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Boletim de Vigilância Tecnológica

Secções

Número 7 **Maio 2025**

NOTÍCIAS

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Produção de Hidrogénio

1 European energy giant to build hydrogen production and export site in Scotland

31/05/2025 | Hidrogen Central | **Link**

Norwegian energy company Statkraft plans to develop a major green hydrogen production and export facility at Hunterston, Scotland. The project will use renewable electricity to power electrolyzers that generate hydrogen. This hydrogen will then be converted into ammonia for easier storage and shipping.
The site aims to supply international markets, particularly Germany, aligning with Europe's broader decarbonization goals. The project is expected to contribute significantly to the local economy, create jobs, and help reduce carbon emissions in heavy industry and transport.

2 Crosswind – Construction of the Base Load Power Hub (BLPH) hydrogen production-battery storage platform completed

16/05/2025 | Hidrogen Central | **Link**

CrossWind, a joint venture between Shell and Eneco, has completed the construction of the Base Load Power Hub (BLPH), an innovative offshore platform designed to stabilize wind energy production. Located near the Hollandse Kust Noord wind farm in the Netherlands, the BLPH combines a 2.5 MW electrolyzer for green hydrogen production, hydrogen storage systems, a 1 MW fuel cell to convert stored hydrogen back into electricity, and a 5 MWh battery system for short-term energy storage. By integrating these technologies, the platform ensures a more stable and continuous energy supply, helping to address the intermittency of renewable sources and contributing to the broader energy transition.

3 Austrian oil company takes 'final investment decision' on 140MW green hydrogen project — if it wins EHB subsidies

29/05/2025 | Hydrogen Insight | **Link**

An Austrian oil company, OMV, has made a final investment decision on a 140 MW green hydrogen project, contingent upon receiving EHB subsidies. The project aims to produce renewable hydrogen and is a significant step towards expanding green hydrogen capacity in Austria. Additionally, OMV recently launched a 10 MW renewable hydrogen plant at its Schwechat refinery near Vienna. This initiative reflects the company's commitment to transitioning towards cleaner energy sources.

NOTÍCIAS

Produção de Hidrogénio

4 'Combining alkaline and solid-oxide electrolysers might be the best option for some green hydrogen projects': Thyssenkrupp Nucera CEO

29/05/2025 | Hydrogen Insight | **Link**

Combining alkaline and solid oxide electrolysers presents a promising approach for green hydrogen production. This hybrid method leverages the cost-effectiveness and maturity of alkaline electrolysers alongside the high-temperature efficiency of solid oxide electrolysers. By integrating both technologies, green hydrogen projects can achieve improved scalability, higher overall efficiency, and potentially lower production costs, making this combination an attractive option for future hydrogen production initiatives.

5 Klaipėda Port to launch Baltic region's first green hydrogen facility

30/05/2025 | Hydrogen Europe | **Link**

The Port of Klaipėda in Lithuania is set to launch the Baltic region's first green hydrogen facility. The project involves building a hydrogen production and refueling station using a PEM electrolyzer, with production expected to start in 2026. The facility will produce approximately 127 tons of green hydrogen annually, supplying fuel for ships, trucks, buses, and port machinery. This initiative supports sustainable mobility and strengthens the region's hydrogen infrastructure by integrating new power, water, and hydrogen pipeline networks.

6 Environmental terms approved for 100MW Hellenic Hydrogen facility

22/05/2025 | Hydrogen Europe | **Link**

The environmental terms have been approved for the 100 MW Hellenic Hydrogen facility located in Amyntaio, Greece. This project, a joint venture between Motor Oil and PPC S.A., aims to produce up to 15,500 tons of green hydrogen annually through electrolysis powered by renewable energy sources. The produced hydrogen will be injected into the natural gas grid managed by DESFA S.A., supplying industrial users, including gas-fired power plants. The facility supports the development of green hydrogen as a sustainable energy source in Greece.

7 AM Green, Port of Rotterdam explore green hydrogen trade link

20/05/2025 | Hydrogen Europe | **Link**

The European Commission has selected 15 projects across the European Economic Area to receive nearly €1 billion in funding to accelerate the production of renewable hydrogen. These projects aim to produce approximately 2.2 million tonnes of renewable hydrogen over the next ten years, helping to reduce over 15 million tonnes of CO_2 emissions.
The projects, located in countries such as Spain, Germany, the Netherlands, and Finland, will support various sectors including transport, chemical industry, and the production of methanol and ammonia. This investment is a significant step towards scaling up renewable hydrogen production and achieving climate goals in Europe.

8 Infinium will deploy Electric Hydrogen's electrolyzer plant at large-scale eFuels facility in Texas

19/05/2025 | Hydrogen Europe | **Link**

Infinium, a company focused on sustainable fuel production, will install Electric Hydrogen's 100 MW electrolyzer plant at its large-scale eFuels facility in Texas. This project, called Project Roadrunner, aims to produce green hydrogen through electrolysis, which will be used to manufacture sustainable aviation fuel (eSAF), eDiesel, and eNaphtha. The initiative supports the transition to clean energy by providing renewable hydrogen for synthetic fuels, helping to decarbonize sectors like aviation and heavy transport. The project also benefits from partnerships with investors such as Breakthrough Energy Catalyst and Brookfield Asset Management, reflecting strong institutional backing.

9 Hy2gen green hydrogen plant RFNBO certified as 5MW expansion looms

16/05/2025 | Hydrogen Europe | **Link**

The Hy2gen Atlantis green hydrogen plant in Werlte, Germany, has been certified as a RFNBO (Renewable Fuels of Non-Biological Origin) under EU regulations. The certification confirms the plant's production of green hydrogen in compliance with renewable fuel standards. Additionally, Hy2gen plans to expand the plant's electrolysis capacity from 5 MW to 11.3 MW by the end of 2025, supported by a new power purchase agreement with a German hydropower plant. This expansion aims to increase green hydrogen production to meet growing demand and sustainability goals.

10 Seoul – Promoting the development of blue – green hydrogen production technology

31/05/2025 | Hydrogen Central | **Link**

The Seoul Metropolitan Government is intensifying efforts to support the development of blue and green hydrogen production technologies as part of its clean energy transition. The city aims to become a leader in hydrogen energy by investing in infrastructure, research, and industrial partnerships. Key initiatives include the construction of production facilities, support for R&D, and fostering collaboration between public and private sectors. The focus on blue hydrogen (produced from natural gas with carbon capture) and green hydrogen (produced using renewable energy) reflects Seoul's commitment to reducing carbon emissions and building a sustainable energy ecosystem.

11 European energy giant to build hydrogen production and export site in Scotland

31/05/2025 | Hydrogen Central | **Link**

A major European energy company is planning to build a large-scale green hydrogen production and export facility in Cromarty Firth, Scotland. The project, called "Project Cavendish," aims to utilize renewable energy (mainly offshore wind) to produce green hydrogen via electrolysis. The hydrogen will be stored and exported to continental Europe to support decarbonization efforts across various sectors. The initiative is part of the UK's broader hydrogen strategy and is expected to create jobs and stimulate economic growth in the region. It also includes collaboration with local partners and infrastructure development to support hydrogen logistics.

12 Ceres Power starts hydrogen production with Indian demonstrator system

21/05/2025 | Hydrogen Central | **Link**

ceres®

Ceres Power has successfully started hydrogen production at its first megawatt-scale solid oxide electrolyser cell (SOEC) demonstrator, located at Shell's technology centre in Bangalore, India. The system can produce up to 600 kg of hydrogen per day with high electrical efficiency, around 37 kWh per kilogram of hydrogen. This is achieved using a metal-supported design that enables operation at lower temperatures compared to conventional SOECs.The project, part of a collaboration launched in 2022, has now entered its operational phase. Ceres and Shell will monitor performance data to refine the technology for industrial-scale applications. The goal is to offer cost-effective and durable solutions for sectors like green steel, ammonia production, and synthetic fuels. According to Ceres CEO Phil Caldwell, this marks an important milestone in proving the commercial viability of green hydrogen.

13 Commission approves a €400 million Spanish State aid scheme to support renewable hydrogen production

15/04/2025 | European Commission | **Link**

The European Commission has approved, under EU State aid rules, a €400 million Spanish State aid scheme to support the production of renewable hydrogen through the European Hydrogen Bank's "Auctions-as-a-Service" tool for the auction closing in 2025. The scheme will contribute to the objectives of the Clean Industrial Deal to accelerate the decarbonisation of EU industry while strengthening its competitiveness, of the REPowerEU Plan to reduce dependence on Russian fossil fuels and accelerate the green transition, as well as the EU Hydrogen Strategy.

14 Nearly €1 billion awarded to boost development of renewable hydrogen

20/05/2025 |European Commission| **Link**

Today, the Commission announced the selection of 15 renewable hydrogen production projects for public funding across the European Economic Area (EEA). The projects, located across five countries, are expected to produce nearly 2.2 million tonnes of renewable hydrogen over ten years, avoiding more than 15 million tonnes of CO_2 emissions. The hydrogen will be produced in sectors such as transportation, the chemical industry, or the production of methanol and ammonia. They will receive a total of €992 million in EU funding, from the Innovation Fund sourced from the EU Emissions Trading System (ETS).

15 Clean Hydrogen Partnership Boosts Innovation with 26 New Cutting-Edge Projects

07/05/2025 | CHJU | **Link**

The Clean Hydrogen Partnership has awarded EUR 154.6 million in grants through its 2024 Call to date, supporting 26 groundbreaking projects that aim to accelerate the development and deployment of hydrogen technologies across Europe. These projects address key challenges in hydrogen production, storage, distribution, and application, playing a vital role in enhancing the EU's industrial competitiveness and advancing hydrogen technology readiness.
Covering the entire hydrogen value chain, the projects bring together partners from 33 countries, fostering research collaboration and innovation that will reshape energy systems across key sectors - from industry to transport and stationary applications.

