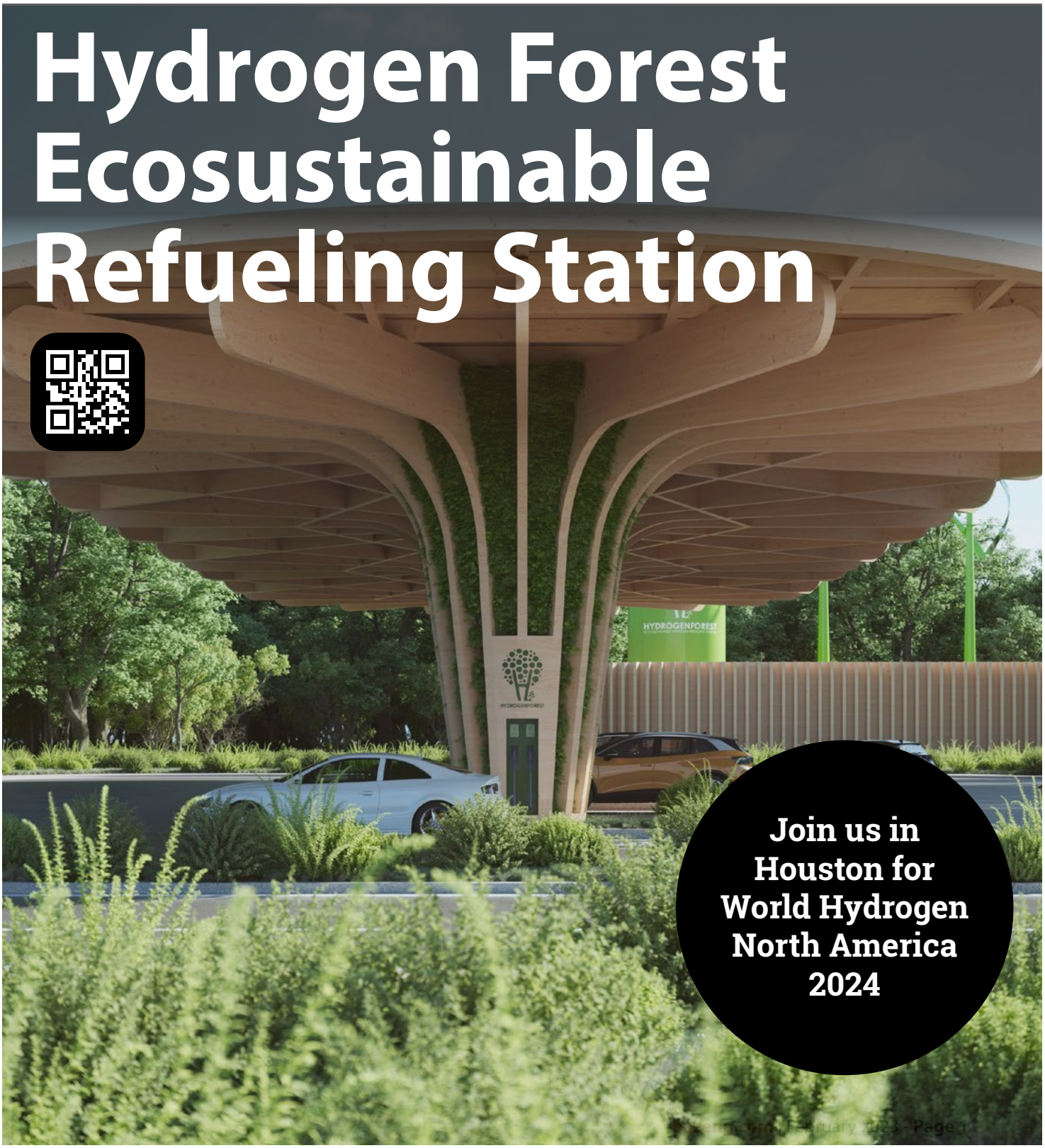
Engineering Solutions
HYDROGEN
March 2024 | Issue 3
www.engineeringhydrogensolutions.com

Hydrogen Forest Ecosustainable Refueling Station



Join us in Houston for World Hydrogen North America 2024

world hydrogen north america

May 21 - 23, 2024
Hilton Americas
Houston, Texas

Strengthening Collaboration Across the North American Hydrogen Community

200+ Speakers

50+ Hours of content and networking

1200+ Attendees

12 In-Depth Masterclasses

Secure your place by visiting worldhydrogennorthamerica.com

worldhydrogennorthamerica.com
World Hydrogen Leaders
#WHNA #WHL

Organised by

world hydrogen leaders

Features

- Fuel Cells
- Metering & Monitoring
- Latest News & Products
- Hydrogen Production
- Research & Development
- Hydrogen Compression
- Awards & Events
- Infrastructure
- Electrolyzers
- Transportation

Publisher
Michael Dominguez
editorial@engineeringmaintenance.info

Advertising
Steve Pheasant
stevep@engineeringmaintenance.info

Website
www.hazeng.com

Telephone
+44(0)207 193 1396

MSL Media Ltd
New Stone Hill Farm,
Stone Hill Road,
Ashford,
Kent,
TN27 9DU
www.mslmedialtd.com

Company Number
05359182

Incorporated
09-02-2005

Join Us In Houston For World Hydrogen North America 2024

The clean hydrogen revolution is well underway in North America. With recent policy support like the Inflation Reduction Act and Bipartisan Infrastructure Law in the USA, and the Clean Hydrogen ITC in Canada, there has been an unprecedented boom in announced hydrogen projects across the continent.

However, as these ambitious plans move toward implementation, the industry is encountering real challenges that must be addressed. From evolving regulations to supply chain constraints, it's clear this transition will not come without growing pains.

That's why events like World Hydrogen North America are so valuable right now. By bringing together key players across the hydrogen value chain, align on solutions to current obstacles, forge new partnerships, and ultimately accelerate the energy transition.

Pictured- General Wesley Clark delivering his keynote during World Hydrogen North America 2023

Building on last year's momentum, World Hydrogen North America 2024 is primed for breakout growth - mirroring the rapidly accelerating pace of progress across the hydrogen landscape. With 50% increase on the Exhibition Floor, the program doubling in size with six info-packed tracks, over 250 renowned experts at the podium, and 1200+ attendees uniting in Houston, this is the perfect time for the hydrogen community to unite and propel development even further.

Agenda Highlights include:

• H2 Derivatives - With hydrogen gaining steam, exciting derivatives like ammonia, LOHC, and methanol are emerging as solutions for decarbonizing aviation, shipping, agriculture, and beyond. The expanded derivatives track dives into the vast potential of these clean fuels to transform supply chains by displacing fossil incumbents.

• H2 End Use - Customer focus is key to hydrogen success. The dedicated end use track directly serves major industries eyeing adoption – from steel to transport to chemicals. Drill into the priorities and pain points of these key buyers to gain insights to inform your hydrogen strategy. Join peers and producers to align on the road ahead.

• H2 Hubs - Six months after their high-profile launch, how are the hydrogen hubs advancing? Check in with key players across all hubs to get inside reports on progress made, obstacles encountered, and strategies evolved. From navigating new hour-matching guidelines to coordinating nationwide scale-up, this session offers prime intel and connectivity.

• Masterclasses – Join 2-hour masterclasses to deep dive into priority topics like the IRA, safety, derivatives, electrolyzers, and much more. With laser focus and expert guidance, you'll gain specific knowledge to boost confidence and maximize on-the-job impact.

• Dedicated Roundtables – Take part in intimate roundtable sessions for stakeholders to tackle obstacles and identify solutions, going beyond thought leadership to real world problem solving. Whether exploring technical hurdles, policy needs, or marketplace dynamics, our roundtables foster action-oriented dialogue and tangible strategies.

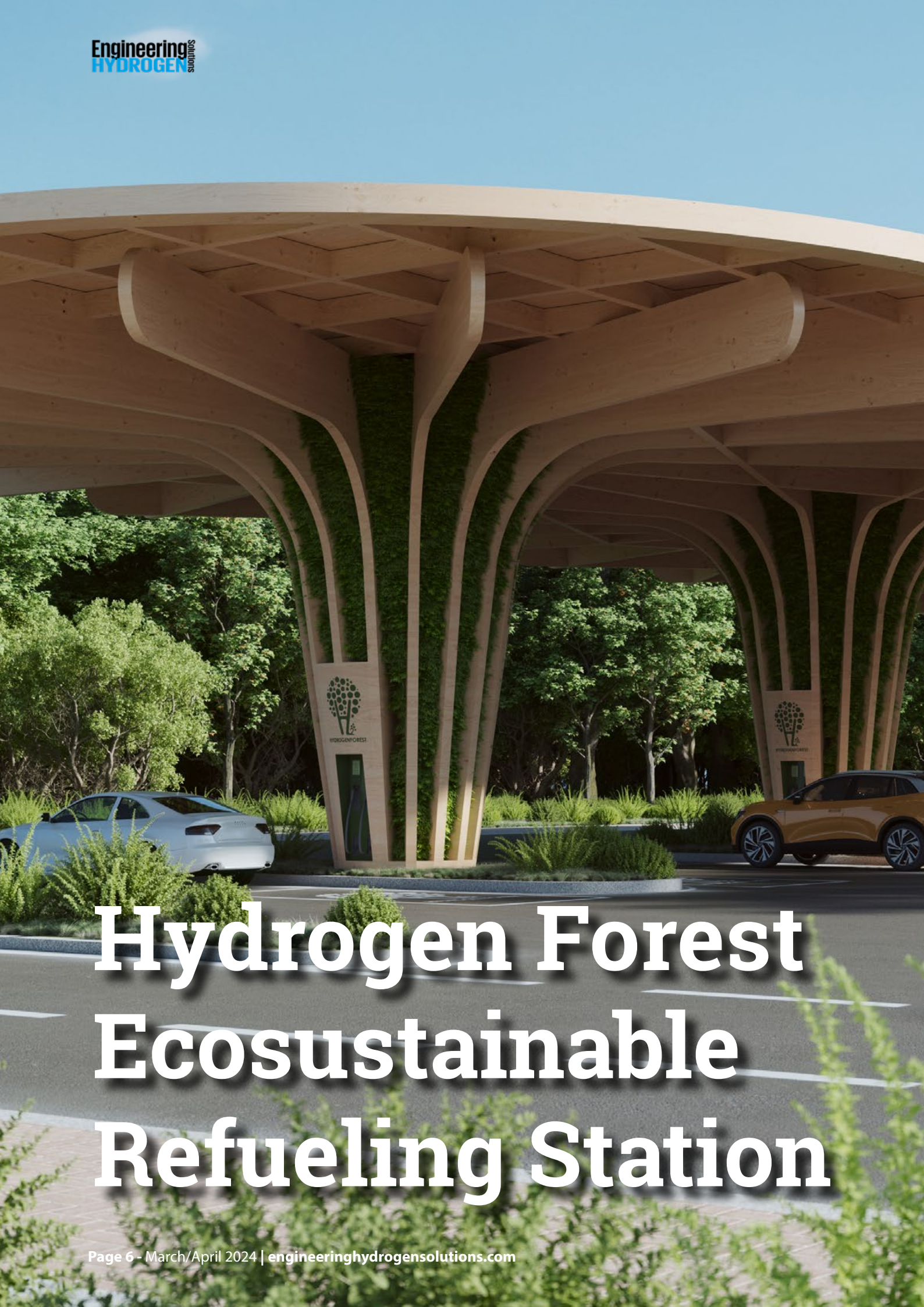
Pictured- The plenary room during World Hydrogen North America 2023

With so much opportunity at stake - Deloitte estimates a $1.5 trillion annual market for hydrogen by 2050 - it's imperative that industry leaders collaborate.

Join the hydrogen value chain in Houston this May 21-23 for three days of productive meetings, relationship building, and idea sharing with the top minds in hydrogen.

For more information, please visit:

https://www.worldhydrogennorthamerica.com



Hydrogen Forest Ecosustainable Refueling Station

The dream of all time, to get around with environmentally friendly vehicles that emit simple water vapor as a waste element, which recharge from nature and in a natural way. From today, the dream becomes reality, thanks to HydrogenForest, the first environmentally sustainable charging stations for hydrogen vehicles.

Large tree-like structures growing inside urban forests of Paulownia, the plant that absorbs the most CO2 in the world, about ten times the CO2 of ordinary trees.

The project bears the signature of renowned architecture firm Giancarlo Zema Design Group, internationally recognized for its sophisticated smart and environmentally sustainable designs.

Tall modular structures with laminated wood ribs measuring 7 meters in height and 20 meters in diameter accommodate hydrogen dispensers at the base and on the stems of the beautiful canopies of vertical greenery. The large green-colored photovoltaic canopy is capable of producing energy from the sun, about 220 kWp in the larger configuration, 60 kWp in the smaller one, and collecting rainwater for maintaining its own foliage.

Two configurations of HydrogenForest charging stations have been developed: the larger one (made by merging four trees) for 16-station highway systems and the smaller one (consisting of one or two single trees with circular foliage) of 4 or 8 stations for restricted or urban areas.

The HydrogenForest charging stations are true oasis of green and oxygen; they will be built within small forests of Paulownia trees, about 1 to 2 hectares capable of absorbing 50 to 100 tons of CO2 per year. Thanks to the partnership with Paulownia4Planet and 17tons, HydrogenForest's trees are connected to IoT sensors, analyzed by Machine Learning algorithms whose digital avatars are blockchained and visualized within the specific application to know in real time how much CO2
they are absorbing and how much oxygen these structures are giving us back.

