the role that clean hydrogen can play in decarbonising these sectors is widely recognised, together with circularity and efficiency through demand-side management and digitisation. This topic calls for a demonstration of the production of clean hydrogen and its integration into those industries, within a circular approach. It is open to any production technology, and even combination of production technologies, if they operate from renewable input.

EU FUNDING: 10M€

TECHNOLOGY READINESS LEVEL TARGET: 7

TOPIC REFERENCE: HORIZON-JTI-CLEANH2-2024-01-05



Investigation of microbial interaction for underground hydrogen porous media storage

In a fully developed hydrogen economy large-scale hydrogen storage is expected to play a crucial role to balance supply and demand of hydrogen, even more so if the hydrogen is produced from fluctuating renewable energy sources. Feasibility of storage in porous reservoirs is not yet proven. In particular, the impact of hydrogen consuming microbial activity needs more research, together with the definition of dedicated standards and guidelines. This topic aims to address these aspects.

EU FUNDING: 3M€

- TECHNOLOGY READINESS LEVEL TARGET: 4
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-02-01

Novel large-scale aboveground storage solutions for demand-optimised supply of hydrogen

Aboveground storage of hydrogen is usually done in liquid or gaseous form. This comes with pros and cons. Considering future hydrogen related infrastructure components need to store significant amounts of hydrogen and deliver it according to the specific requirements (amounts, frequencies, rates) of hydrogen demand, there is a need for further research on novel and high efficiency hydrogen storage systems, optimally integrated into their respective application, suitable for large-scale storage.

EU FUNDING: 4M€

TECHNOLOGY READINESS LEVEL TARGET: 5

TOPIC REFERENCE: HORIZON-JTI-CLEANH2-2024-02-02

Demonstration of hydrogen purification and separation systems for renewable hydrogen-containing streams in industrial applications

Purification of hydrogen containing mixtures is a cost component of hydrogen distribution that can be optimised. Several promising technologies are currently being assessed at laboratory or small scale. However, they have not proven yet their potential under real industrial conditions, which are adding constraints, such as high flows, complex gas composition, etc. Other innovative technologies are also emerging and may offer very interesting perspectives. It is therefore timely to demonstrate these technologies in real industrial application.

- **EU FUNDING:** 6M€
- **TECHNOLOGY READINESS LEVEL TARGET:** 7
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-02-03

Demonstration of innovative solutions for high capacity, reliable, flexible, and sustainable hydrogen compression technologies in commercial applications

Compression technologies are crucial across sectors, especially for hydrogen infrastructure. Meeting demanding requirements, they pose challenges hindering economical and energy-efficient systems. Transitioning to larger, centralized systems necessitates compressors with high capacities and reliability. Developing innovative compressors tailored for these needs is essential for advancing hydrogen infrastructure effectively.

- **EU FUNDING:** 6M€
- **TECHNOLOGY READINESS LEVEL TARGET:** 8
- TOPIC REFERENCE: HORIZON-JTI-CLEANH2-2024-02-04

Demonstration and deployment of multi-purpose

Hydrogen Refuelling Stations combining road and airport, railway, and/or harbour applications

Hydrogen Refuelling Stations are an essential element of the future hydrogen mobility. For widespread hydrogen mobility to be viable, it will be essential to provide a nationwide network of publicly accessible HRS for passenger cars, trucks, buses, vans, etc. all over the EU. Furthermore, larger heavy duty fueling applications for rail, shipping and aviation applications will require very reliable, high-capacity stations capable of delivering many tons each day in a safe manner. This ambitious topic calls for a demonstration of such a station.

- EU FUNDING: 8M€
- TECHNOLOGY READINESS LEVEL TARGET: 7
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-02-05



Balance of plant components, architectures and operation strategies for improved PEMFC system efficiency and lifetime

Improvements on fuel cells technology building blocks can be done, and this topic aims to achieve the overall improvement of the PEMFC-based systems by addressing the Balance of Plant (BoP) as the low hanging fruit within a FC system. The scope remains broad and targets (CAPEX, durability, efficiency, etc.) remain at system level of at least 100kW. This topic calls for a validation in relevant environment.