NOTÍCIAS

Células de Combustível

1 Fincantieri, Viking announce world's first H2-powered cruise ship and sign contracts for two new units

10/04/2025 | Hydrogen Europe | **Link**

Fincantieri and Viking have announced a landmark project: the construction of the world's first hydrogen-powered cruise ship, named Viking Libra. This ship will utilize liquid hydrogen as a fuel source and will be equipped with polymer electrolyte membrane (PEM) fuel cells, capable of producing up to 6 megawatts of power.The ship is part of a broader commitment to sustainability and innovation in the maritime sector, aiming to drastically reduce carbon emissions. Alongside the Viking Libra, contracts have also been signed for the construction of two additional vessels with advanced energy and propulsion systems.This initiative aligns with ongoing efforts to decarbonize the cruise industry and represents a major technological milestone in integrating hydrogen fuel technology into large-scale maritime applications.

2 ZeroAvia to build manufacturing hub in Scotland

21/05/2025 | H2 View | **Link**

ZeroAvia is set to establish a major manufacturing and testing facility in Renfrewshire, near Glasgow Airport, Scotland. The site will be used to produce high-temperature proton exchange membrane (HTPEM) fuel cells, which are a key component of the company's hydrogen-electric propulsion systems for aircraft. This "Hydrogen Centre of Excellence" will become ZeroAvia's main production hub for its 600kW and 900kW fuel cell systems. The project is supported by £9 million in funding from Scottish Enterprise, with additional investment of £20 million from the Scottish National Investment Bank. The facility will play a central role in scaling up hydrogen aviation technology and creating skilled jobs in the region. It marks a significant step toward ZeroAvia's goal of commercial hydrogen-powered flight by 2027.

3 Zeppelin Power Systems demonstrates hydrogen fuel cell generator in Hamburg

19/05/2025 | H2 View | **Link**

Zeppelin Power Systems has unveiled a hydrogen fuel cell generator in Hamburg as part of a demonstration project. The system, housed in a 20-foot container, combines a PEM (Proton Exchange Membrane) fuel cell, lithium-ion batteries, and hydrogen storage cylinders. It delivers a continuous output of 50 kVA and stores approximately 30 kg of hydrogen. This compact, modular solution is designed for various applications including stationary power supply, maritime and rail sectors, and emergency backup power. The demonstration highlights the potential of hydrogen fuel cells as a clean, efficient alternative to diesel generators in off-grid and critical environments.

4 Maersk and Hyundai explore SOFC potential

07/05/2025 | H2 View | **Link**

Maersk and HD Hyundai Heavy Industries are collaborating to explore the potential of Solid Oxide Fuel Cells (SOFCs) for use in maritime vessels as part of their efforts to decarbonize the shipping industry. The two companies signed a memorandum of understanding (MoU) to test SOFC systems, which are highly efficient and capable of using multiple fuels, including hydrogen, ammonia, and natural gas.The focus is on integrating SOFCs into ship designs, assessing their efficiency, and evaluating their scalability for long-distance marine transport. The technology could contribute significantly to Maersk's ambition of achieving net-zero emissions by 2040. Both companies see SOFCs as a promising alternative to conventional marine engines due to their low emissions and flexibility in fuel choice.

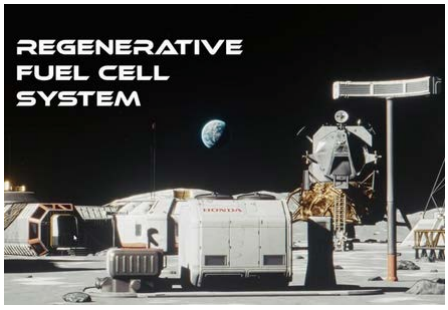
5 Toyota to provide fuel cell modules for Rehlko's stationary power generators

30/04/2025 | H2 View | **Link**

Toyota is set to supply fuel cell modules to Rehlko for use in their stationary power generators. This partnership aims to integrate Toyota's hydrogen fuel cell technology into Rehlko's energy solutions, providing cleaner and more sustainable power generation. The collaboration highlights the growing adoption of fuel cells for stationary energy applications beyond mobility.

6 Honda to test hydrogen fuel cell tech for lunar missions aboard the ISS

07/04/2025 | H2 View | **Link**



Honda is testing hydrogen fuel cell technology aboard the International Space Station (ISS) to support lunar missions. The regenerative fuel cells use solar electricity to split water into hydrogen and oxygen, producing electricity and breathable oxygen with water as the only byproduct. This technology aims to provide a sustainable energy and life support solution for future space exploration. Honda also plans to use similar hydrogen fuel cell technology to help decarbonize its vehicle fleet by 2040.

7 WATT Fuel Cell Completes Installation of its Latest Generation Fuel Cell System, WATT HOME™, within Peoples Natural Gas Service Territory

31/05/2025 | Hydrogen Central | **Link**

WATT Fuel Cell has completed the installation of its latest-generation solid oxide fuel cell (SOFC) system, named WATT HOME™, within the service territory of Peoples Natural Gas. The system provides 24/7 clean, efficient, and reliable power for residential use and serves as a backup energy solution in the event of grid outages. The WATT HOME™ system operates by converting natural gas into electricity using an electrochemical process, making it a quiet and efficient alternative to traditional generators. This installation is part of WATT's collaboration with utility partners to deploy fuel cell technology as a part of distributed energy solutions. The goal is to enhance energy resilience and reduce greenhouse gas emissions while leveraging existing natural gas infrastructure. WATT aims to continue expanding its deployment of SOFC systems to support cleaner, more sustainable energy solutions for homes and small businesses.

8 MIT – New fuel cell could enable electric aviation

31/05/2025 | Hydrogen Central | **Link**

MIT researchers have developed a new sodium–air fuel cell with an energy density over three times higher than current lithium-ion batteries. The design uses sodium metal and oxygen from the air, enabling a lightweight and efficient energy system ideal for electric aviation. It operates at room temperature, is solid-state (improving safety), and can be recharged through a reversible electrochemical reaction. Although still at the prototype stage, it shows strong potential for future use in aerospace and long-range electric vehicles.

9 Zeppelin Power Systems inaugurates fuel cell power generator

20/05/2025 | Hydrogen Central| **Link**

Zeppelin Power Systems has unveiled a stationary fuel cell power generator at its Achim site in Germany. The system uses PEM (Proton Exchange Membrane) fuel cell technology and is housed in a container that includes lithium-ion batteries and hydrogen cylinders. The generator delivers up to 50 kVA of power and is designed for sustainable, emission-free energy production. It serves as a practical demonstration of hydrogen fuel cell technology and reflects the company's commitment to decarbonizing power systems. The initiative is part of Zeppelin's efforts to explore alternative energy sources and develop solutions aligned with the energy transition and future regulatory requirements.

NOTÍCIAS

Tecnologia de Armazenamento de Hidrogénio

1 Hydrogen injection begins at Etzel storage site

12/05/2025 | Hydrogen Tech World | **Link**

Gasunie and Storag Etzel have commenced injecting approximately 90 tonnes of hydrogen into two repurposed salt caverns at the Etzel site in Lower Saxony, Germany. This marks the initiation of the second phase, "H2CAST Build," of the H2CAST Etzel pilot project, following the successful completion of the "H2CAST Ready" phase, which verified the caverns' suitability for hydrogen storage. The hydrogen is sourced from Plug Power's production facility in Werlte, Germany. Simultaneously, construction of the associated above-ground facility has begun. The project aims to demonstrate the feasibility of large-scale underground hydrogen storage, with a total capacity target of up to 1 TWh. Strategically located near the German-Dutch hydrogen market, the Etzel site is well-positioned to integrate into the future hydrogen infrastructure.

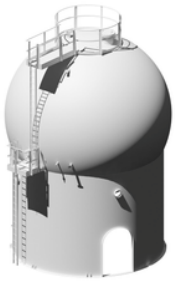
2 Hydrogenious receives approval for world's largest LOHC hydrogen storage plant

29/04/2025 | Hydrogen Tech World | **Link**

Hydrogenious LOHC Technologies has received approval to build the world's largest Liquid Organic Hydrogen Carrier (LOHC) hydrogen storage plant, named "Hector," in Germany. This commercial-scale facility will have an annual hydrogen storage capacity of approximately 1,800 tons. The project marks a significant advancement in hydrogen storage technology, enabling safer and more efficient storage and transport of hydrogen using liquid organic carriers. The plant will help support the growing hydrogen economy by providing a scalable solution to store hydrogen for various applications.

3 CB&I and Shell demonstrate commercial-scale LH_2 storage tank design

16/04/2025 | Hydrogen Tech World | **Link**



CB&I and Shell have collaborated to develop and demonstrate a commercial-scale liquid hydrogen (LH_2) storage tank design. This innovative tank uses a non-vacuum insulated system aimed at reducing costs and improving efficiency for large-scale hydrogen storage. The project, involving partners like NASA, GenH2, and the University of Houston, includes the construction and testing of a small-scale demonstration tank at NASA's Marshall Space Flight Center in Alabama. This technology advances liquid hydrogen storage solutions, supporting international trade and long-term hydrogen storage needs.