The more HydrogenForest charging stations that are put in place, the more oxygen and green mobility we will put into system on our planet.

In addition, by partnering with KIRI Technologies, a leading British company developing software and technologies that incentivize the adoption of sustainable behaviors, it is possible to reward sustainable behaviors and/or sustainable purchases by HydrogenForest customers with the help of KiriCoin. The Kiri token can be used within the marketplace to redeem rewards provided by partners. Kiri operates in several sectors with a focus on sustainable mobility, energy, and retail.
Among Kiri's various initiatives, famous is the one launched with the Stellantis Group in 13 countries for customers of the Fiat brand's New 500 and customers of JEEP brand PHEV vehicles.

HydrogenForest is a poetic project, rich in symbolic meanings, highly technological and concrete, developed and promoted by the Hydrogenscape company. A new, innovative and emotional "Green" infrastructure model capable of changing the rules of the clean energy distribution market forever.

www.giancarlozema.com

An Increasing Range Of Sectors Choose Hart

Hart Door Systems of Newcastle upon Tyne, the industrial door and security shutters manufacturer and market leader best known for its world-class technology through its leading brands such as Speedor high-speed doors, Firebrand fire shutters and Terror Screen and Typhoon industrial roller shutters, reports multi-sector success so far this year.

"Looking at a handful of current projects we are currently involved with international airports, automotive and general manufacturing, security and confectionary , many of which are major contributors to the UK's economy," says Nick Hart, Hart's managing director.

"Clearly there are situations across all sectors where solutions to door and shutter requirements are similar but in very many cases solutions are uniquely different which is where Hart's design and manufacturing originality is essential. We are delivering an important asset for our clients.

"Just as our clients thrive on innovation so must we. In particular the pressure on us all in respect of Climate Change means Hart has a crucial role to play through its leading Speedor brand which is in use throughout the UK and on seven continents globally," adds Mr Hart.

Why is Speedor and its several sub-brands so popular with industry and commence?

"Apart from its proven track record over the years for energy saving and general efficiency, each Speedor can be customised according to specific requirements in addition to its general reputation for durability and reliability, speed of operation and in these times of Climate Change, a very important reduced environmental impact.

"Presently Hart is involved in projects at a major UK airport, a specialist manufacturer, a regional retailer, a national food ingredients producer and an overseas high-value retailer. "So from protection from storms to protection from villains, we deliver the right door systems for each project," says Mr Hart.

www.hartdoors.com

Alleima Sanicro® 31 HT: The Right Alloy For The Right Energy At The Right Time

As the world combats climate change, hydrogen is rapidly becoming key to creating sustainable energy alternatives to fossil fuels. The tremendous performance of Alleima Sanicro® 31 HT in hydrogen production equipment makes it the right alloy for the right energy at the right time.

Sanicro® 31HT

Developed for high-temperature environments such as solar power applications, and can be used at temperatures up to 1100°C.
Sanicro® 31HT

The urgency of global warming has seen hydrogen emerge as a leading driver of sustainable alternatives to fossil fuels.

Little wonder, for hydrogen, is a source of clean energy, an efficient means of energy storage for renewables such as wind and solar power, a fuel for sustainable transport, a way to generate clean electricity and heating, and a cleaner alternative for industrial processes.

For reasons of efficiency and lower costs, 90-95% of global hydrogen production occurs through steam methane reforming, where methane from natural gas is heated in a Reformer to produce pure hydrogen, high temperatures around 800-900 degrees Celsius can be reached.

The reactors themselves consist of multiple vertical catalyst tubes that feed down into horizontal tubing known as a 'pigtail' due to its geometry. The pigtail is one of the most critical pieces of the reformer as it carries the reformer gas from the catalyst tube to the collection manifold while discharging the mechanical stress and displacement experienced by the reformer unit system due to the thermal expansion that comes from the reforming process.

Why Sanicro® 31HT is ideal for hydrogen production?

"Sanicro® 31HT from Alleima is an austenitic nickel-iron-chromium alloy with good structural stability at temperatures as high as 1,100 degrees Celsius," says Eduardo Perea, Senior Product Manager, Alleima Tube division, EMEA.

Eduardo Perea, Senior Product Manager"The usual reasons for failure of the tubing materials are creep fatigue (sagging and deformation) and carburization from the surrounding environments in the tube. But Sanicro® 31HT is a stainless-steel alloy that has very good resistance to oxidation, combustion gases, carburization, and nitrogen environments. The alloy also offers good weldability and high creep strength."

Eduardo Perea is a passionate and convincing advocate of Sanicro® 31HT and even uses cooking metaphors to explain the secret of its success. Quite simply, he says, the alloy is a significant improvement on an established 'recipe', in this case, the industry-standard Alloy 800 HT, which was introduced in 1989.

"Our alloy is super-resistant to the different environments in the steam methane reforming process, including carburization, and creep strength. Getting the balance right in the chemical composition is extremely important to get the optimum recipe, the tubes are produced in our fully integrated Production Unit in Sandviken, Sweden. "If you compare our recipe with others in the market, you're 'eating' different soups from the same recipe and ours not only tastes better but keep your stomach full for a longer time! We offer more superior, stronger versions of the alloy" he says.

Wood Selected As Owner's Engineer For World-Leading Green Hydrogen Project In Spain

Wood, a leading global consulting and engineering company, has been selected as owner's engineer on a major green hydrogen production project in Teruel, Spain. The first-of-a-kind Catalina Project, developed by a consortium led by Copenhagen Infrastructure Partners through its Copenhagen Infrastructure Energy Transition Fund I K/S, will combine 1.5GW of wind and solar energy to power a 500-MW electrolyser producing green hydrogen.

As the owner's engineer, Wood will lead as a technical authority of Catalina's green hydrogen generation plant including technology selection, preliminary studies, front end engineering and design (FEED) and EPC tendering support.

Set to produce enough green hydrogen to satisfy 15% of Spain's current hydrogen demand, the Catalina project will position Spain as a world-class green hydrogen hub. The hydrogen produced by the facility will supply the demand of the local, regional and national industries, helping to decarbonise hard-to-abate fertilizer and petrochemical sectors, as well as contributing to Spanish and European renewable hydrogen targets.

Giuseppe Zuccaro, President of Process & Chemicals Projects at Wood said: "We're incredibly proud to be trusted by our partners to play a leading technical role on Catalina. Complex in nature and first-of-a-kind, Catalina is setting a global standard for large-scale green hydrogen production projects and will support Spain's energy transition journey.

"We are combining Wood's specialist hydrogen expertise and proven ability to deliver complex projects with our strong engineering presence in the region. Catalina will expand our hydrogen portfolio and consolidate our reputation as a partner of choice for hydrogen production and industrial decarbonisation projects."

The project will be delivered by Wood's consulting and projects teams in Spain and the UK.

Landi Renzo Launches The New Mechatronic Hydrogen Pressure Regulator

Landi Renzo, a global leader in sustainable natural gas, biomethane, and hydrogen mobility, is starting the development of advanced electronic pressure regulators for mid- and heavy-duty commercial vehicles with hydrogen-powered internal combustion engines (ICEs), marking a big step towards the energy transition and decarbonization of the mobility and transportation sector. This project is widening the collaboration with the German company Bosch that is one of the leading automotive suppliers worldwide. With this, the two companies are improving their respective contribution to the energy transition path. By 2024, the two companies seek to produce and commercialize hydrogen-based fuel systems featuring the next-generation mechatronic pressure regulator that support the carbon neutral operation of commercial vehicles. Landi Renzo can call upon 70 years of supporting the sector's energy transition path, today backed by over 120 R&D employees who help moving high-tech product solutions from concept to commercial availability. The company even has its own Hydrogen Excellence Center in Bologna, Italy, featuring a modular Class 8 white room and bespoke equipment.

Sitting at the heart of a fuel line, the pressure regulator serves as a decoupling element between the accumulation system and the combustion chamber's fuel introduction system. A simple and robust mechanical regulator was previously sufficient to manage this function. The zero-emission fueled engines of the future, however, require pressure regulators that are not only robust and reliable, but add performance characteristics which were previously unpredictable.

EM-H Mechatronic Hydrogen Pressure Regulator

The EM-H mechatronic pressure regulator ensures optimal management and calibration of hydrogen delivery pressure according to the vehicle's requirements, conveyed with high level accuracy and efficiency. Designed and manufactured in Italy, two phases govern the functionality of the EM-H regulator: a mechanical input stage that reduces pressure from high to medium; and a subsequent entirely electronic stage which lowers pressure from average to desired value. The system features special valves to ensure protection of both the pressure regulator and downstream fuel line.

Thanks to design innovation, the hydrogen-compatible EM-H is able to provide ideal pressure for the injectors at every operating speed and load, thus optimizing combustion for future high-pressure injection systems. To ensure safety, the new pressure regulator is a completely sealed product.

Damiano Micelli, Chief Technology Officer of Landi Renzo Group, commented: "This mechatronic hydrogen pressure regulator is a milestone of technological advancement that we can offer to the rapidly evolving mobility and transportation market. The new regulators combine the potential of traditional vehicles with the possibility of zero CO2 emissions. This is a highly innovative solution that will soon be available for mid and heavy-duty applications, further consolidating Landi Renzo Group's leadership in the development of hydrogen solutions."

SEGULA Technologies Strengthens Its German Locations: 200 New Employees Planned For 2024

The engineering service provider SEGULA Technologies in Germany achieved a solid performance in the 2023 financial year. The company benefited from increased demand for development and testing services as well as successful project acquisition. Sales growth was over 20% in a rather declining overall market. The number of employees is currently over 1,000.

"SEGULA Technologies in Germany has shown a robust performance in 2023. The strength of our teams and our ability to adapt flexibly to market conditions is the basis for the continuation of our successful course. Now we need additional talented people to further expand our good positioning," says Dr Holger Jené, CEO of SEGULA Technologies in Germany, who is pleased with the development of his company.

SEGULA Technologies is planning to recruit 200 new employees in Germany this year. The recruitment activities are also in line with the current dynamic global growth of the French parent company and the good positioning of SEGULA Technologies on the German market. The greatest demand is in the company's central development, testing and homologation locations in the Rhine-Main region, particularly in Rüsselsheim and Rodgau-Dudenhofen. However, there are also vacancies in the other project offices, for example in Munich, Stuttgart, Cologne, Ingolstadt and Wolfsburg. The plan is to recruit mainly project managers, engineers and technicians specialising in mechanical engineering, automotive engineering, aerospace engineering, electronics and software. All levels are concerned, including CA support, engine calibration, hydrogen and fuel cell technology, test drives, test bench operation, mechanics, mechatronics and more. Currently there are already 150 open positions advertised in Germany.

In the automotive sector, SEGULA Technologies works closely with leading domestic manufacturers and a large number of suppliers and also supports Asian customers and start-ups entering the European market. The aim of SEGULA Technologies Deutschland is to further strengthen its position in this historically important sector and also to diversify by focussing on development in other areas such as aerospace, energy and rail.

"We are on the lookout for talented specialists at all German locations in order to meet increasing customer demand and further expand our good positioning," emphasises Dr Holger Jené. Volker Hoffbauer, Director Human Resources, adds: "Recruiting a large number of qualified employees in a sector as tight and innovative as engineering is a daily challenge for our HR teams. I am convinced that we will attract many candidates who want to benefit from our innovative project work, attractive training and development opportunities, the diversity of all personalities in our workforce and our hands-on mentality. The opportunities to make a contribution to a growing and forward-looking company, to develop further and to work in a modern working environment are attractive benefits for candidates."

All open positions can be found here: https://careers.segulatechnologies.com/de/

World Hydrogen 2024 Summit & Exhibition Returns to Rotterdam, 13-15 May, Promising Its Most Impactful Event Yet

The World Hydrogen 2024 Summit & Exhibition, a pivotal event in the global hydrogen industry, is set to return to Rotterdam with its largest and most influential edition yet. Taking place at the Rotterdam Ahoy, this summit & exhibition marks a significant moment in the industry's calendar, offering unparalleled networking opportunities, insightful discussions, and groundbreaking advancements in the field of hydrogen technology.

As part of the SEC World Hydrogen Series, the Official World Hydrogen Summit & Exhibition in Rotterdam is proud to announce its partnership with esteemed entities including the Government of the Netherlands, Province of Zuid-Holland, the Port of Rotterdam, and the City of Rotterdam. This collaboration underscores a steadfast commitment to fostering innovation and driving forward the global hydrogen agenda.

The World Hydrogen 2024 Summit & Exhibition will showcase a diverse range of events and features including the C-Level Summit, the world's largest hydrogen-focused Exhibition, the Africa Hydrogen Forum, 2 x H2 Tech Series Stages, and the prestigious World Hydrogen Awards. Attendees can also look forward to captivating site visits to the Port of Rotterdam's hydrogen projects, providing firsthand insights into pioneering initiatives shaping the future of energy. The event is set to welcome 15,000 attendees from across the global energy value chain.

"This year's summit is poised to be our most impactful yet, as hydrogen continues to emerge as a central component of global energy strategies," said Chris Hugall, Managing Director of The Sustainable Energy Council. "With the support of our esteemed event partners and participants, we are confident that World Hydrogen 2024 will serve as a catalyst for meaningful collaborations, driving innovation, and accelerating the transition towards a sustainable energy future."