- **EU FUNDING:** 4M€
- TECHNOLOGY READINESS LEVEL TARGET: 5
- TOPIC REFERENCE: HORIZON-JTI-CLEANH2-2024-03-01

Scaling-up Balance of Plant components for efficient high-power heavy-duty applications

While highly durable stacks of 250-500kW are under development, most of today's components of BoP are optimised for 100-200 kW systems. Development and validation of scaled-up components are needed to suit the new generation of high power PEMFC systems, that will be integrated into various heavy-duty transport applications such as aviation, maritime, rail or on-/off-road vehicles. This key topic calls for a validation in relevant environment.

- **EU FUNDING:** 4M€
- TECHNOLOGY READINESS LEVEL TARGET: 5
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-03-02

Next generation on-board storage solutions for hydrogen-powered maritime applications

Decarbonising long-haul maritime transport presents challenges in selecting clean fuels to replace conventional fuels. Different applications have varying logistics, storage, and efficiency needs, complicating fuel choice for end users. Solutions for onboard storage must consider aspects such as safety, environmental impact, energy efficiency, etc., with ideally potential spillovers towards other transport applications. This topic calls for a technology demonstration in relevant environment where the proposed solution addresses the need to store hydrogen or a hydrogen carrier below deck of a vessel with high power propulsion needs (>500 kW) and high frequency operation.

- EU FUNDING: 5M€
- TECHNOLOGY READINESS LEVEL TARGET: 6
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-03-03

Demonstration of hydrogen fuel cell-powered inland or short sea shipping

The goal is to create and showcase a hydrogen-powered waterborne transport system for inland or short sea shipping. It includes a fuel cell propulsion system onboard with 48 hours of operational autonomy and requires at least one port with a bunkering facility to safely refuel hydrogen.

- **EU FUNDING:** 6M€
- TECHNOLOGY READINESS LEVEL TARGET: 7
- TOPIC REFERENCE: HORIZON-JTI-CLEANH2-2024-03-04



Portable fuel cells for backup power during natural disasters to power critical infrastructures

The topic focuses on the development and demonstration at an operational environment of a lightweight, robust, containerised and modular zero-emission transportable of at least 50 kWe fuel cell system to power critical infrastructures in the event of a natural disaster. Solutions such as multifuel capable fuel cells, able to reliably provide clean electricity for a sufficiently long timeframe and with highest efficiency, are sought with this topic.

- **EU FUNDING:** 5M€
- TECHNOLOGY READINESS LEVEL TARGET: 7
- TOPIC REFERENCE: HORIZON-JTI-CLEANH2-2024-04-01

Improved characterisation, prediction and optimisation of flame stabilisation in high-pressure premixed hydrogen combustion at gas turbine conditions

Hydrogen-fired gas turbines offer potential for large-scale carbonfree electricity generation, meeting emissions regulations. However, gaps in understanding flame stability limits hinder their development. Fundamental research is needed to address these gaps, enabling breakthrough innovations as hydrogen availability rises, ensuring efficient and stable combustion at high pressures.

EU FUNDING: 4M€

TECHNOLOGY READINESS LEVEL TARGET: 5

TOPIC REFERENCE: HORIZON-JTI-CLEANH2-2024-04-02



Guidelines for sustainable-by-design systems across the hydrogen value chain

Safety and sustainability are paramount for Fuel Cell Hydrogen (FCH) systems, pivotal for a hydrogen economy, particularly in tough-to-decarbonise sectors. Design, operation, and end-of-life management should maximise recycling and circularity aspects, which will in turn increases EU resilience when it comes to materials. EU strategies like the Green Deal advocate for safe and sustainable FCH systems, emphasizing life cycle assessments and eco-design guidelines to ensure holistic sustainability. This topic calls for the creation of such eco-design guidelines.

- EU FUNDING: 1.5M€
- **COORDINATION & SUPPORT ACTION**
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-05-01

Development of non-fluorinated components for fuel cells and electrolysers

PEM-based technologies are promising solutions for electrolytic hydrogen production and usage (notably in transport applications) with unmatched advantages such as flexibility, modularity, and footprint. These technologies rely on fluorinated substances and while future EU regulations may restrict use of these substances, the Partnership aims at pushing boundaries by exploring alternatives that would actually outperform them. This topic calls for research activities in this field.