NOTÍCIAS

Tecnologia de Armazenamento de Hidrogénio

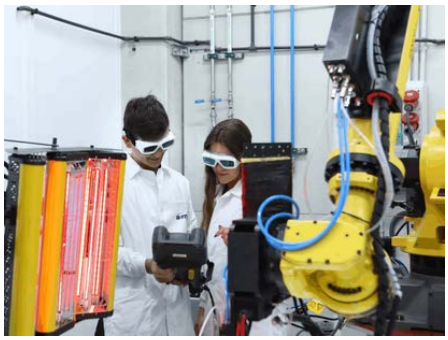
4 UMOE Advanced Composites and Celly H2, LLC Announce US DOT Approval of Type IV Hydrogen Storage Trailers

27/05/2025 | Hydrogen Central | **Link**

Umoe Advanced Composites and Celly H2 LLC have received approval from the U.S. Department of Transportation (DOT) for their Type IV hydrogen storage trailers. These trailers are designed with composite cylinders made of fiberglass, allowing for the safe and efficient transport of hydrogen gas at pressures up to 350 bar. This DOT certification enables the immediate use of the trailers across the U.S. hydrogen distribution network. The approval marks a significant step in advancing hydrogen infrastructure, especially in mobile and decentralized energy solutions.

5 The first 3D cryogenic tank for storing liquid hydrogen in aircraft is manufactured in O Porriño – Spain – It is a 3D printed piece, capable of withstanding temperatures below -250 ºC

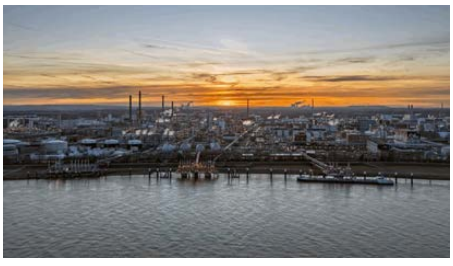
02/05/2025 | Hydrogen Central | **Link**



AIMEN Technology Centre in O Porriño, Spain, has developed the first 3D-printed cryogenic tank designed to store liquid hydrogen for aircraft. This innovative tank is capable of withstanding extreme temperatures below -250 ºC and represents a major breakthrough in hydrogen storage technology. The tank is composed of an inner thermoplastic liner and an external carbon fiber structure, combining lightweight design with high strength and thermal resistance. It was created as part of the European OVERLEAF project, led by the Spanish aerospace company Aciturri, which aims to develop more sustainable aviation solutions. This advancement supports the decarbonization of the aviation sector by enabling safer and more efficient hydrogen storage, a key component for the future use of hydrogen-powered aircraft.

6 Official approval granted for Hydrogenious LOHC's 'Hector' Hydrogen Storage Plant

29/04/2025 | Hydrogen Central | **Link**



Hydrogenious LOHC Technologies has received official approval for its HECTOR project — a commercial-scale hydrogen storage plant based on its Liquid Organic Hydrogen Carrier (LOHC) technology. Located in Chempark Dormagen, Germany, the facility will have a hydrogen storage capacity of up to 1,800 tonnes per year. The LOHC technology involves chemically bonding hydrogen to a liquid carrier (benzyltoluene), making storage and transport safer and more efficient compared to conventional high-pressure or cryogenic methods. The plant is expected to begin operations by the end of 2027 and will be a key milestone in demonstrating the viability of LOHC as a large-scale hydrogen storage solution. It also aims to support Europe's hydrogen economy and energy transition goals.

7 CIMC-Hexagon Delivers First Type IV High-Pressure Hydrogen Cylinders to Europe

24/04/2025 | Hydrogen Central | **Link**

CIMC-HEXAGON, a joint venture between CIMC Enric and Hexagon Purus, has delivered its first batch of Type IV high-pressure hydrogen cylinders to Europe. These lightweight, composite cylinders are designed to store hydrogen at 380 bar pressure, offering high energy density and safety. They are intended for use in hydrogen distribution modules across the European market, supporting the continent's growing hydrogen infrastructure. This milestone follows the company's certification and production efforts and marks an important step in enabling efficient hydrogen transport and storage to meet increasing demand in mobility and energy sectors.

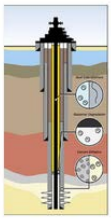
8 Germany can meet future hydrogen storage needs with salt caverns – econ ministry

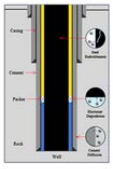
23/04/2025 | Hydrogen Central | **Link**

Germany's Federal Ministry for Economic Affairs and Climate Action has confirmed that the country has sufficient geological capacity to meet its future hydrogen storage needs using underground salt caverns. These caverns are seen as a cost-effective and proven solution for large-scale hydrogen storage, essential for stabilizing energy supply as the country shifts to renewable sources. A new study commissioned by the ministry supports this claim, stating that Germany has enough suitable sites to meet storage demand expected by 2045. The use of salt caverns will play a key role in ensuring the reliability and flexibility of the future hydrogen-based energy system.

9 AIP – Tips for storing hydrogen gas underground

10/04/2025 | Hydrogen Central | **Link**





Underground hydrogen storage is vital for large-scale energy solutions in a hydrogen economy. Options like salt caverns, depleted reservoirs, and aquifers require careful site selection based on geological stability and impermeability. Safety measures are essential to prevent leaks, while advanced modeling helps predict hydrogen behavior underground. Material durability is important to avoid damage from hydrogen exposure. Ongoing research is needed to enhance the safety, reliability, and scalability of these storage methods.

10 Hylium to supply liquefied hydrogen storage tanks to AirFirst

17/04/2025 | Hydrogen Central | **Link**

South Korea-based Hylium Industries has signed an agreement to supply liquefied hydrogen storage tanks to AirFirst, a leading industrial gas supplier. These tanks will be used to support hydrogen infrastructure development in South Korea.Hylium's tanks feature advanced multilayer insulation technology, enabling long-term hydrogen storage at cryogenic temperatures (−253°C). This helps minimize boil-off losses, improving efficiency and safety in hydrogen transport and storage.This partnership aims to strengthen South Korea's hydrogen supply chain and support its clean energy transition, especially in mobility and industrial applications. It also reflects increasing demand for reliable hydrogen storage solutions as the global hydrogen economy expands.

11 Hexagon Purus receives first order from MCV for delivery of hydrogen fuel storage systems

17/04/2025 | Hydrogen Central | **Link**

HEXAGON PURUS

Hexagon Purus, a leading provider of hydrogen storage solutions, has received its first order from MCV (Manufacturing Commercial Vehicles) to supply hydrogen fuel storage systems for fuel cell electric buses. These buses are intended for public transportation use and will be operated in the Middle East and North Africa (MENA) region.The order includes delivery of Type IV hydrogen cylinders and complete storage systems. Production is expected to begin in 2024, with deliveries extending into 2025. This partnership supports MCV's strategy to expand into zero-emission mobility solutions and aligns with regional goals for cleaner public transport.

12 NZ experts aid global report on hydrogen storage tech

11/04/2025 | Hydrogen Central | **Link**

New Zealand researchers contributed to an international IEA report on underground hydrogen storage, focusing on the use of geological formations like porous rocks and salt caverns. The study examines the technical, economic, and environmental feasibility of these solutions to support renewable energy systems, enhance energy security, and reduce emissions. It highlights challenges such as safety and monitoring, calls for further research, and stresses the need for public policy support and private investment to advance the technology.

NOTÍCIAS

Distribuição de Hidrogénio

1 INTERVIEW | 'The UK government absolutely needs to accelerate hydrogen infrastructure': trade body boss

30/05/2025 | Hydrogen Insight | **Link**

Clare Jackson, CEO of Hydrogen UK, has emphasized the urgent need for the UK government to fast-track the development of hydrogen infrastructure. In an interview with Hydrogen Insight, she warns that without swift implementation of strategic measures, the UK risks lagging behind in the global energy transition. Key priorities include establishing dedicated hydrogen transport networks, effective storage solutions, and a robust low-carbon hydrogen certification system. Jackson also highlights the importance of clear and stable policies to attract private investment and support sustainable growth within the hydrogen sector.

2 Global Governments and Industry Leaders Reaffirm Commitment to Developing International Hydrogen and Derivatives Supply Chains

21/05/2025| Hydrogen Council | **Link**

Global leaders from governments and industry have renewed their commitment to building international hydrogen and derivative supply chains. At a meeting in Rotterdam, they emphasized the need for strong partnerships, policy support, and investment to scale up hydrogen infrastructure and promote global trade, aiming to accelerate the energy transition and decarbonization.

3 Enagás abre en Puertollano el debate ciudadano sobre la red de hidrógeno verde

30/05/2025 | Hidrógeno Verde | **Link**

Enagás has launched public participation sessions in Puertollano, Spain, to inform citizens about the future green hydrogen infrastructure that will pass through the region. This initiative is part of the European hydrogen corridor known as H2med, which will connect Spain to France and beyond.
Puertollano is set to become a key hub in this 2,600-kilometer network of hydrogen pipelines, which aims to transport green hydrogen efficiently across the Iberian Peninsula and Europe. The sessions allow local residents to learn about the project, ask questions, and contribute suggestions. Enagás emphasizes transparency and citizen engagement as crucial to the project's success and social acceptance.
These public forums are part of a broader strategy to align infrastructure development with environmental goals and community needs, reinforcing Puertollano's strategic role in Spain's energy transition.

4 Pipeline certified to supply green hydrogen to TotalEnergies refinery from 30MW plant

09/04/2025 | Hydrogen Europe | **Link**

A 25 km hydrogen pipeline has been certified to supply green hydrogen from a 30 MW electrolyzer plant at the Bad Lauchstädt Energy Park to the TotalEnergies refinery in Leuna, Germany. The project involves converting a former natural gas pipeline for hydrogen transport, marking an important step in green hydrogen distribution infrastructure. This certification highlights both the technical readiness and regulatory compliance necessary for the pipeline's operation, supporting the transition to clean energy.