The World Hydrogen 2024 Summit & Exhibition is scheduled to take place from Sunday, May 12th to Thursday, May 16th, 2024. The Summit will be held from May 13th to May 15th, while the Exhibition will run from May 13th to May 14th. Site visits will take place May 12th and May 16th.

www.world-hydrogen-summit.com

Peppers Cable Glands And Accessories That Are Made To Be Seen

Peppers Cable Glands and Accessories are the ultimate in design and functionality and so beautifully engineered you will want to wear them.

Developed over the course of seventy-five years, Peppers has become the name synonymous with quality and excellence – from the products to the service, every bit of the Peppers buying cycle is intended to be first-class.

Providing designer products at project pricing to many sectors including the Hydrogen industry, Peppers Cable Glands and Accessories look and feel expensive and are the industry choice across the world. No corners are cut in the making of them and if quality and reliability is essential to your business, then you will appreciate their worth.
Their value lies in both the excellence of the products and the service that accompanies them, and Peppers understands the importance of both.

Fast-paced supply chains often veer towards cheaper cable glands, but with that comes unmitigated risk. When missing or faulty parts create a torrent of issues further down the supply chain and multi-million-pound projects can be derailed on the back of one missed component, businesses will learn the value of paying for a complete, end-to-end service.

Peppers is now a thriving, growing brand, spearheaded by a managing director who had a deliberate and purposeful approach to Peppers' growth. The refusal to succumb to haste, borrow unnecessarily, or compete recklessly with larger counterparts, has been the cornerstone of their success.

"Customers choose our company, even if sometimes the products cost more than our competitors, not only because they know they are getting a superior cable gland but because they are getting it with a service that money simply cannot buy." Tush Thakore, Managing Director.

So, with Peppers, you can expect to receive a first-class service perfectly accessorised by the quality of its product. But without doubt, the jewel in the Peppers crown is the unyielding commitment to being the cable gland and accessory supplier of the ages. Exquisitely engineered Cable Glands and Accessories you'd be forgiven to want to wear, and a service based on integrity and trust; customers find it impossible to get the same package anywhere else in the world.

Peppers cable glands and accessories are fully certified and compliant – if the label is as important to you as it should be, Peppers is one you'd be happy to show off

Peppers maintains a quality management system approved to ISO 9001 :2015, ISO/IEC 80079-34:2011 Explosive atmospheres - Part 34: Application of quality systems for equipment manufacture and an Environmental System approved to ISO 14001 :2004 as well as operating within Occupational Health and Safety Management (OHS) to BS OHS AS 18001.

Peppers commitment to providing the ultimate cable gland solution is unwavering; a combination of industry knowledge, exceptional service and extraordinary attention to detail should put them at the top of any 'must-have supplier for 2024' list.

30 YEARS OF EXCELLENCE
NOW FOR USE WITH **HYDROGEN**

HI2000H

- Silicon-on-Sapphire Sensor Technology
- High Accuracy
- Pressure ranges from -1bar - 1,500bar
- High Thermal Stability
- Tested to ISO 11114-2-2017 to EC79/2009 & EU406/2010

1994 30 2024
esi SOS

with **ATEX & IECEx** options

ESI TECHNOLOGY LTD
Pressure Measurement Specialists
www.esi-tec.com | sales@esi-tec.com | +44 (0)1978 262255

Notable Pressure Transducer Utilising SOS Technology In Hydrogen Applications

Silicon-on-sapphire (SOS) technology has emerged as a groundbreaking approach in various industries, particularly in the field of pressure sensing applications. When combined with hydrogen-related applications, such as those found in hydrogen fuel cells or hydrogen storage systems, SOS technology offers numerous advantages, including enhanced reliability, stability, and performance. One notable pressure transducer utilising SOS technology in hydrogen applications is the HI2000H from ESI Technology Ltd.

Hydrogen, being a clean and efficient energy carrier, is increasingly gaining traction as a viable alternative to traditional fossil fuels. However, its safe and reliable handling poses significant challenges, particularly in terms of pressure monitoring. Pressure transducers play a crucial role in ensuring the safe operation of hydrogen-related systems by providing accurate and real-time pressure measurements.

The HI2000H pressure transducer from ESI Technology Ltd. stands out as a reliable solution designed specifically for hydrogen applications. At the heart of its performance lies the innovative Silicon-on-Sapphire technology. This technology involves the fabrication of pressure sensing elements on a sapphire substrate, offering exceptional stability and reliability even in harsh environments.

One of the primary advantages of SOS technology in hydrogen applications is its intrinsic resistance to hydrogen embrittlement. Hydrogen, when in contact with certain materials, can cause embrittlement, leading to structural degradation and failure over time. However, sapphire, being an inert and chemically stable material, mitigates this risk, ensuring the long-term reliability of the pressure transducer.

Furthermore, the use of SOS technology results in minimal hysteresis and repeatability errors, crucial factors in accurate pressure measurement. This ensures that the HI2000H maintains its performance integrity over an extended operational lifespan, even in demanding hydrogen environments where fluctuations in pressure are common.

Another significant advantage of SOS technology is its high insulation resistance and low leakage current, making the HI2000H inherently safe for use in hydrogen-rich atmospheres. Safety is paramount in hydrogen applications due to its flammability and potential explosive nature. By utilizing SOS technology, the HI2000H minimizes the risk of electrical hazards, ensuring the safety of personnel and equipment.

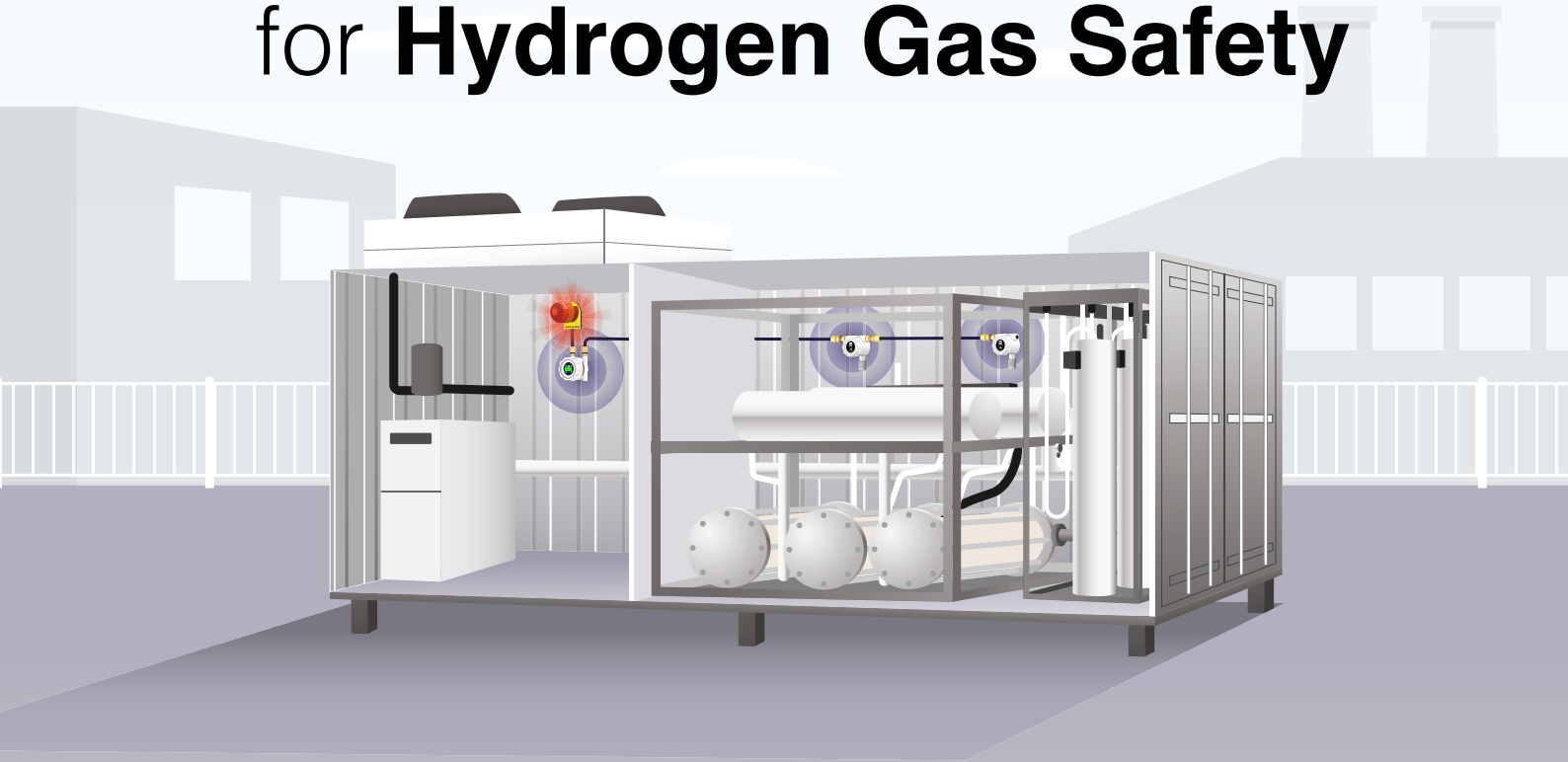
Moreover, the HI2000H offers excellent thermal stability, a critical requirement in hydrogen applications where temperature variations can significantly impact pressure readings. The SOS technology, coupled with advanced temperature compensation techniques, enables the pressure transducer to maintain its accuracy across a wide range of operating temperatures, enhancing its suitability for diverse hydrogen-related applications.

In addition to its robust performance characteristics, the HI2000H features a compact and rugged design, making it suitable for installation in space-constrained and harsh environments commonly encountered in hydrogen systems. Its compatibility with various mounting options and electrical interfaces further enhances its versatility, catering to different integration requirements.

Overall, the combination of Silicon-on-Sapphire technology and the HI2000H pressure transducer from ESI Technology Ltd. offers a compelling solution for pressure sensing in hydrogen applications. With its superior reliability, accuracy, and safety features, the HI2000H contributes to the advancement of hydrogen technologies, supporting their widespread adoption as a clean and sustainable energy solution for the future.

International Gas Detectors

The **Detectably Better** Choice for **Hydrogen Gas Safety**



Take no chances with the safety of your personnel and electrolysers

TOC-750X
Addressable ATEX
Area Detector

TOC-903-X5
Dual ATEX
Detector Transmitter

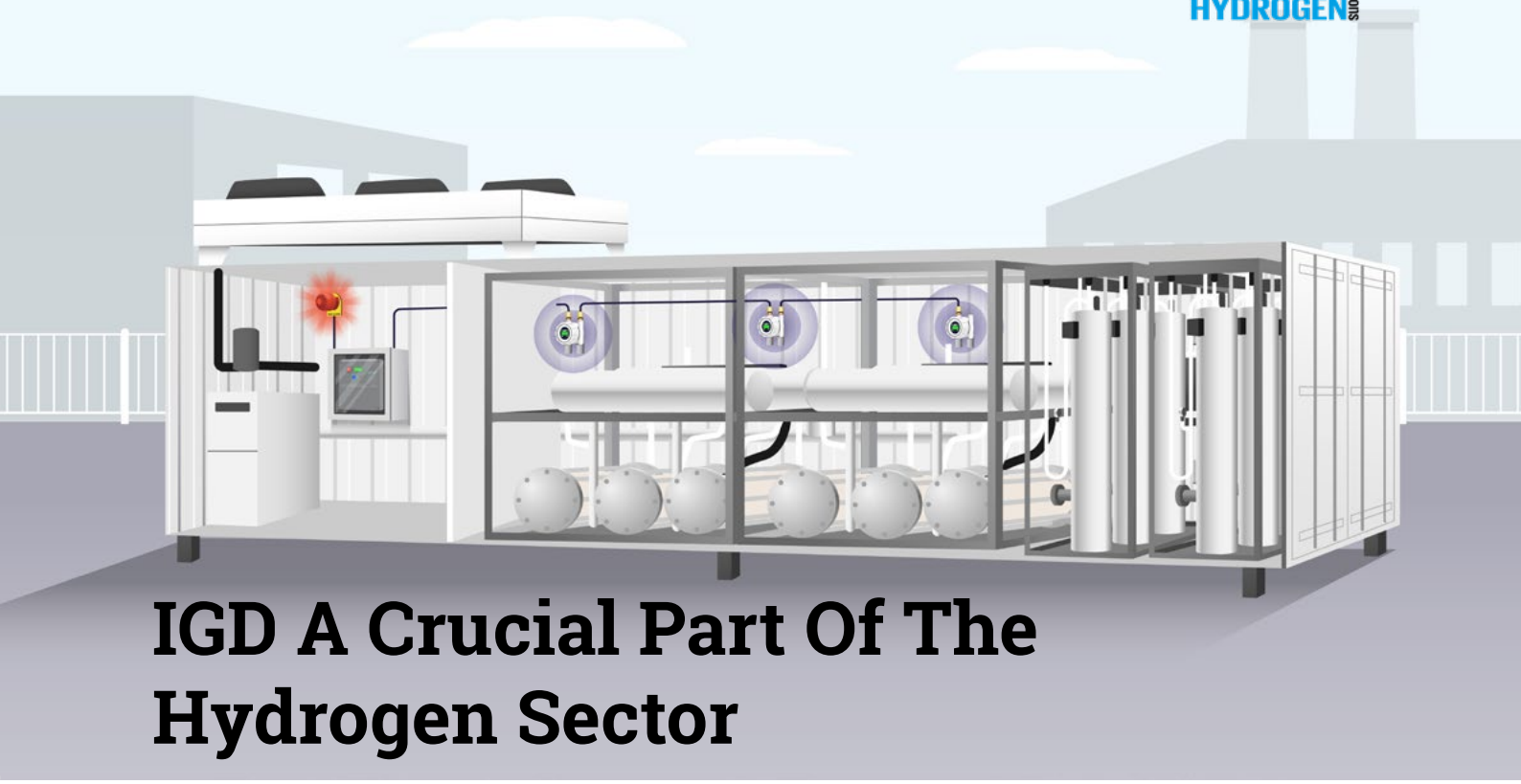
TOC-635 Plus
Gas Detection
Control Panel

Beacon Sounder

To find out more, contact us or scan the QR code

+44 (0) 161 483 1415
sales@internationalgasdetectors.com
/international-gas-detectors-ltd

Triton House
Stockport
SK2 6SH



IGD A Crucial Part Of The Hydrogen Sector

Hydrogen is an emerging market that presents many viable and potentially transformative answers to some of the issues surrounding the future of energy. But, like all great ideas, it needs support and the implementation of appropriate safety measures. With over 100 years of innovation since the development of our first hydrogen detector, the experience and expertise offered by IGD will be a crucial part of the development of this growing industry.