- **EU FUNDING:** 3M€
- TECHNOLOGY READINESS LEVEL TARGET: 4
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-05-02



Large-scale Hydrogen Valley

Hydrogen Valleys are emerging as regional "hydrogen economies" showcasing fully integrated hydrogen ecosystems. The Clean Hydrogen Partnership aims to back projects producing 4000t/pa of clean hydrogen with diverse applications from various sectors, operational for at least 2 years. System-level innovation, clear co-funding, and long-term viability are crucial. Up to 60M€ additional funding from RePowerEU will be provided to support projects.

- **EU FUNDING:** 20M€
- **TECHNOLOGY READINESS LEVEL TARGET:** 8
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-06-01

Small-scale Hydrogen Valley

Hydrogen Valleys, forming regional "hydrogen economies," showcase integrated ecosystems with mature technologies. The Clean Hydrogen Partnership supports projects aiming for 500t/pa clean hydrogen production, serving multiple sectors, operating for at least 2 years. System-level innovation, clear co-funding, and long-term viability are crucial. Up to 60M€ additional funding available.

EU FUNDING: 9M€

- **TECHNOLOGY READINESS LEVEL TARGET:** 8
- **TOPIC REFERENCE:** HORIZON-JTI-CLEANH2-2024-06-02

Were you aware that as an Industry Corporate member of Hydrogen Europe, your organization enjoys privileged access to influence and help shape topics?

Did you know that we facilitate matching you with other partners and provide assistance in forming consortia?

Join us at hydrogeneurope.eu/ become-a-member/



18 - 22 November 2024 Brussels, Belgium euhydrogenweek.eu

Hydrogen Europe Clean Hydroger

The European Hydrogen Week is a melting pot of powerful and influential leaders, policy makers, researchers, and consumers each looking for the next big thing. Organisations at the event will be able to find customers, investors, and partners in the exhibition area and will be attending thought-provoking sessions while engaging with the entire hydrogen value chain.

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Events Overview

1 H2 TALK WEBINAR SERIES: GREEN BONDS FOR CLEAN HYDROGEN DEVELOPMENT

Tuesday, 21st March 2024, 15:00 – 16:30



ONLINE

EVENT DESCRIPTION:

Hydrogen Europe is pleased to invite you to its "Hydrogen Talk" webinar series covering the topic: "Green bonds for clean hydrogen development". Join us on Thursday, 21 March 2024, at 15:00 CET for this 90-minute-long webinar.

This upcoming webinar will aim to shed light on the capacity of the Capital Market Union, with the goal of making financing more accessible to European companies leading the energy transition. Moreover, it will also explore the potential for labeled green bonds to be a powerful tool in redirecting capital towards clean hydrogen projects. The conversation will be led by representatives of key institutions, equity investors, leading issuers of green bonds in the clean hydrogen sector, and sustainable debt market representatives, all gathered to discuss the shaping of Europe's green finance strategy.

The growth of clean hydrogen projects is advancing rapidly, yet only 4% of the total potential output has progressed to the stage of securing a final investment decision. In order to achieve the European Union's ambitious goals, USD 1.2¹ to 2.6² trillion investment in the global clean hydrogen economy will be needed by 2050.

To fully unlock the sector's potential, public support and the timely implementation of innovative funding instruments are imperative to mitigate risk and attract the entire private finance value chain. Concurrently, the EU budget allocated for supporting the climate transition will not be sufficient to meet investment needs. On 20 December 2023 the EU Green Bond Regulation entered into force, setting out requirements for issuers of environmentally sustainable bonds to label them as 'European Green Bonds' or 'EuGB', in order to foster consistency and comparability in the market. This will require corporate and sovereign issuers to demonstrate that they are funding legitimate green projects mostly aligned with the EU taxonomy.