5 World's first floating ammonia-to-hydrogen cracker developed

25/04/2025| Hydrogen Tech World | **Link**

A pioneering technology has been developed that enables the conversion of ammonia into hydrogen onboard floating units. This "floating ammonia-to-hydrogen cracker" allows for efficient production and supply of hydrogen at sea, addressing logistical challenges in hydrogen transport and distribution. By converting ammonia—which is easier to store and transport—directly into hydrogen where it is needed, this innovation supports the growth of the hydrogen economy, especially in remote or offshore locations. The technology could play a key role in expanding hydrogen use for energy and fuel applications.

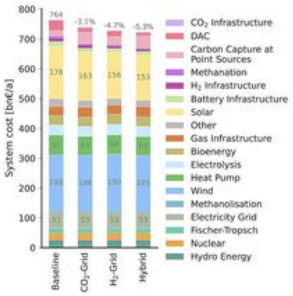
6 Hydrogen highway: Oman to fuel Europe via LH_2 corridor

17/04/2025 | Hydrogen Tech World | **Link**

Oman and European partners have agreed to establish the world's first commercial liquid hydrogen (LH_2) corridor, linking the Port of Duqm in Oman to the Port of Amsterdam and logistic hubs in Germany. This historic project aims to produce green hydrogen in Oman using renewable energy, liquefy it for efficient storage and transport, and distribute it via maritime shipping and inland transport like pipelines and trains in Europe. The corridor supports the use of hydrogen for land mobility, including trucks and trains, and aligns with regulatory frameworks promoting the green hydrogen economy. This initiative marks a major step in creating a sustainable, interconnected hydrogen supply chain between the Middle East and Europe.

7 Assessing the potential of hydrogen and carbon dioxide networks for the future of European energy systems

02/05/2025 | Hidrogen Central | **Link**



This study explores the potential of hydrogen and carbon dioxide (CO_2) transport networks to support the decarbonization of European energy systems. Researchers from the Technical University of Berlin employed a detailed energy model of Europe to analyze scenarios involving dedicated networks for CO_2, hydrogen, or a combination of both. The research evaluates the feasibility, benefits, and costs associated with integrating these networks to improve energy distribution and reduce emissions. Emphasis is placed on the role of hydrogen distribution infrastructure and the regulatory and promotional frameworks necessary to facilitate the transition towards a low-carbon energy future. The results underline the importance of coordinated infrastructure planning for the successful development of a hydrogen economy alongside CO_2 management.

8 Düsseldorf Opens Europe's Most Powerful Hydrogen Refuelling Station

31/05/2025| Hydrogen Central | **Link**

Düsseldorf has inaugurated Europe's most powerful hydrogen refuelling station, designed to serve a growing fleet of hydrogen-powered vehicles. The station features high-capacity dispensers operating at pressures of 350, 500, and 700 bar, allowing fast and efficient refuelling. It supports around 20 hydrogen buses operated by the local transit company Rheinbahn, along with other commercial vehicles. The station's hydrogen is produced locally via a 2 MW electrolyser powered by waste energy, promoting sustainable and clean fuel supply. This infrastructure marks a significant step forward in the distribution of hydrogen fuel and the promotion of hydrogen mobility in the region.

9 SANY Delivers the First Hydrogen Refueling Project to Australia, Marking a Milestone in Global Green Energy Expansion

31/05/2025 | Hydrogen Central | **Link**

SANY has delivered its first hydrogen refueling project to Australia, marking an important milestone in the global expansion of green energy. The project features a flexible electrolyzer system and high-pressure hydrogen storage tanks (operating at 50 MPa and 90 MPa), all certified to international safety standards. This delivery expands SANY's hydrogen infrastructure beyond China and supports the development of clean energy solutions in Australia by providing reliable hydrogen refueling for vehicles.

NOTÍCIAS

Mobilidade Terrestre com Hidrogénio

1 First green hydrogen refueling station opened in Indre-Et-Loire, marking regional milestone

19/05/2025 | Hydrogen Europe | **Link**

The first green hydrogen refueling station has opened in Indre-et-Loire, France, marking a significant regional milestone. Located in the Isoparc business park in Sorigny, the station is operated by the Touraine Vallée de l'Indre Community of Municipalities (CCTVI). It has a daily production capacity of 200 kg of hydrogen and uses a hybrid compression technology developed by Eifhytec, combining mechanical and thermochemical methods to improve energy efficiency and reduce space requirements. This station supports the regional initiative Hy'Touraine, which promotes sustainable mobility through hydrogen-powered vehicles such as bikes, heavy-duty trucks, and waste collection trucks. The project represents an important step forward for hydrogen mobility and distribution in the region.

2 German rail network to introduce Siemens hydrogen-powered trains

28/04/2025 | Hydrogen Europe | **Link**

Siemens Mobility is set to introduce hydrogen-powered trains on the German rail network, specifically on the non-electrified line between Mühldorf and Burghausen in Bavaria. The trains, known as Mireo Plus H, use hydrogen fuel cells in combination with lithium-ion batteries to enable emission-free operation, replacing existing diesel trains.
In partnership with Deutsche Bahn, the project also includes the construction of a new hydrogen production facility in Mühldorf. This plant will use green electricity to produce hydrogen through electrolysis, ensuring the entire system remains environmentally friendly.
This initiative is part of Germany's broader efforts to decarbonize transportation and promote sustainable mobility using hydrogen technology.

3 Hyundai Motor Unveils 'the all-new NEXO' FCEV

07/04/2025 | Hydrogen Europe | **Link**

Hyundai Motor has unveiled the all-new NEXO, a next-generation fuel cell electric vehicle (FCEV) powered by hydrogen. The NEXO features advanced fuel cell technology, offering improved efficiency, longer driving range, and enhanced safety features. This model represents Hyundai's continued commitment to hydrogen mobility and sustainable transportation solutions. The new NEXO aims to provide a cleaner, zero-emission alternative for terrestrial mobility, contributing to the broader adoption of hydrogen as a clean energy source.

4 Hyundai and Plus unveil autonomous hydrogen truck concept

05/05/2025 | H2 View | **Link**

Hyundai Motor Company, in collaboration with autonomous driving technology company Plus, has unveiled a new concept truck that combines hydrogen fuel cell technology with autonomous driving capabilities. The truck is based on Hyundai's XCIENT Fuel Cell model and is equipped with Plus's Level 4 autonomous driving system. The goal is to reduce carbon emissions and improve road safety and efficiency in freight transport.The hydrogen-powered truck has a 180 kW fuel cell system and can store 31 kg of hydrogen at 350 bar, enabling long-distance travel. It can be refueled in 8 to 20 minutes. The concept represents a significant step toward zero-emission, self-driving heavy-duty transport and is being showcased at the Advanced Clean Transportation (ACT) Expo in Las Vegas.

5 Wrightbus expands German presence with 12 hydrogen buses for WestVerkehr

01/05/2025 | H2 View | **Link**

Wrightbus is expanding its presence in Germany by delivering 12 hydrogen-powered buses to the operator WestVerkehr in North Rhine-Westphalia. These buses, called Kite Hydroliner FCEVs, can carry up to 90 passengers, have a range of up to 1,000 kilometers, and refuel in just 10 minutes. The project is supported by funding from the German Federal Ministry of Digital and Transport Affairs (BMDV) and the H2HS consortium. This initiative aims to help decarbonize public transport in the region by introducing clean hydrogen fuel cell vehicles.

6 Toyota plans to roll out hydrogen trucks for California logistics operations

29/04/2025 | H2 View | **Link**

Toyota plans to deploy hydrogen fuel cell trucks for logistics operations in California. The trucks, Kenworth T680 models developed jointly with Toyota, will operate on routes between the Port of Long Beach and Toyota's parts distribution center. This initiative aims to reduce diesel truck usage and cut emissions in freight transport. A liquid hydrogen refueling station, provided by Iwatani and supplied with hydrogen from Air Liquide's plant in North Las Vegas, will be installed at Toyota's campus to support these trucks. This project marks a significant step in adopting hydrogen mobility solutions for heavy-duty logistics in the U.S. West Coast.

7 Exeter Airport hosts UK's first hydrogen-powered aircraft turnaround

30/04/2025 | H2 View | **Link**

Exeter Airport in the UK has hosted the country's first hydrogen-powered aircraft turnaround operation. This pioneering event involved the use of hydrogen-powered ground support equipment to service a commercial aircraft. Key partners in the project included TUI, Cranfield University, ULEMCo, MULAG, Boeing, and the UK Civil Aviation Authority. The initiative showcases the potential of hydrogen technology to reduce emissions and improve sustainability in airport ground operations.

8 Three-minute hydrogen-powered helicopter test flight completed in Canada

08/04/2025 | H2 View | **Link**

Unither Bioelectronics successfully completed a three-minute test flight of a hydrogen-powered helicopter at Roland-Désourdy Airport in Bromont, Québec. The helicopter, a Robinson R44 Raven II, was equipped with a hybrid powertrain combining dual Proton Exchange Membrane (PEM) fuel cells and batteries. The flight, conducted under an experimental permit from Transport Canada Civil Aviation, demonstrated the viability of hydrogen fuel cells for aviation. This milestone is part of Project Proticity, aimed at developing zero-emission aviation solutions and advancing sustainable air travel.

9 ZeroAvia will provide ZA600-equipped Cessna Caravan to power initial UK domestic services, likely to be the world's first hydrogen-electric commercial operations

14/05/2025 | Hydrogen Central | **Link**

ZeroAvia is providing its ZA600 hydrogen-electric propulsion system to equip the Cessna Grand Caravan 208B aircraft, aiming to power the UK's initial domestic commercial flights using zero-emission technology. This project represents one of the world's first hydrogen-electric commercial operations in aviation. By combining hydrogen fuel cells with electric motors, ZeroAvia seeks to significantly reduce carbon emissions in regional air travel.