What is an electrolyser?

An electrolyser is a device that uses electricity to split water into hydrogen and oxygen. This process, known as electrolysis, is a way to produce hydrogen gas which can be utilised as a clean energy source. But, as hydrogen is the smallest molecule in the universe, it is prone to leaking and extremely flammable. It's vital that you manage the explosive nature of hydrogen with sufficient gas monitoring, particularly in enclosed containerised installations, and there's no one better placed to provide that monitoring than IGD. The oxygen produced during electrolysis can also present a threat, as oxygen-enriched areas can be both flammable and toxic. Fortunately, both gases can be monitored with one revolutionary detector.

The World's Most Versatile Gas Detector.

This is the result of more than a century of innovation. This is the TOC-903-X5 - a standalone detector transmitter approved for ATEX/IECEx Zone 1 & 2 (Gas) and Zone 21 & 22 (Dust) offering advanced dual-gas detection capabilities in one compact housing. Complete with one-person non-intrusive calibration and our 2-Wire Addressable system, it can also be used as a controller for additional interconnected detectors, or external devices such as beacon sounders.

Our Plug-and-Play sensors enable the monitoring of over 400 gases and vapours but when it comes to electrolysers you'll be relying on our MK8 pellistor and our oxygen sensor for fast, reliable and accurate detection. The MK8 pellistor flammable gas sensor is the most poison-resistant detector on the market, and our long-life oxygen sensors have a 5-year service life making maintenance of our system even more hassle-free.

Detectably Better Electrolyser Monitoring.

Flammable gas detectors are key to scaling the potential of electrolysers and protecting people who want to use electrolysers to safely create hydrogen as an energy source. The modular flexibility of the TOC-903-X5 makes it the perfect solution for scaling the potential of an electrolyser.

The TOC-903-X5 can be placed inside smaller electrolysers and used as a standalone detector to enable oxygen and hydrogen monitoring or it can be interconnected with additional TOC-750X detectors independently monitoring for oxygen and hydrogen. For a larger electrolyser with a safe area, the addition of a TOC-635 control panel accommodates even more modular options.
The TOC-903-X5 can revolutionise any gas detection set-up. Check out our recent article to find out why we call it the world's most versatile gas detector.

The TOC-903-X5 comes with our 10-year warranty and is backed by more than a century of innovation, expertise and experience in gas detection.

That's why IGD is the Detectably Better choice for hydrogen gas safety.

Compressed Hydrogen, The Most Efficient Way To Store Energy

Hiperbaric is positioned as the European benchmark for hydrogen compression at high pressures, up to 1,000 bar, with solutions that drive the energy transition

Hiperbaric is a specialist and world leader in the development of high pressure technology for the compression of liquids and gases. One of its business lines is High Pressure Hydrogen Compression: the company manufactures hydraulically driven piston compressor units, a Plug & Play Solution, adaptable to any production level and demand up to 500 or 1000 bar.

The hydrogen economy is already a reality, and in fact we are making great strides in developing new technologies, processes and solutions along the entire value chain, and high-pressure hydrogen compression is one of them.

"To make its use extensible for some services and applications, hydrogen presents some storage challenges due to its low density at ambient temperature and pressure. Therefore, the basic way to densify hydrogen is to compress it at very high pressure", says Andrés Hernando, CEO at Hiperbaric. For this reason, Hiperbaric, a world leader in high-pressure technologies, has developed a range of H2 compressor units with a plug-and-play solution, adaptable to any level of production and demand.

High Pressure Hydrogen Compression

At Hiperbaric, innovation has been present in every step the company has taken in its 25-year history, making the brand synonymous with innovative technology, quality and reliability. Hiperbaric is an international reference in the development of high pressure technologies and a world leader in industrial high pressure processing equipment, known as HPP, since 1999. The company has installed more than 1,000 water compressors up to 6,000 bar for HPP applications for the food industry, in more than 50 countries on five continents.

Thanks to this experience, the company has made its way into the renewable hydrogen value chain, and now presents a complete and advanced solution for compressing hydrogen at high pressure up to 1,000 bar.

It is safe, efficient, and reliable equipment, capable of compressing hydrogen with an inlet pressure range from 20 bar to an outlet pressure up to 500 or 950 bar. This wide range of inlet and outlet pressures allows it to be positioned both in the production stage, being able to be fed directly from an electrolyzer, or a medium pressure storage tank (such as tube trailers at 200 bar).

All in all, it is a versatile technology that can be used in multiple applications adapting to different suction and discharge pressures.

Strategic agreements in Renewable Hydrogen

Hiperbaric has strategic agreements with different players in the hydrogen value chain. One of the main ones is with the French company Lhyfe, by which Hiperbaric will supply and deliver to Lhyfe renewable and green hydrogen compressors for several locations throughout Europe in the next two years.

Hiperbaric's compressor technology was already installed in Germany for a Framatome green hydrogen refueling station for public buses. Hiperbaric compressors are also part of the first Spanish green hydrogen project "Green Hysland – Power to Green Hydrogen" on the island of Mallorca, which has received EU funding through FCH JU (Fuel Cell and Hydrogen Joint Undertaking).

Fore more information visit Hiperbaric.com

Plastics Technology Offers Great Potential For Economic Scaling Of Green Hydrogen Production

Interview with Dr.-Ing. Kai Fischer, scientific director at IKV and responsible for the topic hydrogen at the Institute for Plastics Processing (IKV) in Industry and Craft at RWTH Aachen University

The efficient scaling of green hydrogen production technologies is an essential step in making hydrogen an economically sound part of the energy transition.

With regard to this necessary and massive capacity expansion, the plastics industry has a lot to offer as far as the hydrogen industry is concerned, because:

• Plastics are high-performance materials whose property profile can be engineered very precisely for the intended application.
• The processing technologies in the plastics industry allow high-tech components to be produced efficiently and in large numbers.

With its "Hydrogen Business and Technology Forum", the Institute for Plastics Processing (IKV) in Industry and Craft at RWTH Aachen University has established a close network between the hydrogen economy and the plastics industry, where it regularly fosters the connection of requirements and application know-how with material and production know-how.

The "Hydrogen Business and Technology Forum" emerged from a market and technology study on plastics in the hydrogen economy initiated by the IKV and completed in November 2022. About 20 industry partners were already involved in the study. With regular workshops and a continuous Market & Technology Monitoring, the work is now being continued in the "Hydrogen Business and Technology Forum". The kick-off for the Forum was 16 May 2023. The first thematic workshop dealt with "Testing and Analysis of Plastics in Hydrogen Applications" and took place on 9 August 2023 and was hosted by the Forum member Freudenberg. On 19 October 2023 Forum members met again at the IKV for its second regular Workshop.

The Forum is still open to new members. Information at H2@ikv.rwth-aachen.de

Dr.-Ing. Kai Fischer, scientific director at the IKV and responsible for the topic hydrogen economy, explains in an interview why the exchange between the two industries is so important, what significance plastics have for the scaling of hydrogen technologies, and how the cooperation between the participating industry partners is to be continued in the "Hydrogen Business and Technology Forum".

Following the hydrogen study produced in the past two years, there now is the "Hydrogen Business and Technology Forum" to intensify the exchange between the hydrogen industry and the plasticsindustry.

Why is that now important?

Fischer:

Hydrogen is intended to become the backbone of the energy turnaround. Today, approx. 96 % is obtained from fossil resources such as natural gas and coal. Only 4 % is produced by electrolysis. For this – as some people may remember from school – water is broken down into hydrogen and oxygen using electricity. Electrolysis is the way to produce "green", i.e. climate-neutral, hydrogen. And even for this 4 % electrolysis, only a small proportion of renewable energy is currently being deployed. Consequently, only a very, very small part of the production capacity is at present suitable for producing green hydrogen. Yet all today's projections are aimed at producing green hydrogen. It is indeed important to see that a great deal needs to be done here with completely new development work. Large numbers of electrolysers and the corresponding infrastructure have to be put in place. That again means working with large numbers, and large numbers are always predestined for plastics. For this reason, we believe that plastics are the enablers to make hydrogen production economically scalable.

And that is why you believe the plastics industry must get together with the hydrogen industry to exchange information and ideas.

Fischer:

Exactly. The people in the hydrogen industry are familiar with all the requirements of the process engineering plants, the media, the temperatures, the pressures etc. But, of course, they think not in plastic but in metal. It is not the case that the construction can simply be switched from metal to plastic. That would not bring any advantages. In order to find new solutions for the requirements of systems, it is necessary to go beyond substituting single metal components with single plastic components, and to look at functional integration. Precisely for this, this application know-how must be communicated so that the plastic value chain can say how solutions would ideally look in plastics.

Are there already examples in the hydrogen industry?

Fischer:

Yes of course. As an example, let us look at the end plates of a fuel cell. Here, many media have to be conveyed, both gaseous and liquid. Connections also have to be integrated. If they are made of metal, it means that a very large number of individual components have to be mounted. In the meantime, there are some applications in which this is solved by a single large injection-moulded part in which all media lines, connections, electronics etc. are already integrated.

This means that the hydrogen industry is not yet aware of the possibilities offered by the plastics industry?

Fischer:

These are two completely different worlds. The facilities for producing or converting hydrogen are classic process engineering plants. They consist predominantly of stainless steel with stainless steel pipes. The

producers of such plants are indeed only seldom aware of the possibilities offered by plastics. For this reason it is important to bring the hydrogen OEMs with their knowledge of the requirements together with the plastics specialists with their know-how and their technical capabilities. Only in this way can we start to think in terms of highly integrated products that can be automatically manufactured in very, very large numbers. This is an absolute necessity if the scale-up of green hydrogen technologies is to succeed within a reasonable time and at reasonable cost.

How did the idea of a network forum come about?

Fischer:

The idea of a network forum came because, in 2021, we at IKV launched a market and technology study in cooperation with more than 20 companies in order to deal with this issue holistically. The study is, however, only really the basic package. Our aim was always to operate a continuous exchange to identify how plastics can help in establishing hydrogen. For this, we need continuity, and we have now implemented this in the form of this forum, which will meet regularly twice a year. These meetings will be supplemented by continuous technology monitoring. At the kick-off meeting, we also decided that there would be individual workshops on special topics between the meetings.

What were your impressions of the kick-off meeting and what did you think of the content?

Fischer:

It was a great event! We had a total of 50 participants in the room and four keynote presentations that were divided in equal parts between users of hydrogen systems and solution providers from the plastics value chain. We had very open and transparent discussions. In the breaks, the business cards were flying around and everyone was networking on a grand scale. As part of the event, we also charted the course for defining, according to the requirements, the elements of further cooperation for these two target groups.

As far as the content was concerned, I felt that a very lively demand exists for understanding the systems in the various segments – especially on the part of the plastics industry. I also felt that there are many companies who, irrespective of the competition in their hydrogen systems, are prepared to talk about the challenges because they hope for the push of the open-innovation approach – in other words the push from the supplier industry – and want to create competitive advantages through this in future.

Another aspect that I took from the meeting is that the companies in the plastics value chain, some of which are competing with each other, are very open to cooperation. For example, we discussed the fact that we would sound out in the consortium which testing and characterisation processes are available in which companies so that the companies can supplement each other. In this way, it will also be possible to identify supplementary demands and derive measures to realise them. It was truly noticeable that everyone is keen on baking this large pie together instead of generating competition and trying to grab the biggest slice of a small pie. This seemed to me to reflect the spirit of the meeting generally.

As you said at the beginning, the market and technology study forms the basis for this network. What are the most important things you have taken from this?