For clean hydrogen projects, this new framework has the capacity to unlock access to significant long-term capital. EU Member States will have the opportunity to leverage the attractivity of European Green Bonds to raise the necessary funding to implement their national hydrogen strategies. Additionally, due to their low-risk nature and extended maturities, EuGBs can help institutional investors such as pension, sovereign wealth funds and asset managers to seize opportunities in the clean hydrogen sector and bridge the financing gap. Lastly, the EuGB standards could further push the issuance of green bonds by companies developing clean hydrogen projects, building on the existing active demand from energy utilities.

The question arises: how could green bonds be a game-changer for access to finance in clean hydrogen? Is the EuGB framework aligned with the expectations of governments, companies, and investors regarding transaction costs and reporting requirements? Are leading stakeholders confident about the expected growth of the green bonds market and its impact on the sector?

1 / Deloitte 2 / Goldman Sachs

2 HYDROGEN EUROPE SPRING MARKET DRINKS RECEPTION

Wednesday, 24th April 2024, 18:30 – 22:00

IN-PERSON | HYDROGEN EUROPE OFFICE



EVENT DESCRIPTION:

Join us for the Hydrogen Europe Spring Market. This gathering marks the beginning of a year-long series of seasonal markets designed to bring together members and stakeholders of the hydrogen sector. Taking place in the heart of Brussels, this inperson event offers a unique networking opportunity, fostering collaborations that will shape the future of hydrogen innovation.

EXCLUSIVE TO MEMBERS OF HYDROGEN EUROPE



3 MEET THE CANDIDATES

Tuesday, 20th June 2024



Hydrogen Europe

Meet the Candidates 20 June 2024

ONLINE

MEMBERS ONLY AREA >>

EVENT DESCRIPTION:

To streamline the General Assembly meeting scheduled for June 25, 2024, a webinar will take place on **Tuesday, June 20**, 2024 for candidates to introduce themselves. Please note that participation in this event is exclusive to members of Hydrogen Europe.

More information regarding the agenda, **registration link and next steps will be shared with members on Members Only Area closer to the day.**

4 HYDROGEN EUROPE GENERAL ASSEMBLY

Tuesday, 25th June 2024



MEMBERS ONLY AREA >>

HYBRID | BRUSSELS AND ONLINE

EVENT DESCRIPTION:

Hydrogen Europe General Assembly takes place twice per year and the next one will be in a hybrid format, allowing our members to join online or in Brussels. Please note that participation in this event is exclusive to members of Hydrogen Europe. More information regarding the agenda, **registration link and next steps will be shared with members on Members Only Area closer to the day.**
5 HYDROGEN EUROPE SUMMER MARKET DRINKS RECEPTION

Tuesday, 25th June 2024, 18:30 – 22:00

IN-PERSON | BRUSSELS



EVENT DESCRIPTION:

Join us for the Hydrogen Europe Summer Market. This gathering brings together members and stakeholders of the hydrogen sector. Taking place in the heart of Brussels, this in-person event offers a unique networking opportunity, fostering collaborations that will shape the future of hydrogen innovation.

EXCLUSIVE TO MEMBERS OF HYDROGEN EUROPE



A warm welcome to all our new Hydrogen Europe members



Renault SAS

Renault Group is at the forefront of a mobility that is reinventing itself. Strengthened by its alliance with Nissan and Mitsubishi Motors, and its unique expertise in electrification, Renault Group comprises 4 complementary brands – Renault, Dacia, Alpine and Mobilize – offering sustainable and innovative mobility solutions to its customers.



CONTACT contact.group@renault.com



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Your first choice - Hensel Recycling is your first choice when it comes to recovering precious metals. We recycle these valuable raw materials from automotive (cars, trucks) and stationary applications (industrial catalysts). In addition, we are active in many future markets such as the recycling of fuel cells and PV modules and thus contribute to a sustainable circular economy. We always have an open ear for your individual challenges and offer you tailor-made services.



management@hensel-recycling.com

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Centrica plc

Centrica is an international energy services and solutions business. Through our trusted brands, we deliver innovative energy and services solutions to help solve customers' needs. We are committed to creating a cleaner and greener future. And we're making big changes to help us get there.





PROTIUM

Protium Green Solutions Ltd is a green energy company driving decarbonisation by displacing fossil fuels with electrolytic hydrogen in industrial heating and logistics applications. Founded in the UK in 2019, Protium Green Solutions supplies hydrogen in the UK and has now opened an office in Europe.