NOTÍCIAS

Corredores de Hidrogénio: Aspetos Normativos e de Promoção

1 Don't expect the US Senate to reinstate 45V green hydrogen tax credits, warn political lobbyists

29/05/2025 | Hydrogen Insight | **Link**

The 45V tax credit, established under the Inflation Reduction Act, provides up to $3 per kilogram for green hydrogen produced using renewable energy. Political lobbyists warn that the Biden administration's stringent rules have made the program difficult to implement, leading to decreased support. Consequently, there is little expectation that the US Senate will reinstate or continue the tax credit in its current form. This situation raises concerns about the future of financial incentives for green hydrogen production in the United States.

2 France launches public consultation on IRICC, putting H2 at heart of new fuel decarbonisation mandate

14/05/2025 | Hydrogen Europe | **Link**

France has launched a public consultation on the IRICC (Incentive for Reducing the Carbon Intensity of Fuels), a new fuel decarbonization mandate. This initiative aims to replace the current TIRUERT system starting in 2026 and sets national targets for the use of renewable and low-carbon hydrogen in transport fuels. The goal is to align with the EU's RED III directive and promote hydrogen competitiveness in the market by providing incentives for reducing carbon intensity. The consultation, open until June 10, 2025, invites stakeholders to give feedback on the proposals, including specific targets and penalties for non-compliance.

3 'Policymakers should require a high burden of proof to support the use of clean hydrogen across various industries': Nature paper

23/04/2025 | Hydrogen Insight | **Link**

Governments are being urged to adopt stricter criteria before supporting clean hydrogen in various industries. Experts warn that hydrogen is often promoted in sectors where it may not be the most efficient or necessary solution — such as passenger cars and home heating — where electric alternatives already perform better. The recommendation is to prioritize hydrogen investment in hard-to-abate sectors like heavy industry, maritime transport, and long-distance aviation, where decarbonization is more difficult and hydrogen could have a greater impact. Policymakers are encouraged to require solid evidence that hydrogen is the most suitable option in each context, ensuring public funds are used effectively and the energy transition is not delayed by misplaced investments.

4 International low-carbon hydrogen initiative launched by Arab fossil-fuel states

24/04/2025 | Hydrogen Insight | **Link**

An international low-carbon hydrogen initiative has been launched by the Arab states that are members of the Organization of Arab Petroleum Exporting Countries (OAPEC). This initiative aims to accelerate the development and deployment of green and blue hydrogen technologies across the 11 member countries. The effort focuses on fostering cooperation, policy alignment, and investment to promote low-carbon hydrogen as a key component of the energy transition in the region.

5 Billions of euros allocated, but only 21% of green hydrogen projects awarded IPCEI funding by EU have reached FID

25/04/2025 | Hydrogen Europe | **Link**

Billions of euros have been allocated by the European Union to support green hydrogen projects under the IPCEI funding scheme. Despite this significant investment, only 21% of these projects have reached the Final Investment Decision (FID) stage, showing slow progress in moving from funding approval to actual implementation. Challenges such as regulatory barriers and the complexity of building green hydrogen infrastructure contribute to delays. This slow advancement raises concerns about the EU's ability to achieve its ambitious hydrogen and climate goals within the expected timelines.

6 China to increase policy support for hydrogen industry in its forthcoming Five-Year Plan for 2026-30

28/04/2025 | Hydrogen Insight | **Link**

China is set to enhance its policy support for the hydrogen sector as part of its upcoming Five-Year Plan for 2026-2030. The government aims to accelerate the development of the hydrogen industry across the full value chain, including production, storage, distribution, and utilization. This strategic move is intended to boost clean energy adoption, reduce carbon emissions, and strengthen China's position as a global leader in hydrogen technologies. The plan will focus on expanding infrastructure, improving technology innovation, and fostering a favorable regulatory environment to promote widespread hydrogen deployment.

7 Commission enhances interoperability and transparency of alternative fuels infrastructure data

29/04/2025 | European Commission | **Link**

The European Commission has adopted a new Implementing Regulation to support the uniform and effective provision of compatible, interoperable and real-time alternative fuels infrastructure data, further advancing the goals set out in the Alternative Fuels Infrastructure Regulation (AFIR) (Regulation (EU) 2023/1804). This milestone marks a concrete step in the implementation of AFIR and the transition towards more sustainable and digital transport solutions.

8 Net-Zero Industry Act to further accelerate decarbonisation technologies manufacturing in the EU

23/05/2025 |European Commission| **Link**

European Commission

Today, the European Commission has taken further steps to support the EU's transition to a low-carbon economy. Four new pieces of secondary legislation and a communication relating to the Net-Zero Industry Act (NZIA) will help the EU's industry to become more resilient, competitive and reduce their carbon footprint. These rules clarify which manufacturing projects can benefit from specific provisions in the Act, such as on permitting, strategic project status and on non-price criteria. They will help scale up the manufacturing of net-zero technologies that reduce greenhouse gas emissions, and leverage the competitive advantage of the EU's clean tech industry.

9 Renewables Directive sectoral targets reach transposition deadline

21/05/2025 | DG ENERGY| **Link**

European Commission

Today (21 May 2025) is the deadline for the transposition of a series of key provisions to accelerate the deployment of renewable energy, as required under in the revised Renewable Energy Directive.
Agreed by the co-legislators in 2023 and in force since 20 November 2023, the ultimate ambition of the directive is to achieve the EU's renewable target for 2030 of at least 42.5%, with the ambition to aim for 45%. This objective will require a concerted effort by the end of this decade - the latest official figures show a share of 24.5% in the EU energy mix in 2023. Given the relatively slow progress seen in some sectors at the time that the directive was being revised, the new legislation strengthens specific targets for the use of renewables in heating and cooling and in transport and sets such targets for the first time for the industry sector.

10 Important step towards establishing the European Network of Network Operators for Hydrogen

16/05/2025 | DG ENERGY | **Link**

The Commission has today published its Opinion (C/2025/2004) on the statutory documents of the European Network of Network Operators for Hydrogen (ENNOH) – the independent association representing future hydrogen transmission network operators at EU level. Detailing the Commission opinion on the draft articles of association, rules of procedure and list of members of ENNOH, this document is an important step in the process of establishing ENNOH. In its findings, the Commission flags the need to allow operators to start cooperating as soon as possible through ENNOH, while ensuring a framework that is in line with the EU legislation. This echoes the earlier opinion from the Agency for the Cooperation of Energy Regulators (ACER).

11 Net-Zero Industry Act to further accelerate decarbonisation technologies manufacturing in the EU

23/05/2025 |European Commission| **Link**

European Commission

Today, the European Commission has taken further steps to support the EU's transition to a low-carbon economy. Four new pieces of secondary legislation and a communication relating to the Net-Zero Industry Act (NZIA) will help the EU's industry to become more resilient, competitive and reduce their carbon footprint. These rules clarify which manufacturing projects can benefit from specific provisions in the Act, such as on permitting, strategic project status and on non-price criteria. They will help scale up the manufacturing of net-zero technologies that reduce greenhouse gas emissions, and leverage the competitive advantage of the EU's clean tech industry.

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Produção de Hidrogénio

1 Cleaner hydrogen production by microwaves: Experimental investigation and comparative assessment

D. Erdemir and I. Dincer, Journal of Cleaner Production, vol. 509, 2025. **Link**

Abstract Sustainable development goals of the United Nations require cleaner energy solutions and carbon-free fuels. Hydrogen, in this regard, appears to be a unique candidate for all, and its production in a cleaner manner is critically important, which is the prime focus in the present paper. This study focuses on the newly designed experimental investigations into microwave-driven water dissociation for cleaner hydrogen production, specif ically exploring the effect of various tungsten-based electrode materials and steam inlet conditions on hydrogen production. The evaluation is conducted in two main sections, assessing hydrogen production at the water dissociation level and the overall system. Some of the key observations include a positive correlation between steam inlet temperature and hydrogen production for all electrode materials, with lanthanated tungsten demonstrating superior performance. When only the water dissociation is considered, lanthanated tungsten electrodes exhibit the most favorable energy consumption, showcasing the minimum energy requirement for hydrogen production. Incorporating the overall energy and exergy efficiencies, the lanthanated tungsten emerges as the top performer, followed by ceriated tungsten, attributed to their superior arc stability. The energy requirement per kg of hydrogen varies from 51.98 kWh/kg to 56.66 kWh/kg for varying steam inlet tempera tures from 104 ◦ C to 120 ◦ C. The highest energy and exergy efficiencies are recorded to be 64.1 % and 62.3 %, respectively, for lanthanated tungsten electrodes at 120 ◦ C steam inlet temperature. When all energy inputs (steam generation, preheating, condenser pump, and microwave generator) are considered, the overall energy and exergy efficiencies are found to be 35.1 % and 34.2 %, respectively. The energy needed for 1 kg of hydrogen production is recorded to be 94.87 kWh/kg. Consequently, the lanthanated tungsten electrode stands out as a superior performer, offering valuable implications for advancing microwave hydrogen production technologies.

2 Large-scale green hydrogen production via chemical looping of unused biomass with optimized supply networks

N. Kim et al., International Journal of Hydrogen Energy, vol. 139, pp. 325-345, 2025. **Link**

Abstract This study examines a hydrogen production system using unused biomass for large-scale industrial application. The process integrates chemical looping with a waste separation system for byproduct recovery. To improve efficiency, optimal transportation routes were identified to cut logistics costs and carbon emissions. A deter ministic programming-based optimization model was applied for practicality. Economic and environmental as sessments showed efficient resource use, lower hydrogen production costs, and reduced carbon emissions. This system reduces greenhouse gas emissions by over 68 % compared to conventional green hydrogen production, demonstrating its environmental advantage. The study introduces a novel approach by integrating chemical looping with biomass and optimizing transportation through electric vehicles. Additionally, multi-criteria de cision-making was applied to develop operational strategies from government and corporate perspectives. This study offers a sustainable solution for hydrogen supply chains and outlines a pathway for carbon-neutral hydrogen production, providing insights for industry and policymakers aiming for a low-carbon economy.