Fischer:

The hydrogen industry is still driven very much by traditional process engineering plants. An important finding is, however that we do not have to revolutionise the plastics industry in order to offer solutions to the hydrogen industry. Plastics can be compatible and there are numerous applications and good examples for the implementation of highly integrated and function-integrated components. This means that if the scale-up is necessary and the number of pieces must increase, the plastics industry can offer these solutions without reinventing the world. It is possible to transfer a lot from other industries, but it is naturally not necessary to be familiar with the specific applications in order to be able to suggest suitable solutions for the hydrogen industry. The good news is that we do not now have ten years of development ahead of us and the plastics industry must not fundamentally change or develop completely new products. For each industry it can take what is already there in order to further develop it and transfer it.

What happens now?

Fischer:

Our Forum member Freudenberg held theme workshop in August in addition to our half-yearly meetings to discuss the questions that the Forum participants had addressed fairly openly at the kick-off. The idea for specific workshops was born during the kick-off because the participants deisred an exchange on how to bring plastics expertise specifically into the development of new systems. Furthermore, the team is now starting the Market & Technology Monitor in order to continuously observe the market. We have agreed that it should be more than simply collecting the available information. The information should be questioned, evaluated and categorised. We will look exactly how reliable it is and how realistic the implementation scenarios are. In this way we will draw up an organised list of information, that we will pass on at three-month intervals to the partners in the forum.

Is it still possible to join?

Fischer:

Yes, it is. We naturally want this network to grow, and are pleased to have both small and large companies from the plastics value chain and naturally companies from the hydrogen value chain. Through the synergies of both industries, we can master a scale-up for green hydrogen and make it economical.

The Global Hydrogen Awards 2024

The Global Hydrogen Awards for 2024 were recently held at the Denise Coates Foundation Building at Keele University celebrating innovation and excellence across the hydrogen value chain. From automotive to research, installation, marketing, and more, various sectors were recognized for their contributions to advancing hydrogen technology.

Winners like GeoPura and HVS in the automotive sector, Johnson Matthey in production, and Cranfield University in research and innovation showcase the diverse range of talent and expertise driving the hydrogen industry forward.

Luxfer Gas Cylinders and Parker Hannifin UK, as sponsors of the event, highlighted the importance of collaboration and innovation in achieving a sustainable future through hydrogen technology.

Congratulations to all the winners and participants for their dedication to pushing the boundaries of hydrogen technology and contributing to a greener tomorrow!

This years winners were as follows:

Automotive (from motorcycles, through cars, pickup trucks and vans), GeoPura

Automotive (all types of heavy trucks for haulage of goods, and buses and coaches), HVS

Production, Johnson Matthey

Research Initiatives, Energy Safety Research Institute

Installation, Service and Maintenance, Hydrogenscape with Giancarlo Zema Design Group

Marketing and Communication, Parker Hannifin UK

Recruitment, Training and Development, Gexcon

Legal, Financial, Professional and Consultancy Services, IKM Consulting

Large Project and System Solutions, GeoPura

UK Universities' Award for excellence in hydrogen research and innovation. High Commendation to Derby University. Winner Cranfield University

International Award for Academic Excellence and International Collaborations in Hydrogen, Loughborough University

HyDEX Universities' Award for excellence in hydrogen research and innovation, Cranfield University

Gold Outstanding Achievement Award, Johnson Matthey

Lewis Anderson, Head of Transformational Projects, Luxfer Gas Cylinders, said:

"Congratulations to GeoPura and HVS, Luxfer's fellow hydrogen pioneers in the automotive sector, and to all the deserving winners in the various categories, who demonstrated innovation and industry-leading excellence. The need to decarbonise the transport sector is pivotal to achieving net zero, which is why the achievements of GeoPura and HVS are so commendable.

"Luxfer is at the forefront of hydrogen storage solutions, consistently developing our trusted technology and applying our vast experience to reflect movement in the market. It was a privilege to take part in celebrating the extraordinary projects and companies who, like us, are driving the hydrogen industry forward."

Robert Airey, market development manger, Parker Hannifin UK

Parker Hannifin was delighted to be the headline sponsor at the Hydrogen Awards. A fantastic evening recognising great people, companies and engineering feats in the Hydrogen Sector. Congratulations to the winners and all the entrants in pushing advancements for a greener tomorrow.

https://www.linkedin.com/company/hydrogen-awards

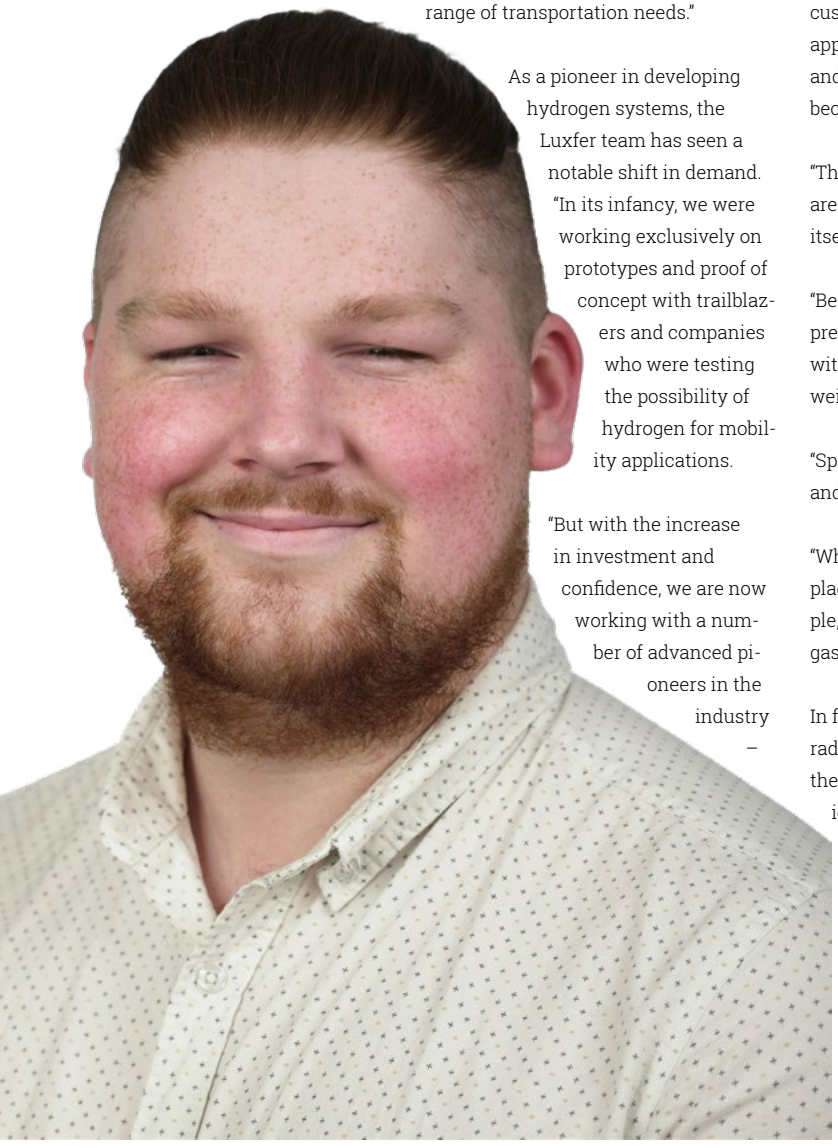
https://www.facebook.com/HydrogenAwards

The Design Expertise Behind The Hydrogen Fuel Systems Driving Clean Energy Adoption

With more than 40% of hydrogen mobility storage systems in operation globally developed with expertise from Luxfer Gas Cylinders, its dedicated alternative fuel team is at the forefront of innovation.

While the hydrogen sector is expanding rapidly, progress has been incremental over the past two decades, with Luxfer's experience in compressed natural gas informing what is possible when it comes to harnessing hydrogen for mobility applications.

"The hydrogen systems we're developing now are really around 20 years in the making," explains Adam Smith, Alternative Fuel Systems Designer at Luxfer Gas Cylinders. "That's because we're bringing to the market an 80-year legacy in gas containment, adapting solutions based on our significant knowledge in alternative fuels, across a huge range of transportation needs."



As a pioneer in developing hydrogen systems, the Luxfer team has seen a notable shift in demand. "In its infancy, we were working exclusively on prototypes and proof of concept with trailblazers and companies who were testing the possibility of hydrogen for mobility applications.

"But with the increase in investment and confidence, we are now working with a number of advanced pioneers in the industry – including hydrogen specific teams from OEMs, which are committing to hydrogen technology with ambitions for serial production.

"Of course, industry challenges around generation of the clean gas and infrastructure to get it to those who need it, are impacting adoption. Our objective is to apply our design and engineering prowess to find solutions that will enable companies to use hydrogen as a power source and achieve their decarbonisation goals, both now and in the long term."

No 'perfect' hydrogen system solution

Currently the alternative fuel design team at Luxfer Gas Cylinders takes a bespoke approach to developing complex hydrogen systems across many different vehicle platforms. "There is no perfect solution," Adam explains. "Currently each build is designed to a specific customer brief. Essentially the ideal system would be one per vehicle application that fits, works, and is tailored to each customer's needs, and as hydrogen adoption evolves, this method of product design may become more applicable.

"The design challenges in this process are considerable. Gas cylinders are inherently heavy, and the weight of the cylinder and the system itself is fundamental.

"Being technology neutral, we can offer our leading line of high pressure lightweight G-Stor™ H2 Type 3 or Type 4 hydrogen cylinders, with the selection of cylinder type led by factors including application, weight, required gas capacity, regulatory approvals and end use.

"Space is also key. We need to fit systems within designated spaces, and consider how the solution can best be mounted.

"When it comes to how a system is designed, considerations such as placement of other vehicle components are also important. For example, an element that could inadvertently heat up the cylinder, and the gas within it, needs to be factored in."

In fact, a recent customer project presented just this challenge. A radiator that needed to cool the vehicle's fuel cell blew hot air onto the gas cylinder system. Working with the customer, the Luxfer team identified a heat calculation formula, resulting in a heat shield being implemented into the system design to ensure safety and efficiency.

Developing talent in the hydrogen landscape

As a project lead, Adam works with key customers, including industry-leading global manufacturers who are at the forefront of the hydrogen opportunity. Since joining Luxfer as an apprentice in 2018, Adam has progressed in his design career, earning qualifications in Mechanical Engineering along the way. The challenge

of tapping into talent is a topic close to home.

He says: "There is a training and knowledge gap in the industry, which could ultimately curtail growth. It's such an exciting time to be involved in hydrogen, so it's important to widen the talent pool with the skills required and attract individuals to want to learn about this emerging, dynamic market."

The Luxfer Gas Cylinders alternative fuel design team is based at the company's UK site in Nottingham, which is home to a new fit-for-purpose production facility, currently in development. The dedicated hub will deliver virtual gas pipeline solutions – the G-Stor™ Hydrosphere – from summer 2024.

To learn more about Luxfer Gas Cylinder's alternative fuels portfolio, visit: https://www.luxfercylinders.com/market/alternative-fuel/

Hydrogen Insights: Hydrogen Project Pipeline Grows By 35% Since January 2023 Despite Macro-Economic Headwinds

The global hydrogen economy is growing despite global headwinds resulting from rising interest rates and constrained supply chains, according to an analysis of over 1,400 large hydrogen projects published today by the Hydrogen Council.

Hydrogen Insights 2023 December Update, co-authored by McKinsey & Company, is the industry's latest update on global hydrogen development. The project pipeline has grown to USD 570 billion, including clean hydrogen production, end use and infrastructure – a 35% increase from 6 months ago.

Europe is found to maintain its lead in the overall project pipeline with over USD 190 billion of announced investments. However, only 7% of announced investments in clean hydrogen have passed FID – in Europe this figure is only 4% (USD 8 billion), in North America 15% (USD 10 billion), in China 35% (USD 12 billion).

Hydrogen projects globally account for 45 Mt p.a. of announced clean hydrogen production capacity through 2030, of which more than 3 Mt p.a. have passed FID as of October this year.

Yoshinori Kanehana, Chairman of the Board, Kawasaki Heavy Industries Ltd., and Co-Chair of the Hydrogen Council, said: "The latest data shows clean hydrogen is progressing steadily, but to achieve our goals we must work together. Making the globally announced 1,400+ clean hydrogen projects a reality with its associated 45 Mt annual supply through 2030 will require ambitious concerted action by both private and public stakeholders."

While the reported growth continues to be strong, more projects need to be announced and existing projects need to mature faster. An additional USD 430 billion in projects are required to put the world on track to a timely decarbonization.

Sanjiv Lamba, CEO of Linde and Co-Chair of the Hydrogen Council, said: "It's promising to see clean hydrogen projects developing across geographies, with 12 GW of electrolyzer capacity reaching FID. However, we need to further build on this momentum if hydrogen is to fulfil its role in supporting the energy transition. This is achievable with the right regulatory frameworks in place, and through collaboration across the entire hydrogen value chain."

These developments in hydrogen are playing out in a more challenging macroeconomic environment. Higher costs of capital, higher EPC costs and higher costs of renewable power have increased the cost of making renewable hydrogen. Estimates for production costs of renewable hydrogen are up 30-65%, resulting in USD 4.5-6.5/kg.

In the long run, the Hydrogen Council expects production costs to fall to USD 2.5-4/kg of renewable hydrogen.

Reductions in electrolyzer costs of up to 70% through 2050 are considered to be the strongest lever to bring down renewable hydrogen CapEx and overall costs. However, further measures – such as the standardization of projects – are required to fully optimize renewable hydrogen production CapEx, and while it could fall by 45% through 2030, the report finds that active project optimization could decrease costs by an additional 25%.