CONTACT enquiries@protium.co.uk



Matteco

Matteco is a company dedicated to developing next-generation materials to decarbonize the economy through the mass adoption of green hydrogen in industries that are challenging to electrify. A group of scientists, entrepreneurs, and impact investors have come together with a common purpose: to create new materials for a better future. It is a spin-off from the University of Valencia with over 10 years of R&D in materials technology and is part of Zubi Labs, an impact company builder within the Zubi Group.



Wielkopolska Region

Wielkopolska Region supports the creation of a hydrogen ecosystem: the development of local hydrogen applications, the integration of SMEs into the hydrogen economy and the creation of new opportunities and green jobs. Wielkopolska is part of EU-wide networks: the European Hydrogen Valleys S3 Partnership, the Powering Past Coal Alliance. In 2023 Wielkopolska developed "The Wielkopolska Hydrogen Strategy 2030".



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EUREC EEIG

EUREC is the Association of European Renewable Energy Research Centres, connecting our research centre members to EU institutions, participating in Horizon Europe projects, and running two Master courses in renewable energy with some of our university members (one engineering focused, the other with more of a project management slant).



TECHNOKRATI

Educational center Technokrati uses the natural state of children's mind - creativity, curiosity, imagination and transforms that into real practical knowledge. Partnering with schools and students from 3rd to 12th grade developing and teaching practical classes in science (renewable energy) and technology (robotics, programming, 3D and etc.). Our team also organizes national races with robotics and hydrogen powered cars and organizing practical trainings for teachers. Our programs also cover non-technical topics such as: teamwork, self-awareness, responsibility and critical thinking.



Technokrati LTD



Croatian Chamber of Economy

The largest business network in Croatia, the Croatian Chamber of Economy (HGK/ CCE), connects key sectors of the national economy through a network of county chambers, communities, associations, international representative offices, and memberships in international chambers. It also promotes the interests of its members before government bodies.





Joltech Soltutions, S.L.

JOLT is a startup that developed a coating technology to revolutionize electrodes manufacturing for water electrolysis. After a successful tech validation, the company secured nearly €7.5M in 2023 to build a R&D center to power innovation and produce 60,000 m² of electrodes per year.



CONTACT info@jolt-solutions.com



Staubli Electrical Connectors

Stäubli Group offers innovative mechatronics solutions in its four divisions: Electrical Connectors, Fluid Connectors, Robotics, and Textile. Stäubli Electrical Connectors develops advanced connection solutions based on the reliable MULTILAM contact technology and provides connections for life in industries using hydrogen such as industrial automation applications, power transmission and distribution, railway, welding automation, test and measurement, medical devices and E-mobility.





Mabanaft GmbH & Co. KG

Mabanaft is a leading independent and integrated energy company providing its customers with innovative energy solutions for their transportation, heating, industrial and agricultural needs. The group is active in import, distribution and marketing of petroleum products, natural gas liquids, chemicals and biofuels, and supports its customers' transition to cleaner fuels by providing alternative long-term solutions. From ammonia to hydrogen and synthetic efuels, Mabanaft is ready and able to support its customers with exactly the solutions they need, as they accelerate their path to a carbon-neutral future.



CONTACT post@mabanaft.com





KIC InnoEnergy SE

EIT InnoEnergy is spearheading the way to a decarbonized Europe by 2050 through the leadership of three industrial value chains: European Battery Alliance (EBA) for battery storage, European Green Hydrogen Acceleration Center (EGHAC) for green hydrogen, and the European Solar PV Industry Alliance (ESIA) for solar photovoltaics. **The InnoEnergy Skills Institute** is one of Europe's leading training skills providers for the sustainable energy workforce, spanning energy storage, photovoltaics, and green hydrogen. We equip the global workforce with the expertise and skills required to create a sustainable economy, distilling our unrivalled knowledge and know-how into relevant, applicable, and effective modular training courses. Our agility and expertise transform the skills of today's workforce into those needed for a clean tomorrow.



CONTACT benelux@innoenergy.com



Redexis S.A.