3 Thermocatalytic hydrogen production by integrated multi-stage steam methane fuel processing with an exhaust gas recirculation loop in a high-temperature fuel cell power plant

J. Oh, S. Park and S. Um, Fuel, vol. 400, 2025. **Link**

Abstract This study investigates thermocatalytic low-carbon hydrogen production in an integrated steam methane fuel processing system with exhaust fuel recirculation, specifically designed for residential fuel cell applications. The steam methane fuel processor comprises a combustor, preheater, steam methane reformer, water–gas shift reactor, and preferential oxidizer in the streamwise direction. Fundamental kinetic models for thermocatalytic hydrogen production were developed by considering catalyst particulate packing arrangements, thermofluidic

characteristics, and chemical kinetics. These numerical models were then applied to evaluate hydrogen pro ductivity in conventional steam-reforming reactors, independent of their geometric designs. The models were successfully validated against experimental data and subsequently integrated into extensive three-dimensional numerical analyses of transport phenomena and chemical reactions within a 5 kW e hydrogen production sys tem. This system featured a top-fired combustor positioned at the center of a cylindrical fuel processor. The external hydrogen production model was further applied to a solid oxide fuel cell (SOFC) system with an anode off-fuel recirculation loop using a model-in-the-loop simulation. Numerical results indicated that the majority of hydrogen was generated via the steam methane reforming reaction, accompanied by a high-temperature water–gas shift side reaction. The remaining high-temperature water–gas shift and preferential oxidation re actions enhanced hydrogen purity. Additionally, the temperature increase caused by fuel recirculation shifted chemical reactions to mitigate temperature variations, consistent with Le Chˆatelier's principle. The optimal steam-to-carbon ratio was determined to be 2.4 by hydrogen production efficiency. Under this condition a fuel and air utilization ratio of 75 and 45.5 %, the integrated fuel processor achieved a system efficiency of 47.58 %, with a thermal energy consumption of 0.78 kcal. Notably, the recirculated anode exhaust gases in SOFC system can fully cover the steam demand for hydrogen production, including the thermal energy required for water preheating and vaporization.

4 Assessment of the potential and environmental benefits of hydrogen production from sludge under different SSPs scenarios in China

B. Liu et al., Journal of Environmental Chemical Engineering, vol. 13, 2025. **Link**

Abstract Although sludge poses a great challenge to the water industry, it can be valuable if handled properly. Hydrogen production from sludge not only enables the energy use of sludge but also achieves greenhouse gas(GHG) re ductions during the production process. In this study, the Bidirectional long and short-term memory model (BiLSTM) combined with the Shared socio-economic pathways(SSPs) framework was used to evaluate the pos sibility of hydrogen production from sludge throughout China, as well as the effect of emission reductions. According to forecasts, China will generate up to 276.8 million tons of sludge by 2036, which can produce about 7.49 million tons of hydrogen through anaerobic digestion (AD) and steam reforming technologies. Hydrogen production from biogas is the best way to reduce GHG emissions during the conversion process. It could replace 43 million tons of coal by 2036 and reduce GHG emissions by 91.2 MtCO 2 eq. The development of hydrogen production from sludge is essential, both from the environmentally sound treatment of sludge and from the energy perspective.

5 Structural optimization design of combustion reaction support for decreasing temperature difference coefficient of hydrogen production reaction support

T. Zheng et al., Fuel, vol. 400, 2025. **Link**

Abstract To decrease temperature difference coefficient of hydrogen production reaction support heat-supplied by com bustion reaction support, further improving the long-term hydrogen production performance of reaction support, the optimization design of the structure of combustion reaction support is performed in this paper. A porous combustion reaction support with coupled channel is proposed as optimization scheme of the structure of combustion reaction support. On this basis, temperature performances of different combustion reaction supports are studied by numerical simulation method. And temperature performances of hydrogen production reaction supports heat-supplied by the different combustion reaction supports are investigated. Meanwhile, temperature performances of large-scale microreactors are studied. The results show that the temperature difference coeffi cient of hydrogen production reaction support can be effectively decreased by using the coupled channel of flow channels and diffusion channel on the surface of combustion reaction support. At 0.6 mL/min injection rate of combustion reactant and 4 mL/h injection rate of hydrogen production reactant, the temperature difference coefficient of hydrogen production reaction support heat-supplied by the optimized combustion reaction support is decreased by 50 % compared with that of non-optimized combustion reaction support, which effectively improves long-term reaction performance of hydrogen production reaction support. In addition, compared with the size-scaled microreactor, the number-scaled microreactor has a lower temperature difference coefficient.

6 Performance of magnetite fines for continuous hydrogen production

I. Stanicic et al., International Journal of Hydrogen Energy, vol. 139, pp. 753-765, 2025. **Link**

Abstract Hydrogen production from biogenic fuels in fluidized beds may provide the steel industry with a path to decarbonization and negative emissions. Magnetite fines (MAF), a common intermediate product in the Euro pean iron and steel industry, was utilized as an oxygen carrier for continuous hydrogen production. Performance was evaluated in a fluidized bed reactor, demonstrating that MAF effectively converts low-grade gaseous biofuels and subsequently generates high-purity hydrogen through water splitting. A kinetic model accounting for thermodynamic limitations was developed to assess MAF's reactivity towards reduction with CO and H2, and oxidation with H2O. The activation energy as a function of the mass conversion degree ranged from 32.7 to 70.5 kJ/mol for reduction with CO, and from 22.6 to 67.4 kJ/mol for H2: for oxidation with H2O, it ranged from 51.2 to 121.3 kJ/mol. Significant variations in the apparent activation energy were observed, which can be linked to changes in the rate-controlling mechanisms, highlighting the influence of microstructural evolution on reactivity. The findings provide valuable insights into the apparent kinetics of MAF and suitable operating conditions for optimizing hydrogen production, with the highest hydrogen production rate of 0.37 mmol g 1 min 1 achieved at 800 ◦ C.

7 Architecture of hydrogen production system at hydroelectric power station in local intelligent network using machine learning tools and internet of energy

I.V. Ilin et al., International Journal of Hydrogen Energy, vol. 138, pp. 165-174, 2025. **Link**

Abstract Currently, there is an active discussion about hydrogen as a source of «green » energy. At the same time, due to the lack of development of many technological aspects of using hydrogen as an energy resource, as well as the unpreparedness of the infrastructure and other elements of energy systems for the widespread use of hydrogen, the technology of energy production from hydrogen remains economically not entirely feasible. The authors explore the possibilities of increasing the efficiency of energy systems using hydrogen using digital technologies, namely, the Internet of Energy and machine learning systems. The purpose of this article is to develop a digital architecture for a hydrogen production system at a hydroelectric power station in a local smart grid using the Internet of Energy. Methodologically, the article is based on the concept of enterprise architecture. The result of the article is a set of descriptions of the architecture of the Internet of Energy, its elements, such as « Plug-and- play» and Microgrid, on the basis of which a simulation model of using hydrogen as an energy source in a local smart grid was developed.

8 Inherent safety assessment of water electrolysis hydrogen production systems

H. Wei et al., International Journal of Hydrogen Energy, vol. 139, pp. 766-778, 2025. **Link**

Abstract PEM water electrolysis for hydrogen production is a method of producing green hydrogen; however, research on the safety of this system is limited. This study investigates the inherent safety of PEM water electrolysis hydrogen production systems. Considering jet fires and vapor cloud explosions (VCE), an inherent safety assessment framework was established to evaluate the inherent safety of PEM. The analysis results show that when a jet fire occurs, the radiation intensity at 0.5 m from the outlet pipeline of the hydrogen-water separator is 94.24 kW/m . When equipment rupture occurs, the hydrogen-water separator experiences the most severe consequences of a vapor cloud explosion, with an impact range of up to 25 m. When small-aperture leakage occurs, the condenser at the outlet of the heating tower experiences the most severe consequences of a vapor cloud explosion, with an impact range of up to 14 m. The study concludes that the hydrogen separator and the condenser at the outlet of the heating tower pose significant risks. Compared to other studies, this research quantifies the risks of equip ment and pipelines in PEM water electrolysis hydrogen production systems, providing relevant suggestions and references for the inherent safety design of the system.

PUBLICAÇÕES

Células de Combustível

1 A review on hydrogen supply subsystem of proton exchange membrane fuel cell system: Configuration, core components, theoretical model, and control strategy

D. Chen et al., International Journal of Hydrogen Energy, vol. 133, pp. 38-62, 2025. **Link**

Abstract This review provides a comprehensive survey of the design and optimization of hydrogen supply subsystems in proton exchange membrane fuel cell (PEMFC) systems, with particular emphasis on the importance of cycling modes in enhancing hydrogen utilization and cell efficiency. The review starts with the introduction of hydrogen storage methods, exploring multiple modes of hydrogen supply, including flow-through, dead-end, and recir culation modes, each of which has its own unique advantages and challenges. The recirculation mode improves system efficiency by recycling unreacted hydrogen, but also places greater demands on the design of the recirculation pumps, which need to be long-life and vane cavitation-resistant, and the ejectors, which need to be able to operate efficiently across a wide power range. In addition, pressure dynamic control and purge strategy play a key role in maintaining fuel cell stability and life extension. Future research will focus on developing more intelligent control algorithms to adapt the fuel cell to different operating conditions, and exploring new materials and technologies to improve the durability of system and environmental resilience. These advances will contribute to the application of hydrogen supply subsystems in PEMFC technology, promoting its development towards higher efficiency, longer life and wider application.