Bernd Heid, Senior Partner at McKinsey, said: "Optimizing renewable hydrogen CapEx is key to countering recent increases in the cost of producing renewable hydrogen of about 30-65%. Cost increases have mainly been caused by global interest rate hikes, supply chain constraints, and increased renewable energy costs. Optimizing renewable hydrogen production could cut CapEx by half vs 2023 levels."

You can read the full Hydrogen Insights 2023 December Update report here.

About Hydrogen Insights

Hydrogen Insights is the Hydrogen Council's perspective on the hydrogen industry's evolution. It summarizes the current state of the global hydrogen sector and actual hydrogen deployment.

The Hydrogen Council and McKinsey & Company co-author this publication. It represents a collaborative effort to share an objective, holistic, and quantitative perspective on the status of the global hydrogen ecosystem.

About The Hydrogen Council

The Hydrogen Council is a global CEO-led initiative that brings together leading companies with a united vision and long-term ambition for hydrogen to foster the clean energy transition.

The Council understands that hydrogen has a key role to play in reaching global decarbonization goals by helping to diversify energy sources worldwide, to foster business and technological innovation as drivers for long-term economic growth, and to decarbonize especially hard-to-abate industrial sectors.

To find out more visit www.hydrogencouncil.com and follow us on Twitter @HydrogenCouncil and LinkedIn.

RGU Researchers Make Steam-Based Hydrogen Production Breakthrough

Researchers at Robert Gordon University (RGU) have designed a tubular cell that can withstand high temperatures which will help cut costs as well as moves toward greener forms of energy.

Led by RGU's School of Engineering in collaboration with University of Surrey the team have developed a solution to aid the production of hydrogen by designing, fabricating, and testing electrodes used in solid oxide steam electrolysis (SOSE) for waste steam generated from nuclear power plants.

SOSE systems operate at between 600 °C to 900 °C temperature range and the associated cathode, electrolyte and anode layers were manufactured with thermal spray and dip coating techniques.

Advances in the design of the cell as well as the materials and arrangement were made in the laboratory during the project. All of this helped contribute to the performance of the system.

The research showed that the tubular electrolyser cell provides an improved performance, which means the design has a higher hydrogen production rate, compared to the existing cells.

More research is needed to develop improved manufacturing techniques to prevent cracking while the system is used at high temperatures. Another move forward for the team and the project would to be upscaling and life cycle assessment (LCA) before it becomes a commercial product.

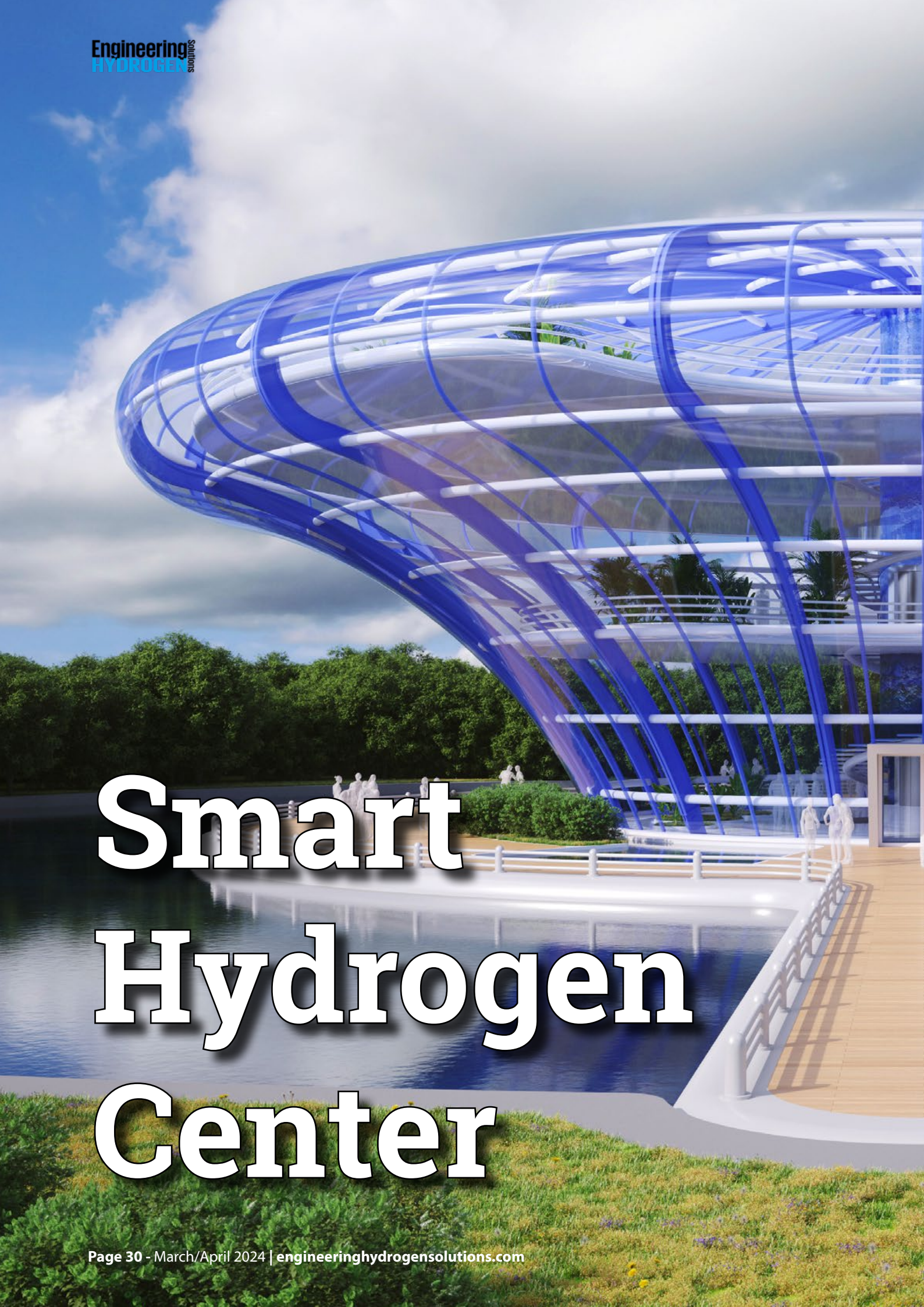
Developing electrolyser cells with enhanced hydrogen production and their scalable manufacturing can play an important role in enabling not only eco-friendly development but also cost-effective, reliable, and sustainable opportunities.

The research was funded by the Engineering and Physical Sciences Research Council (METASIS, EP/W033178/1) with co-investigators Prof Qiong Cai and Dr Bahman Horri from the University of Surrey. Dr Victoria Kurushina (PDRF), Dr Ajith Kumar Soman (PDRF), and Vinooth Rajendran (RA) worked on various aspects of this project.

Professor Nadimul Faisal (METASIS lead investigator), from the School of Engineering, said: "Developing electrolyser cells with enhanced hydrogen production and their scalable manufacturing can play an important role in enabling not only eco-friendly development but also cost-effective, reliable, and sustainable opportunities. This project has the potential to advance technology to produce green hydrogen and thus we will exploit the outcomes and commercialise the product."

Professor Mamdud Hossain, from RGU's School of Engineering, said: "This EPSRC funded project gave us an opportunity for building something from scratch through fundamental research. We have shown our technology works and provide a better performance compared to existing design. We are seeking further partners to take the technology near to market."

Dr Anil Prathuru, Lecturer at the School of Engineering added: "Solid oxide electrolyser technology is set to play a key role in UK's energy goals. Scalable manufacturing is a potential issue. This project gave us the opportunity to try some unique ideas towards enhancing the operational efficiency and demonstrate a highly scalable method of electrolyser manufacture."



Smart Hydrogen Center

An enormous drop appears to splash out of the water where it forms softly gleaming transparence and intriguing reflections. This is DROP - Smart Hydrogen Center, designed by the Italian architect Giancarlo Zema for Hydrogenscape company, the first floating multipurpose cultural Center dedicated to the hydrogen. The Center combines the focus on the latest frontiers of hydrogen technology and design with the pleasure of contemplating nature's beauty with a totally new perspective, from the water.

Hydrogen which from Greek means "water generator" is the first chemical element of the periodic table, the lightest and most abundant in nature, it will be the undisputed protagonist of the energy revolution in the coming years. The water, from which it is extracted, is also intended as a metaphor for the creative thinking of enlightened minds that have the ability to change the world through a fluid and circular flow of ideas. This is the vision behind the Drop project.
A floating circular platform with stretches of water and green areas supports the winding 50 meters diameter steel structure and provides a continual interplay between interior and exterior due its transparent surface.

In full view of the spectacular surrounding scenery, two totally suspended floors host exhibitions, meetings and catering activities, making full use of its great flexibility in meeting the different demands of different organizational needs. Green areas also provide oxygen and lovely color effects for visitors. The various levels are connected vertically by a spiral staircase whose thinly water-coated core houses local and technical services.

The external surface provides charming visual effects through the use of electrochromatic smart glass which can also modify its opacity according to the degree of external insolation, as well as checking on UV ray penetration in order to regulate the internal temperature. A fully integrated RGB LED controller system creates fascinating color variations in line with the features of the surrounding area and any events underway.

During the summer, natural microventilation is assured by means of a chimney effect through small openings in the lower part of the drop which allow fresh air to enter which then exits by means of openings located at the top of the crown. Amorphous photovoltaic panels capture the sun's rays and produce the energy needed to generate hydrogen to meet the needs of the changing internal functions. A floating walkway and stunning light effects on the water complete the visual appeal of the technological drop.

A unique Center in the world that communicates the innovative message of hydrogen both in form and function, as it is capable of producing the energy necessary for its own sustenance

www.giancarlozema.com

Using Electrolyzers For Industrial H2 Production

Much of the hydrogen (H2) produced for industry comes from fossil fuels. Steam reforming is a thermochemical process whereby a fossil fuel is heated with water to produce hydrogen and carbon dioxide. 'Blue' Hydrogen is produced from natural gas reforming, and 'brown' hydrogen from gasified coal.

Both these methods produce carbon dioxide (CO2) as a by-product, which is either released to the atmosphere or collected for use in another process (such as food and drink processing).

There is now a marked trend to move away from the production of hydrogen (H2) via the reduction of natural gas, towards electrolysis of water. In many countries, the power used to operate electrolyzers comes from solar, wind and hydro, as well as from bio-methane fuelled power generation.

Hydrogen produced using renewable energy is termed 'green'. Although electrolysis requires a lot of energy, renewables like wind and solar don't emit CO2 like the blue- and grey-produced hydrogen.

Hydrogen can also be produced via biomass gasification. This involves high temperatures (700 °C), but without combustion. The quantities of O2 and steam in the process are controlled to produce CO & H2. This gas, syngas, is then used to power turbines via combustion.

Though growing biomass removes CO2 from the atmosphere, this process needs to be combined with carbon capture to keep the net emissions low.

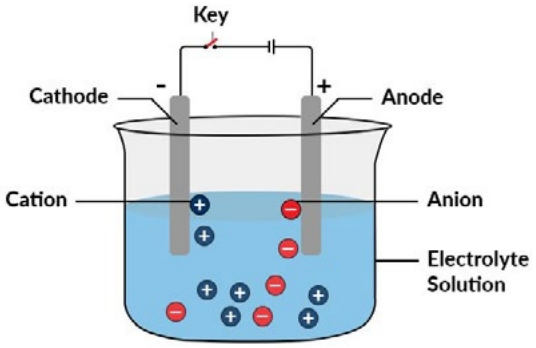
The electricity required for electrolysis can be up to 75 % of the cost of production of hydrogen, hence the trend towards renewable sources.

Gasification - Wikipedia

How are developments in electrolyzer driving production of green hydrogen?

Electrolyser technology is rapidly advancing and replacing the production of hydrogen using fossil fuels, which is reducing the amount of CO2 produced as a by-product. The growth in this industry is driven by the requirements of various governments to reduce the use of fossil fuels for power generation and transportation, replacing them with fuel cell technology. Fuel cells convert hydrogen and oxygen into electricity and the by-product water. Heat is also generated in this process. That heat in larger facilities can be used to drive steam turbines for power generation – known as 'co-generation'.

Put simply, electrolysis is the passing of DC current through an electrolyte, resulting in a chemical reaction at the anode and cathode. O2 is produced by oxidation at the anode and H2 by reduction at the cathode.



Electrolysis Process

Caption: Electrolysis Process

Electrolysis has been with us since 1800, when Alessandro Volta developed the early electrical pile using acid as a medium, and it was noticed that, when current flowed, oxygen and hydrogen appeared at the poles of the pile. Further research was carried out by Sir Humphry Davy (of the Davy safety lamp fame) and his then assistant Michael Faraday (who formulated two laws of electrolysis)

Alkaline electrolyzers (AEL)

It was found that pure water is not always a good medium for electrolysis. For that reason, modern electrolyzers will use potassium and sodium hydroxide, which offer better reactions. See Electrolysis of water - *Wikipedia*

The hydroxide ions travel from the cathode to the anode through the electrolyte. Hydrogen is generated on the cathode and oxygen at the anode. This method of production is termed 'alkaline electrolysis' and works at a temperature range of 70...90 °C, at pressures of around 30 bar.

PEM electrolyzers

Another type is the polymer electrolyte membrane (PEM) electrolyzer, which uses water to react at the anode to form O2 and positively charged hydrogen ions which move across the ion-conducting membrane to the cathode. The membrane is a special solid polymer material.