Redexis is an energy infrastructure company that is dedicated to promoting the energy transition, economic development, and growth. We are committed to the growth of gas infrastructures and energy efficiency, including solar selfconsumption, and dedicated to the development of renewable gas projects, such as biomethane or renewable hydrogen.



CONTACT comunicacion@redexis.es



Bureau Veritas Marine & offshore

Bureau Veritas Marine & Offshore is a leading classification society and offshore safety and verification body. Our deep technical expertise has earned us leadership positions across a broad scope of vessels, including gas ships, small cruise ships, dry bulk and offshore vessels.



CONTACT contact@bureauveritas.com



Burckhardt Compression is the market leader for reciprocating compressor systems and has gained extensive experience and know-how in hydrogen compression solutions over the last several decades For hydrogen mobility & energy applications, Burckhardt is continuously investing in further development of four features compression technology.



CONTACT info@burckhardtcompression.com

Burckhardt Compression AG

Estonian Hydrogen Cluster



Estonian Hydrogen Cluster supports establishing green hydrogen value chains in Estonia, the Baltic States and in Europe. We bring together public and private sector stakeholders to develop a framework for production and use of green hydrogen in Estonia, as well as looking for and developing business opportunities for Estonian companies through networking, events and knowledge sharing.



CONTACT steven.sepp@vesinikuklaster.ee



Innovation Norway

Innovation Norway helps Norwegian companies to grow sustainably and increase exports by providing access to competence, capital and networks.



CONTACT ivar-jo.baunbaek.theien@innovasjonnorge.no



ETHNICON METSOVION POLYTECHNION

(NTUA) – School of Naval Architecture and Marine Engineering

The National Technical University of Athens is structured according to the continental European system for training engineers, with an emphasis on solid background. The duration of courses leading, after the acquisition of 300 credit units to a Diploma, of Master's level, is five years. The valuable work of NTUA and its international reputation are due to its well-organised educational andresearch system, the quality of its staff and students, and the adequacy of its technical infrastructure.



CONTACT secretariat@naval.ntua.gr



Battolyser Systems B.V.

Battolyser Systems is an innovative European clean-tech equipment manufacturer making green hydrogen affordable and energy systems net-zero. We develop and manufacture an integrated battery and electrolyser called 'Battolyser' that can store electricity and produce hydrogen from renewable power to balance societal demand. Our 'Battolyser' is fully flexible, but also efficient and sustainable — using only abundantly available and easy to recycle materials.



CONTACT info@battolysersystems.com



EASN Innovation Technology Services B.V.

The European Aeronautics Science Network (EASN) is the Association of the European Academia active in Aviation and Space research. The main objective of EASN is to support the development of new knowledge, innovation, and breakthrough technologies through fundamental research in Aviation & Space. The long term goal of EASN is to develop an open, unique European platform to structure, support and upgrade the research activities of the European Universities and to facilitate them to respond to their key role within the European Aviation & Space Research Community. EASN currently has more than 300 registered members, including individuals, universities, and other organizations, through which it can network with more than 10,000 academic staff, researchers, and scientists throughout Europe.





Port of Galway

The Port of Galway aims to be an engine of Ireland's future economic prosperity. Located in the largest city in the West of Ireland, we have plans to relocate and redevelop the inner dock area, thereby stimulating commercial activities and the development of the inner-city lands.



CONTACT info@theportofgalway.ie

Job Market



Project Manager H2

Virya H2

📀 Full time job, Belgium, Braine l'Alleud

31.03.2024

DESCRIPTION:

As a young and ambitious company, working in the development of sustainable hydrogen production we, at Virya H2, are looking for new and energetic colleagues for our development team. We are recruiting a project manager who will support the further development of our hydrogen projects. As a Project Developer H2 your goal is to contribute to our green mission through the following tasks:

You initiate and coordinate all project phases: from the concept and development phase to the final entry into force of the project.