2 Optimization of air-cooled PEM fuel cell system with battery hybridization and experimental validation on hydrogen powered fuel cell bike

A. Kumari et al., Renewable Energy, vol. 250, 2025. **Link**

Abstract Highly efficient, zero-emission fuel cell technology provides a sustainable alternative to fossil fuels, delivering continuous power, high density, longer range, and faster refueling than battery-electric vehicles. In this paper, a novel hybrid control methodology is developed using MATLAB to minimize fuel consumption for a 300W fuel cell (FC) bike. The methodology is utilized to optimize an air-cooled fuel cell (FC) stack to 250W, operating within a voltage range of 27V–36V and a current of 9.3A, in combination with a 24V, 2Ah Li-Po battery. A Type- III cylinder with a 2L water capacity is used for hydrogen storage at 350 bar and regulated at 0.4–0.7 bar fuel supply. FC bike is validated on test bench based on control methodology and developed drive cycle of 610sec with maximum motor/load power demand of 249.92W. The FC bike, validated through on-road tests, achieves a 100 km range per 50 gm hydrogen refill-double that of a battery bike while offering significantly faster refueling times.

3 Cryogenic cooling and fuel cell hybrid system for HTS maglev trains Employing liquid hydrogen

J. Mun, C. Lee and S. Kim, Cryogenics, vol. 149, 2025. **Link**

Abstract High-Temperature Superconducting (HTS) maglev trains hold great promise for transforming transportation, achieving speeds beyond 1000 km/h with superior energy efficiency. However, maintaining the superconducting state requires cryogenic cooling, which presents challenges under constrained space, weight, and power con ditions. To overcome these limitations, this study proposes a hybrid system combining a liquid hydrogen (LH thermal battery and a fuel cell. LH 2 2) , with its low boiling point and high latent heat, serves as an effective coolant for HTS magnets, while the evaporated hydrogen is utilized in a fuel cell to produce onboard power, enhancing the system's overall efficiency. To validate the proposed concept, a thermal network model was developed incorporating sections for HTS magnets, an LH 2 the thermal resistance variation due to LH 2 thermal battery, and a fuel cell. The HTS magnet section models level reduction and considers heat influx from conduction, radiation, and AC losses. The LH 2 thermal battery simulates hydrogen evaporation caused by heat transfer, with the vaporized hydrogen directed to the fuel cell for power generation. Simulations using MATLAB Simscape analyzed the dynamic thermal behavior of the system under operational scenarios. The study demonstrates the capability of the LH 2 thermal battery to maintain thermal stability for HTS magnets while leveraging evaporated

hydrogen for onboard power generation. This integrated approach offers a foundation for optimizing cryogenic cooling and energy management, providing key insights for the development of next-generation HTS maglev train systems.

4 Experimental investigation and assessment of a new direct urea-hydrogen peroxide fuel cell stack

A. S. Meke and I. Dincer, Energy, vol. 328, 2025. **Link**

Abstract This study addresses the existing technology gaps in fuel cell development by investigating the design and performance assessment of a Direct Urea-Hydrogen Peroxide Fuel Cell (DUHPFC) stack. A significant focus was placed on the preparation of electrodes, where nickel zinc iron oxide was successfully deposited on stainless steel foil via electrodeposition, resulting in high-activity, stable anodes. The 16-cell fuel cell stack was tested under various conditions, with optimal performance observed at 65 ◦ ◦ C, achieving a power output of 0.307 kW and an open circuit voltage (OCV) of 8.8 V. The energy and exergy efficiencies at 65 C were determined to be 48.88 % and 41.27 %, respectively, highlighting the crucial role of temperature optimization for better performance. The electrochemical impedance spectroscopy (EIS) measurements showed a reduction in impedance from 30 Ωcm 25 ◦ C to 15 Ωcm 2 at 65 ◦ 2 at C, suggesting improved charge transfer characteristics and reduced internal resistance, which contribute to enhanced fuel cell performance. These findings not only demonstrate the efficiency and scalability of the DUHPFC stack for large-scale energy applications, but also address the need for more efficient and scalable fuel cell technologies by offering a viable solution to harness urea as a sustainable fuel source.

5 Cost trajectory of hydrogen fuel cell technology in China

X. Wang et al., iScience, vol. 28, 2025. **Link**

Abstract Reducing the cost of hydrogen fuel cell technology is crucial in propelling the hydrogen economy and achieving decarbonized energy systems. This study identifies the hydrogen fuel cell cost trajectory through a multi-stage learning curve model, highlighting technology learning mechanisms across different stages. Findings show that innovation and production contribute to cost reduction, and the learning by researching holds a more significant role presently, while the learning by doing takes precedence in the long term, achieving a 14% learning rate. The cost predictions imply that the system cost of hydrogen fuel cell is ex pected to fall below 1,000 yuan/kW after 2031. Moreover, the scenario analyses highlight the conducive role of various hydrogenproductiontechnologies andtheevolutionofcostinfluencingfactors oncostreduc tion. Our research provides critical insights into the evolving dynamics of technological learning and cost tra jectory in the hydrogen fuel cell industry, with significant implications for policy-making.

6 Proton exchange membrane fuel cell fueled by impure hydrogen and air: A review

Z. Yao et al., International Journal of Hydrogen Energy, vol. 126, pp. 110-124, 2025. **Link**

Abstract Proton exchange membrane fuel cells (PEMFCs) technology has been rapidly developed in recent years. How ever, the high cost of high-purity hydrogen/air has hindered their further development. On-site hydrogen pro duction and direct input of hydrogen-rich gas can solve this challenge, but impurities in them may hinder their performance and durability. In this paper, we synthesize recent experimental studies, computational models, and real-world case studies to systematically investigate the challenges and solutions to the use of impure hydrogen PEMFCs, addressing three main objectives: (1) identifying the main sources of impurities and their poisoning mechanisms; (2) evaluating mitigation strategies for anode/cathode contamination; and (3) assessing the practical applications of PEMFCs fueled by impure hydrogen. Among them, CO, H 2 SO 2 and NO x S and NH 3 at the anode and at the cathode are toxic to PEMFCs. In terms of mitigation strategies, HT-PEMFC can improve CO tolerance by simply changing the material of the electrolyte membrane, which is currently the most mature and widely used. The demand for pure hydrogen has been reduced by ammonia-hydrogen fuel cells, methanol and methane-to-hydrogen PEMFCs, which show great environmental potential and value for transportation and home heating. The paper concludes with recommendations for future research and policy.

PUBLICAÇÕES

Tecnologia de Armazenamento de Hidrogénio

1 Advancements in hydrogen storage technologies: Integrating with renewable energy and innovative solutions for a sustainable future

Y. Khalili et al., Energy Geoscience, vol. 6, 2025. **Link**

Abstract Hydrogen storage plays a crucial role in achieving net-zero emissions by enabling large-scale energy storage, balancing renewable energy fluctuations, and ensuring a stable supply for various applications. This study provides a comprehensive analysis of hydrogen storage technologies, with a particular focus on underground storage in geological formations such as salt caverns, depleted gas reservoirs, and aquifers. These formations offer high-capacity storage solutions, with salt caverns capable of holding up to 6 TWh of hydrogen and depleted gas reservoirs exceeding 1 TWh per site. Case studies from leading projects demonstrate the feasibility of underground hydrogen storage (UHS) in reducing energy inter mittency and enhancing supply security. Challenges such as hydrogen leakage, groundwater contami nation, induced seismicity, and economic constraints remain critical concerns. Our findings highlight the technical, economic, and regulatory considerations for integrating UHS into the oil and gas industry, emphasizing its role in sustainable energy transition and decarbonization strategies. © 2025 Petroleum Exploration and Production Research Institute Corporation, SINOPEC. Publishing services by Elsevier B.V. on behalf of KeAi Communications Co. Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

2 Distributionally robust optimization for green hydrogen plant planning considering extreme scenarios

L. A. Oroya et al., International Journal of Hydrogen Energy, vol. 133, pp. 112-123, 2025. **Link**

Abstract As efforts to reduce carbon emissions increase, green hydrogen from sources like wind (WD) and photovoltaic (PV) power is a promising solution for industrial decarbonization. However, the variability of renewable energy sources (RES) challenges the planning and operation of green hydrogen plants. To address these challenges, this paper proposes a novel two-stage extreme distributionally robust optimization (X-DRO) model for sizing distributed energy resources efficiently for green hydrogen production and selling. The proposed model minimizes the total capital (CAPEX) and operating expenditures (OPEX) while ensuring the robustness of performance under an uncertain renewable energy supply. The methodology includes selecting representative and extreme scenarios to input into the model, representing the variability of RES. In the first stage, capacity planning decisions, including the sizing of PV and WD units, battery energy storage systems (BESS), hydrogen storage tanks (HSTs), and electrolyzers (ELs), are considered. The second stage addresses the operating decisions concerning power exchange with the grid, hydrogen production, and storage under worst-case scenario probabilities of RES generation. The column-and-constraint generation (C&CG) algorithm is applied to solve the X-DRO model. Simulations show that the proposed model balances economic efficiency and robustness compared to robust optimization (RO) and stochastic optimization (SO) models. A comparison between the X-DRO and DRO models highlights the importance of considering extreme cases for resilient planning.