These ions then recombine with the external electrons running through the circuit to produce hydrogen gas. Thus, O2 is produced at the anode and H2 at the cathode. This technology produces very pure hydrogen.

Developing other methods of hydrogen production

Photoelectrochemical (PEC) and Photobiological: These processes use light energy to split water into H2 and O2, and are mainly experimental at present.

PEC utilizes panels similar to photovoltaic cells immersed in an electrolyte, with the Sun providing the energy to make the water-electrolyte splitting happen.

For photobiological generation, green microalgae or cyanobacteria use sunlight to split water into hydrogen and oxygen ions.

Process Sensing Technologies' products for hydrogen and oxygen production

We offer a wide selection of products to ensure both hydrogen and oxygen quality in various stages of the process.

At the outlet of the electrolyzers:

For measuring H2 in O2: The Michell XTC601 This is capable of operating at the production level, which can be a wet process.

For measuring O2 in H2: The Michell XTP601 Both the XTP & XTC can be SIL2-capable.

At the post-production of hydrogen:

Where the gas has been dried, the operators want to see low ppm O2 and dry dew points; <10 ppmV and -50°C and below are typical requests.

We recommend:

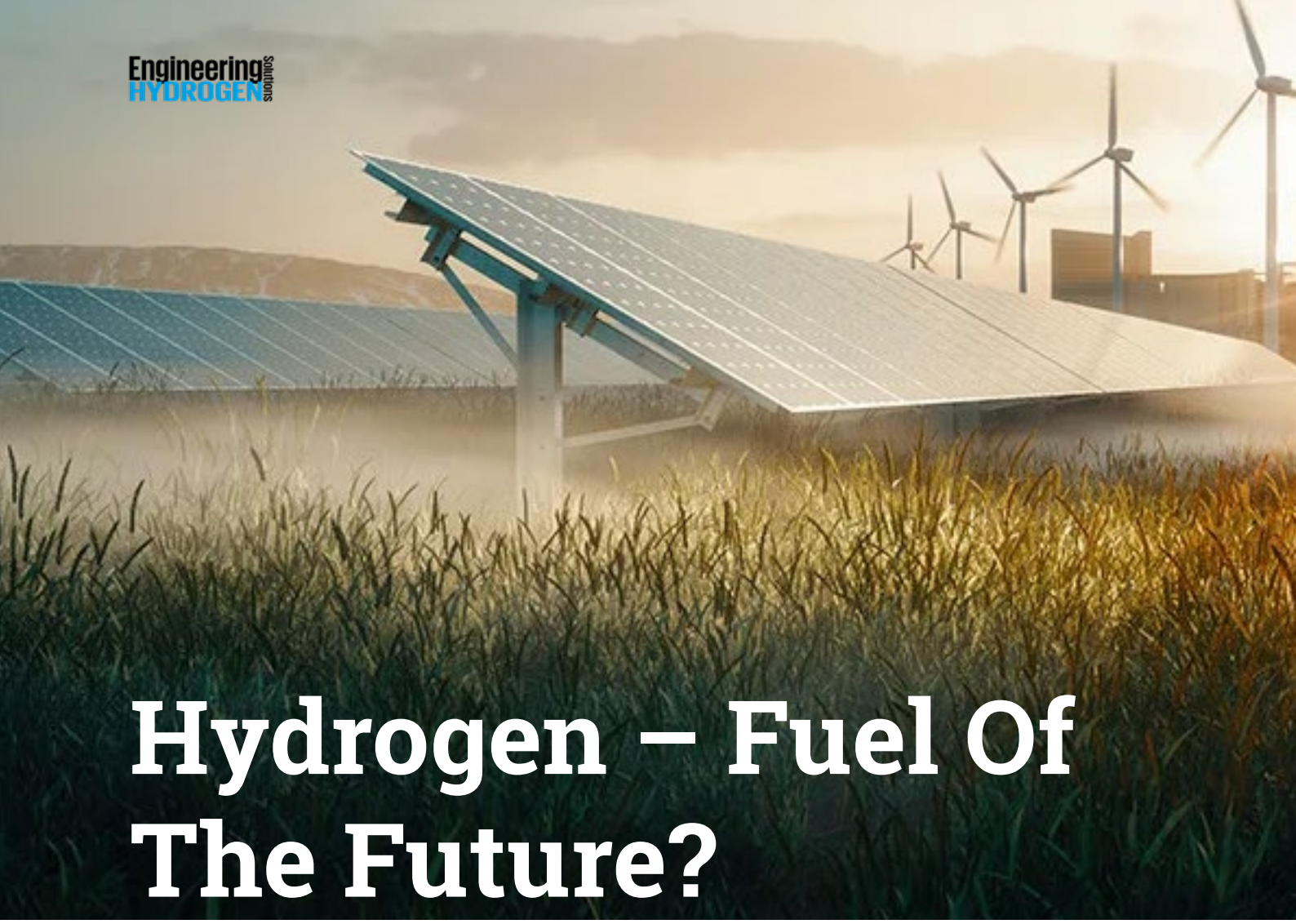
The Michell Easidew PRO XP Explosion-Proof Dew-Point Transmitter, with a measurement range from -110 up to +20 °C dew point.

The Michell XTP601 Oxygen Analyzer offers a choice of ranges, from 0...0.5 % O2 up to 90...100 % O2.

For high-purity H2, the producers often want to know both how dry the gas is and that the oxygen levels are below certain ppm limits. For this we can offer the Michell Easidew Pro I.S. and the Ntron Minox-i ppm sensor.

For monitoring trace gas in hydrogen, the LDetek HyDetek is a good choice. This instrument is capable of measuring trace impurities in hydrogen down to low parts per trillion, to meet ISO 14687 Part 2 for Hydrogen for use in fuel cells. It can also measure N2 in Hydrogen for leak check and to ensure there is no residual N2 during pipes purging.

https://www.processsensing.com/en-us/contact/?utm_source=header&utm_medium=link



Hydrogen – Fuel Of The Future?

Faced with climate change and general demand for sustainability in an energy sector driven by renewables, there is currently a large amount of research into and development of alternative energy sources and fuels. This is the background from which the EU Hydrogen Strategy emerged, and is making hydrogen a central pillar in the fight against climate change. As such, hydrogen is being considered the potential fuel and energy source of the future. However, alongside its political and structural hurdles, this new course of action also brings technical challenges with it.

Sustainability

The sustainability of hydrogen is heavily dependent on how it is produced, i.e. what type of energy is used to produce it. The basic difference is between grey and green hydrogen. Grey hydrogen is produced using energy from fossil fuels, meaning it isn't carbon neutral.

By contrast, green hydrogen is produced through electrolysis, i.e. splitting water into hydrogen and oxygen, using electricity from renewable sources. Green hydrogen will play an increasingly significant role in the coming phases of the energy transition.

For the moment, however, green hydrogen is very costly to produce and can't yet be generated in large quantities. This type of hydrogen will therefore most likely be imported from countries with the potential for generating energy from renewable sources such as solar or wind power. Green hydrogen is expected to be used to help cover energy requirements during periods of peak demand on the power grid. Experts believe that the technology will play a pivotal role in combating climate change.

What is hydrogen?

Hydrogen is the lightest chemical element in the universe. It has many positive properties, as well as a few negative, even dangerous ones. One of hydrogen's simultaneously positive and dangerous characteristics is its chemical reactivity, while its high level of permeability also poses a challenge. «Permeability» means that hydrogen is able to «pass through» other materials such as stainless steel. The scientific term for this process is «diffusion».

Materials that come into contact with hydrogen must therefore meet particularly stringent requirements. This fact is what gives pressure transmitters manufacturers one of our biggest collective headaches. What materials can we use to ensure that our pressure transmitters have the best possible service life? At what point does it start to jeopardise the safety of the system as a whole? And how long do your measurements stay sufficiently accurate?

Hydrogen applications

Pressure transmitters are used at every point along the hydrogen pro-

duction and supply chain. The pressure of the hydrogen medium has to be monitored at every process step; from production and transport to final use.

That said, there are significant differences in terms of the requirements and specifications on the measuring device. Hydrogen gas can be transported through pipelines or with HGV tankers. The gas is transported through pipelines at low pressures ranging between 25 to 80 bar; by contrast, pressures of up to 350 bar can be measured when hydrogen is transported via HGV.

Hydrogen must be stored in highly pressurised tanks when in use; the pressure in these tanks is kept at 350 bar or between 700 and 900 bar. The pressure difference here depends on whether the hydrogen is being used in HGVs/buses (350 bar) or in smaller vehicles (700 / 900 bar). The hydrogen is compressed to a pressure calculated at 950 bar at the refuelling station in order to fill these vehicles. Even small deviations in the measurement can cause considerable losses for the operator or even the customer.

Despite these differing fields of application, each pressure transmitter must satisfy the following requirements:

- Accuracy
- Longevity
- Safety / intrinsic safety

The KELLER solution

A pressure transmitter based on piezoresistive technology has a stainless-steel diaphragm behind which oil is found. As already mentioned, permeability is one of the problems to contend with when it comes to dealing with hydrogen; the gas can easily diffuse through the steel. Even small amounts of hydrogen behind the stainless-steel diaphragm can result in inaccurate measurement results, and can even destroy the sensor itself.

Scientific studies have found that gold is far less permeable than stainless steel. As such, one tried-and-tested solution is to coat the steel diaphragm with gold and thus significantly slow down the rate of penetration.

The parts of the pressure transmitters that come into contact with the diaphragm are completely free of elastomers. The transmitter is fully welded inside, and the point between transmitter and measuring point is sealed metallically.

The sensor is cleaned with an oil- and grease-free solution, thereby preventing the entire hydrogen system from becoming contaminated. What's more, all our hydrogen sensors are ATEX certified for increased safety (3G).

keller-druck.com

Hong Kong's First Hydrogen Bus

Hong Kong's public transportation landscape undergoes a revolutionary transformation with the deployment to service of a cutting-edge zeroemission hydrogen bus today. The first-ever hydrogen double deck bus has commenced service on our Route 20, marking a remarkable achievement and the next step in the transition of Hong Kong's rich transport history as it takes to the road with customers on board, following our previous debut of Hong Kong's first ever electric double deck bus two years ago.

We eagerly anticipate reaching even more significant milestones in the near future, as the hydrogen bus will expand its operations to two additional routes in the next phase, underscoring our leading position in the public transport zero-emission space and making a further transformation for citizens and travellers in the vibrant heart of Kowloon.

Our hydrogen double deck bus, which is operated from and refuelled at Hong Kong's first hydrogen refuelling station in our West Kowloon Depot, embarks on its first journey at 11:00am today. We were proud to welcome many joyful bus and transport enthusiasts on board the bus and share in the joy by handing out some certificates and gifts to commemorate this historic moment - "The Future is H2re". Serving Route 20, the hydrogen bus will travel from Kai Tak (Muk On Street) to Cheung Sha Wan (Hoi Tat), offering in the initial phase a daily schedule of 6 to 8 trips.

Roger Ma, General Manager (Operations) of Citybus expressed his pride in the groundbreaking achievement of our "#MissionZero" campaign. "We take great pride as a company in serving the citizens of Hong Kong every day and in debuting Hong Kong's first ever hydrogen double deck bus, which will shuttle through the bustling heart of Kowloon, encompassing the districts of Sham Shui Po, Yau Tsim Mong, and Kowloon

City. In the next phase, our hydrogen bus will expand its service coverage to include Routes 20A and 22M.

These three routes, include two prominent trunk routes, serve as core routes for Citybus, enabling us to gather further invaluable operational insights into real-world scenarios, including differing traffic conditions, weather factors and performance."

Citybus is proud to stand as the industry leader in zero-emission transformation, being the sole franchised bus company in Hong Kong with extensive experience in research and development by our skilled engineering team and valuable real operating experience of both double deck electric and hydrogen buses. We introduced Hong Kong's first electric double deck bus in 2021 and remain committed to introducing additional next generationhydrogen and electric buses for parallel testing and deployment within this year, solidifying our role as a leader in the field of new energy vehicles. We have also pledged to operate a full-fleet of zero-emission buses by 2045.

Building upon the success of Hong Kong's first hydrogen project, we eagerly anticipate working further and continuing our collaboration with the Inter-departmental Working Group and wider government and promoting further policy reforms that support ongoing hydrogen development and operations of new energy vehicles and infrastructure.

Citybus is owned by Bravo Transport Services and is committed to improving the quality of life for the citizens of Hong Kong that we serve, whilst providing safe and reliable bus services. The company employs over 5,000 staff, operates over 1,700 buses across Hong Kong Island, Kowloon and the New Territories and carries over 1m customers per day. Citybus has an industry leading bus fleet with all buses operating at Euro5 emissions standard or above.

Citybus is owned by Bravo Transport Services and is committed to improving the quality of life for the citizens of Hong Kong that we serve, whilst providing safe and reliable bus services. The company employs over 5,000 staff, operates over 1,700 buses across Hong Kong Island, Kowloon and the New Territories and carries over 1m customers per day. Citybus has an industry leading bus fleet with all buses operating at Euro5 emissions standard or above.