You closely monitor the project planning and report on overall

achievements and project milestones

You monitor and manage the project costs

You ensure the planning of the project resources, taking into account the project priorities and in function of the project planning

viryaH₂

You negotiate with site owners and grid operators

You ensure the preparation of the permitting process

 You prepare investment decisions and assist in negotiations with suppliers

You streamline communication with other departments such as architects, engineers, the drawing office, procurement and finance
 You ensure the follow-up and contractual completion of purchase contracts

You build on your knowledge and expertise within this specific sector. Together, we will make you an expert in your field

Supply Chain Planner – Electrolyzers

Accelera by Cummins

Full time job, Belgium, Oevel

31.03.2024

DESCRIPTION:

Develop planning system strategies to enhance signals across the supply chain.

Monitor and adjust parameters in the planning system.

Plan and maintain daily supply chain operations in various functional areas.

Ensure internal and external customer expectations are exceeded.

- Utilize common processes, tools, and information systems.

Analyze Key Performance Indicators to identify areas for improvement and action plans.

Execute the daily operational planning process within a specified functional area.

Identify and mitigate potential supply chain failures.

Collaborate closely with internal and external stakeholders to develop short-term tactical improvements.

Use the planning system to drive consistent planning signals across the supply chain.



Aftermarket Sales Specialist – Hydrogen

Accelera by Cummins Full time job, Belgium, Oevel 31.03.2024



DESCRIPTION:

Being the Aftermarket Sales Specialist, you will be finding the opportunities to increase sales by identifying, researching, and contacting prospective customers and developing account plans for top prospects and conducts agreed upon face-to-face sales calls.

Develops, manages, and maintains business relationships with assigned accounts supporting the organization's sales strategy. Strengthens current customer relationships that enable identification of a customer's needs, business model and buying process.

Support customers' requirements and inquires worldwide.

Managing RFQ's / creating quotations according to customer requirements and Cummins maintenance recommendation.

Prepare Long Terms Maintenance Contracts, LTSA

 Prepare commercial quotations (spare parts and services), build costing-sales price sheets.

Lead internal interactions during the bidding process to obtain

the deliverables allowing you to develop the proposal (Service team, finance, legal, manufacturing)

Negotiate proposal and terms and conditions with customer.

Develop new maintenance contracts and parts sales opportunities for aftersales units in a defined area.

Reporting maintenance contract tracker, quote log, sales forecast, CRM tool management.

Negotiate proposal and terms and conditions with customer according to company guidelines, including payment terms. Assists with collection of accounts receivables when needed.

Drives sales, achieving sales targets and ensuring customer satisfaction. Deliver Sales and Prime Margin Annual Operation Plan (AOP).

Leads, manages, and coordinates communication and interfaces with the customer at appropriate levels.

Welding engineer – Electrolyzers

Accelera by Cummins

Full time job, Belgium, Oevel

31.03.2024

DESCRIPTION:

Leads the design, documentation, and implementation of welding processes for manufacturing.

Leads the work for specific projects to create and implement all aspects of welding processes to ensure safety requirements, manufacturing goals, business goals, and product specifications are met.

Leads by applying the knowledge or use of welding principles and practices to improve manufacturing equipment and processes.

Leads the communications with and influences key external stakeholders, business leaders, and functional members.

 Works with internal and external resources on specific project assignments.

Applies the principles of product quality planning, evaluation, and control in support of the manufacturing and installation operations of the organization. Responsible for applicable systems related to plant customer issues such as corrective action requests, supplier corrective action requests, nonconforming material reports, etc.

Facilitates continuous improvement quality activities to reduce the potential for defects, and ensures continual improvement in process and product design.

Ensures products and process development meet quality standards.

 Identifies problems, prioritizes actions, leads or participates in Six Sigma projects

Participates in change management activities by verifying products and processes, developing key measures, analyzing data for decision support, and presenting results to plant leadership.

this role has a set trajectory to develop the selected candidate to became a people manager for the QC team.



Installation & Commissioning Engineer

Accelera by Cummins

Full time job, Belgium, Oevel

31.03.2024

DESCRIPTION:

In this dual product/customer-focused position you will be acting as a technical liaison between the Cummins field service organization and the Engineering, Quality, and Manufacturing organizations to proactively identify, define, and prioritize product issues and to implement both short-term and long-term solutions. You will also be:

Plan and execute the commissioning of hydrogen Electrolyzer equipment at customer sites within the schedule and budget;

Perform site acceptance test (SAT) for final handover/acceptance by customers;

 Supervise installation and construction activities at customer sites, manage subcontractors on location; Conduct In-house testing of our manufactured equipment in the local test facility;

Resolve installation issues, procedures, and methods by working with management, engineering, quality control, and contractors.