Groundbreaking Hydrogen Fuel Cell Truck Trial

Hydrogen Vehicle Systems (HVS), the UK's first Hydrogen Fuel Cell truck OEM, has entered into a Memorandum of Agreement (MOA) with Mannok Build Ltd (Mannok) to explore the integration of Hydrogen Fuel Cell HGVs into the Mannok fleet. This strategic collaboration marks the beginning of a groundbreaking zero emission commercial vehicle trial showcasing Mannok's commitment to sustainability to achieve its net-zero carbon goal by 2050.

The MOA outlines the partnership's objective to provide Mannok with trial vehicles to test the application of HVS hydrogen fuel cell HGVs on its fleet. The trial is set to commence when these groundbreaking vehicles become available for trial in late 2025. Following this phase, Mannok will be in a favourable position to initiate the conversion of part of its fleet to these cutting edge, zero-emission HGVs.

Mannok is renowned for its manufacturing and service excellence in the UK and Ireland and has been a leading provider of premium construction products and sustainable consumer packaging solutions for over 50 years. The company's commitment to sustainability and innovation is evident in its diverse range of products. As one of the largest employers and contributors to the social and economic prosperity of the region, Mannok's embrace of hydrogen fuel cell HGVs aligns seamlessly with its broader goal of achieving net-zero carbon emissions by 2050.

Kevin Lunney, Chief Operations Officer for Mannok, said, "We are excited about this partnership with HVS as it aligns perfectly with our commitment to sustainability and innovation. By exploring the integration of hydrogen fuel cell HGVs into our fleet, we are taking a crucial step towards achieving our net-zero carbon goals."

Hydrogen Vehicle Systems (HVS), headquartered in Glasgow, has emerged as a trailblazing force in the transportation sector. Focused on engineering excellence, design innovation, and sustainability, HVS aims to revolutionise the heavy-duty commercial

vehicle industry. Their state-of-the-art powertrain solution, designed as a native Fuel Cell Electric Vehicle (FCEV) from the ground up, promises superior efficiency, outstanding performance, and a reduced environmental impact.

John McLeister, Chief Commercial Officer at HVS, comments, "We are delighted to partner with Mannok in pioneering the integration of hydrogen fuel cell HGVs into its vehicle fleet. This collaboration represents a significant stride towards decarbonising the transportation sector and underscores our shared commitment to sustainability. We look forward to working together to transition to zero."

The Transition to Zero Programme outlines HVS' commitment to supporting potential partners in their journey towards zero-emission transportation. Through their collaboration in the Transition to Zero Programme, participants will have the opportunity to engage in a trial involving HVS' innovative Hydrogen FCEV HGVs. This trial allows potential operators to test drive the vehicles on their delivery routes and experience hydrogen fuelling equipment firsthand. Following this trial, HVS anticipates that partners will select and acquire their vehicles for their transition to zero-emission operations.

Throughout continuous collaboration, both parties will provide comprehensive support to facilitate the transition to zero-emission fleets. This structured framework encompasses various aspects, including technology options, hydrogen refuelling infrastructure, safety and regulation guidance, finance options, government incentives, warranty information, training programmes for driving and maintenance, and fleet assessment. The aim is to ensure a smooth transition by sharing detailed insights, information, and the resources necessary for a successful adoption of Hydrogen FCEV HGVs, aligned to partners' sustainability goals.

Mannok is one of the UK and Ireland's most diverse and experienced manufacturers of construction products and consumer packaging, producing a wide range of premium sustainable solutions. With a heritage of over 50 years, the Mannok name is synonymous with manufacturing and service excellence coupled with a passion for sustainability and innovation. Its main operations base occupies a 3km stretch of road which straddles the border between Northern Ireland and the Republic of Ireland, and it is one of the largest employers and contributors to the social and economic prosperity of the region. Adopting hydrogen fuel heavy goods vehicles as part of its fleet would support Mannok in achieving their net zero carbon goal by 2050.

For more information about Mannok, please visit https://www.mannok-holdings.com/

HVS (Hydrogen Vehicle Systems) is a UK company founded 2017. From innovative powertrain design to ground up production, HVS aims to disrupt the commercial vehicle industry by being an early mover with the most advanced, all–new zero emission HGV. Leading the way in

hydrogen electric vehicle design, HVS is pioneering cutting-edge solutions that will decarbonise one of the heaviest polluting sectors worldwide. Combining unique design, efficiency, and performance; HVS will provide the ultimate driver experience at lower costs and lowest emissions.

For more information about Hydrogen Vehicle Systems (HVS), please visit https://www.hvs.co.uk

Top Facts

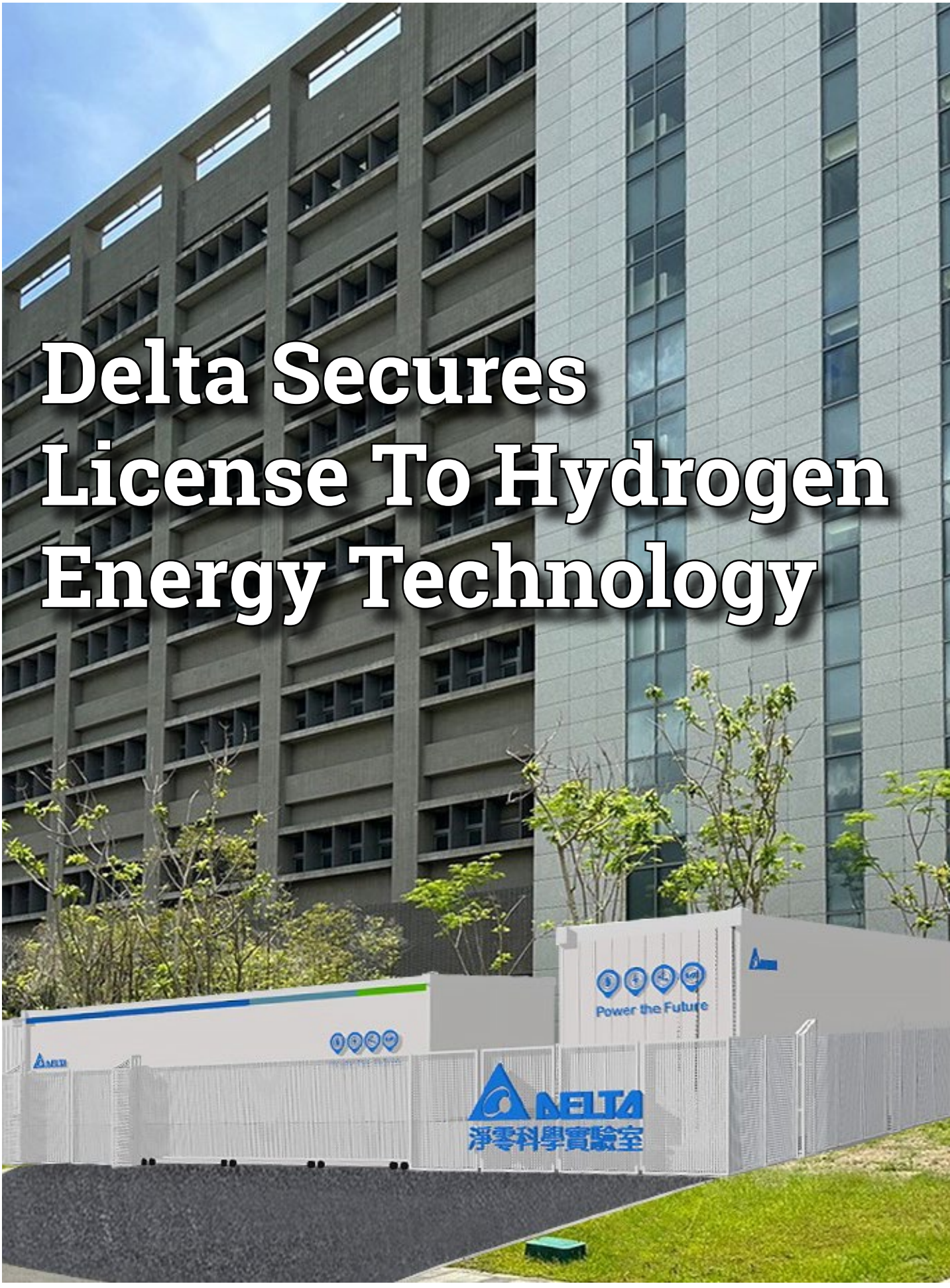
Based on HVS' conservative sales projections, by 2030 the new UK fleet of hydrogen HGVs displacing diesel vehicles could prevent more CO2 and noxious air emissions than the reported annual emissions of Heathrow airport.

Green hydrogen is an infinitely renewable fuel. It is made using renewable electricity to split water (H2O) into hydrogen and oxygen. In the fuel cell, hydrogen recombines with oxygen from the air to produce heat, power and water.

Fuel Cells were invented in the UK by a Welsh scientist Sir William Grove in 1839.

The UK is home to leading international hydrogen production, supply and storage industries, and HVS is an emerging OEM.

Delta Secures License To Hydrogen Energy Technology



Delta Electronics, Inc. (hereinafter referred to as "Delta"), a global leader in power and thermal management and provider of IoT-based Smart Green Solutions, today announced the signing of a long-term collaboration agreement, which includes technology transfer and licensing, with Ceres Power Limited, subsidiary of London Stock Exchange-listed Ceres Power Holdings plc (hereinafter referred to as "Ceres") to access Ceres' Hydrogen energy stack technology portfolio for approx. GBP43 million.

Ceres is a global leader in solid oxide fuel cell and electrochemical technology. Through this partnership, Delta expects to integrate Ceres' energy stack technology with its own industry-leading power electronics and thermal management technologies to develop solid oxide fuel cell (SOFC) and solid oxide electrolysis cell (SOEC) systems for hydrogen energy applications, with production expected to start by the end of 2026, with strong ambition for future scale-up. These SOFC and SOEC systems are expected to enhance the capabilities of Delta's green solutions for a myriad of sectors, such as, chemicals, energy, transportation, steel and more.

Ping Cheng, Delta's CEO, said, "Hydrogen has high heating value and zero CO2 emission potential characteristics, and thus, will play a crucial role in the global transition towards net-zero. Moreover, Hydrogen SOFC systems boast reliability and high efficiency in electricity generation, making them ideal for micro-grid applications, distributed power systems, mission-critical facilities, such as data centers, semiconductor production lines, and other advanced manufacturing.

SOEC systems will also play a key role in the chemical, utilities, and steel industries as they are adopting green hydrogen to replace fossil fuels in their manufacturing processes and operations. By leveraging Ceres' expertise in solid oxide stack technology and our industry-leading technologies in power and thermal management, Delta will enrich its infrastructure solutions portfolio by delivering high-efficiency SOFC and SOEC systems for our customers worldwide, hence, further contributing to global carbon reduction targets."

Phil Caldwell, CEO of Ceres added, "It's great to announce a new partnership today with Delta, a company with worldwide expertise in mass manufacturing, power electronics and system integration. We believe Delta can deliver efficient clean hydrogen solutions for its customers utilising both our SOFC and SOEC technologies. Green hydrogen has a key role to play in delivering a more secure and sustainable future energy system and today we take this first step towards what promises to be a strong collaboration with Delta to accelerate the industry globally."

In addition to licensing key energy stack technologies, Delta will also establish a "Net-zero Science Laboratory" at its Tainan manufacturing complex to develop cutting-edge zero-carbon technologies, including hydrogen energy, and to enrich its own R&D capabilities in related application fields. From 2024 to 2026, Delta expects to carry out product development and production line integration at its Tainan plant with Ceres' engineering service support.

Production for the aforementioned technology is expected to start by the end of 2026. Delta expects to further integrate its diverse smart energy solutions, including microgrid applications and energy management platforms, with these hydrogen energy systems to provide a more comprehensive and flexible low-carbon infrastructure offerings to its customers.

Ceres' stack technology is the core for both SOFC and SOEC. In the application of SOFC, it can generate electricity, water and heat by reacting oxygen with hydrogen or methane. Its power generation efficiency, which is around 60% and can even reach 85% with a heat recovery system, is significantly higher than the efficiency of centralized gas-fired power generation units, which are around 40~50%. As SOFC can be built near places with electricity demands, it is able to avoid power transmission loss and other unexpected unstable factors during the transmission and distribution process. Hence, it's highly suitable for facilities that require stable power.

SOEC technology produces hydrogen up to 25% more efficiently than incumbent low temperature technologies particularly when thermally integrated with industrial processes. With electricity coming from renewable sources, the technology can produce green hydrogen, which would be optimal for the decarbonisation of various industries, including steel and chemical, which are seeking to replace the fossil-based materials in their processes to ultimately reduce carbon emissions.

Green hydrogen is also one of the key ingredients to produce carbon-neutral e-fuels, with the support of carbon capture technology for its carbon sources. E-fuels are alternative energy sources for ICE vehicles, ships and aircrafts under the net-zero transition.

Ceres, headquartered in Horsham, the UK and listed on the London Stock Exchange since 2023, has been perfecting its solid oxide technology for more than 20 years, with an industry-leading position in fuel cell and electrochemical technology. Ceres operates a licensing business model.

With global energy transition trends, it is expected that the global demand for hydrogen will reach 223 Mt in 2030, and 630 Mt in 2050*. Hydrogen applications will play a crucial role in achieving net zero targets.

www.deltaww.com

REUTERS EVENTS™

HYDROGEN 2024

Where Projects Reach Financial Close

Leonardo Royal Amsterdam City

9 - 10 April

FIND OUT MORE