 Leads the investigation of product or system problems, understands causal mechanisms, recommends appropriate action, and documents results;

Manages and coaches others on large-scale development or issue-resolution projects.

Promote the efficient flow of information and ensure complete and proper record-keeping of commissioned equipment.

Field Service Engineer

BOSS Energy Consulting

• Full time job, USA

29.03.2024

DESCRIPTION:

Execute site survey, on-site installation, and commissioning of our fuel cell systems.

Conduct thorough system testing to ensure optimal functionality and performance

Perform routine maintenance activities to maximize system reliability.

Diagnose and troubleshoot technical issues to identify root causes and implement effective solutions.

Coordinate with the technical support team for complex problem resolution.

Provide excellent customer service by responding to service requests promptly and professionally.

Offer technical guidance and training to end-users to optimize system operation.

BOSS

Establish and maintain strong relationships with customers to ensure satisfaction and loyalty.

Maintain detailed records of service activities, including installation reports, maintenance logs, and troubleshooting documentation.

Generate comprehensive service reports for both internal and external stakeholders.

Collaborate with internal teams, including engineering and product development, to provide feedback on field performance and contribute to continuous improvement initiatives.

Participate in regular team meetings and training sessions to stay updated on product enhancements.



Approval Manager / Permit Manager Carbon Capture

BOSS Energy Consulting

Full time job, Germany, Munich

0 29.03.2024

DESCRIPTION:

As a Permit Manager for Carbon Capture Plants, your role entails the planning and approval feasibility of the construction and operation of CCUS plants.

This includes conducting risk assessment, cost estimation and scheduling.

You prepare, manage, and implement approval procedures for new construction projects and existing plants (environmental law, construction law as well as plant and operational safety law).

You take care of communication with authorities, project management and other stakeholders.

You qualify, commission and coordinate external service providers and experts. You are responsible for the preparation of the application documents and the management of the procedure until the decision is issued.

You will provide professional and legal support in opposition and lawsuit proceedings, in close cooperation with internal lawyers.

You support the project management in the implementation of the requirements from the decision.

You monitor technical regulations in Germany and at EU level.
You will mandate, manage and monitor external regional permitting service providers.

In the future, you will build a team of approval managers and experts.

Technical Project Manager

BOSS Energy Consulting

• Full time job, United Kingdom

() 29.03.2024

DESCRIPTION:

Oversee cross-disciplinary projects focused on technical assets, particularly in the realm of green and blue hydrogen initiatives within the UK.

Drive the creation and integration of connections to hydrogenrelated products such as sustainable aviation fuels, methanol, and ammonia projects where appropriate.

Direct technical project management processes from initial concept to the ultimate investment decision.

Coordinate both technical and commercial agreements and collaborations with primary equipment suppliers.

Assist in facilitating communication between stakeholders, customers, and the business development team. Supervise international contractors with the backing of our expanding engineering team.

Offer guidance and assistance to other business sectors regarding hydrogen and its derivatives.

Spearhead the enhancement of the company's technical proficiency in H2 technologies, specializing in electrolysis, pyrolysis, and gas reforming.

Serve as a primary internal and external liaison, acting as a key contact and manager for green, turquoise, and blue hydrogen technologies.

Manage the designated operational and capital expenditure budgets for the advancement and execution of hydrogen project endeavors.





Technical Specialist – Hydrogen & CCS

BOSS Energy Consulting

Full time job, Houston, TX (On-site)

29.03.2024

DESCRIPTION:

Lead Process efforts on major projects, providing valuable input and creative solutions within time and budget constraints.

Mentorship of engineers in areas of expertise, demonstrating a commitment to team success.

Report to the Delivery Manager, serving as an expert for both blue and green Hydrogen projects/proposals.







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THE HYDROGEN EUROPE GUARTERLY