3 Regret-aware optimization of hydrogen-assisted congestion control in a renewable-dominated reconfigurable distribution network

X. He et al., Renewable Energy, vol. 250, 2025. **Link**

Abstract The implementation of active power distribution network architectures, combined with significant renewable energy integration, enables better congestion management in power distribution systems. Hydrogen-based en ergy systems, electric vehicles, and diverse storage technologies are emerging as key solutions for managing contingent distribution networks under renewable energy variability. This study introduces an integrated virtual energy storage system (VESS) that combines renewable energy, hydrogen technology, electric vehicles, and various storage solutions to optimize congestion management. The main focus is network topology optimization through reconfiguration, which dynamically adjusts the grid's configuration to improve load balancing, reduce

congestion, and minimize network losses. Additionally, a demand response program is incorporated, allowing dynamic adjustments to power and thermal consumption in response to price signals and grid congestion. To manage the uncertainties inherent in this approach, a stochastic P-robust optimization method is proposed, evaluating system performance under risk-aware operational strategies. Results demonstrate substantial im provements, with the risk-averse mode reducing regret levels by 70 % at the cost of a 10 % increase in opera tional costs, while storage utilization increased from 13 % to 46 %. The reconfiguration process improved system reliability and flexibility through a strategic switching mechanism, emphasizing the potential of the proposed VESS to advance the capabilities of smart grid technology.

4 Assessing hydrogen storage challenges based on circular economy through comparative decision-making methods under uncertainty

L. A. Oroya et al., International Journal of Hydrogen Energy, vol. 133, pp. 112-123, 2025. **Link**

Abstract In the fight against climate change, hydrogen is a clean, renewable resource that lessens reliance on fossil fuels. The adoption of hydrogen energy faces significant challenges, particularly in storage systems. Addressing the challenges of hydrogen storage requires comprehensive and detailed studies to assess and address storage sys tems. The problem in this research is identifying and assessing the challenges of hydrogen storage based on the circular economy. In this regard, a decision-making framework is presented to assess the integration of the circular economy into hydrogen storage systems. The hybrid decision-making techniques, including Best Worst Method (BWM) and Combined Compromise Solution (CoCoSo), are utilized to assess challenges using fuzzy theory, and the validation and sensitivity are investigated. Based on the findings, the factors of initial capital reduction, energy consumption reduction, and productivity rate are the most significant, with weights of 0.255, 0.145, and 0.110, respectively. The challenges of the need for substantial initial capital in purchasing equipment, the costs of construction and installation and repairs, the limitation of methods and channels for funding, the uncertainty of the future of investment, and the reduction of energy conversion efficiency in different stages of hydrogen production and use were important priorities.

5 Challenges and opportunities in hydrogen storage and transportation: A comprehensive review

X. Wang et al., Renewable and Sustainable Energy Reviews, vol. 219, 2025. **Link**

Abstract The large-scale deployment of hydrogen energy is a key pathway to building a renewable energy society. Developing safe, efficient, and low-cost hydrogen storage and transportation technologies is crucial for the widespread adoption of hydrogen energy. Existing hydrogen storage and transportation technologies are energy-intensive and costly, making it difficult to meet the flexible demands of various hydrogen use scenarios. Therefore, this review compares the hydrogen energy roadmaps and strategies of different countries, provides an overview of the current status and technological bottlenecks of various hydrogen storage and transportation methods, and outlines future directions for the development of hydrogen storage and transportation technolo gies. The results indicated that the development and integration of application scenario-oriented hydrogen storage and transportation technologies is essential for enhancing the energy efficiency of the hydrogen energy chain. In addition, this review provides a detailed analysis of the advantages and disadvantages of various hydrogen storage technologies across different application scenarios. It also offers valuable insights for policy makers in making decisions on hydrogen storage and transportation development at the regional or industry level, and provides guidance for advancing these technologies to support decarbonization and large-scale applications.

6 Review of solid-state hydrogen storage: Materials categorisation, recent developments, challenges and industrial perspectives

M. Altaf, U.B. Demirci and A.K. Haldar, Energy Reports, vol. 13, pp. 5746-5772, 2025. **Link**

Abstract In the era of carbonisation and climate change, hydrogen has consistently been seen as a potential source of energy. Besides being clean and versatile as an energy carrier, it has a high calorific value of 140 MJ kg 1 which makes it suitable for different applications such as transportation, power generation and aerospace applications. Despite several benefits, hydrogen storage has consistently posed a challenge to its adoption due to

issues of leakage, material degradation and safety concerns. This review focuses on hydrogen storage technologies, with an emphasis on material-based storage and its industrial implications. It begins with an explanation on the fundamentals of hydrogen storage, followed by the evolution of standard benchmarks set by international or ganisations to be achieved by 2030. It further elaborates on major hydrogen storage techniques and provides a comprehensive classification of materials based on physisorption and chemisorption. A detailed discussion is provided on compression, liquid, and material-based storage mechanisms, along with their associated challenges. Additionally, the review investigates specific hydrides with high future potential, including Magnesium (Mg), Titanium-Iron (TiFe), Titanium-Manganese ($TiMn_2$), Lanthanum-Penta-Nickel ($LaNi_5$), Magnesium-Nickel (Mg_2Ni), and Sodium-Aluminum Hydride ($NaAlH_4$). A significant section is also dedicated to assessing recent industrial advancements and startups engaged in manufacturing materials or providing services related to solid-state hydrogen storage. Finally, the review explores potential pathways for the development of next-generation hydrogen storage materials, including novel hybrid material compositions. Overall, this review provides insights into the broad spectrum of hydrogen storage materials, emerging hydrides, and industrial perspectives, offering a foundation for future advancements in solid-state hydrogen storage.

7 Hydrogen storage capacity in clay: An analytical model for storage density as a function of pore size, pressure, and temperature

J. Zhang, R. Sander, D. Heryanto and M. B. Clennell, Fuel, vol. 398, 2025. **Link**

Abstract Clay minerals, abundant underground, maybe suitable for natural hydrogen storage and sealing. However, research on high-pressure hydrogen adsorption in clay under typical geological conditions has been limited. To address this, we conducted molecular dynamics simulations to investigate the effects of pressure, temperature, and pore size on hydrogen storage in clay-based materials like smectite. Simulations at temperatures from 308 to 400 K and pressures up to 259 MPa revealed that hydrogen adsorption is primarily governed by monolayer adsorption. We derived analytical expressions for bulk density and storage density (storage capacity normalized by pore volume) as functions of pressure, temperature, and pore size. Results indicate that the excess hydrogen storage by adsorption ranges from a few percent to over 15 %, with more storage enhancement being found in small pores, especially in interlayer space smaller than 5 nm across. Our models provide a framework for esti mating the hydrogen storage capacity in clay formations.

8 Exploring hydrogen storage properties of Graphene-MgH2 systems: A combined computational and experimental study

K. Iyakutti et al., International Journal of Hydrogen Energy, vol. 139, pp. 740-752, 2025. **Link**

Abstract Magnesium hydride (MgH 2 2) is recognized as a prominent material in hydrogen storage research because of its high hydrogen storage capacity and reversible hydrogen absorption properties. However, its sluggish hydrogen desorption kinetics and thermodynamics are the key bottlenecks. To overcome these bottlenecks, the graphene/ MgH based systems are designed computationally and the selected systems are experimented. Graphene is functionalized with varying the amounts of MgH 2 H 2 +6H and then hydrogenated to achieve an optimal balance between binding and hydrogen storage capacity (wt. %). From the computational investigations, which identified that the graphene+4MgH 2 2 system possesses the hydrogen storage capacity of 5.8 wt % in the desorption temperature of 82 K with H 2 plausible graphene-XMgH 2 adsorption energy of 0.064 eV. With the aid of the computational design, the systems have been prepared and characterized systematically. Then, the systems were subjected to the hydrogenation and dehydrogenation process under mild conditions. From the experimental desorption results, the graphene-15 % MgH 2 between 305 and 573 K with H 2 system desorbed ~3.71 wt % hydrogen in the range temperature binding energy of 0.28 eV. The findings of this study propel us towards the design and fabrication of efficient and high-capacity hydrogen storage systems based on graphene + MgH This progress brings closer to achieving the clean and sustainable hydrogen energy storage goals set by the United States Department of Energy (US-DOE).

PUBLICAÇÕES

Distribuição de Hidrogénio

1 Modelling and safe control of hydrogen doped natural gas pipeline using pressure-flow dual control methodology

Q. Xu et al., Computers and Chemical Engineering, vol. 199, 2025. **Link**

Abstract Blending hydrogen into a natural gas pipeline system for transportation changes the dynamic characteristics of the gas, and consequently, disturbances caused by valve misoperation, water hammer, and other factors will have a greater impact on the safe operation of the pipeline. This article establishes a boundary control model for pipeline transportation systems, which controls the safe operation of hydrogen doped natural gas pipeline transportation systems by regulating pressure and flow rate. Using the model predictive control method, the constraint relaxation variables and safety index are used as the constraint conditions for the quadratic optimi zation function, ensuring the safe operation of the pipeline system during the process of solving the control variables. Finally, the model predictive control simulation under water hammer conditions proves that the control strategy can effectively suppress the fluctuation of state variables, ensuring the safe and stable operation of pipeline transportation systems.

2 Hydrogen degradation of materials and changes in the operation mode of compressor station equipment as factors of increased risks and costs during transportation of hydrogen-containing gas through main gas pipelines

A.G. Ishkov et al., International Journal of Hydrogen Energy, vol. 130, pp. 147-155, 2025. **Link**

Abstract The problems of changing operating modes of the main technological equipment of compressor stations (CS) of the existing gas transportation system, as well as degradation of mechanical properties of the CS equipment material in case of transportation of methane-hydrogen mixtures or hydrogen at increased pressure are considered. The peculiarities of centrifugal compressor operation at pipeline transportation of hydrogen-containing mixtures are considered. Due to the peculiarities of physical and chemical properties of hydrogen, leading to an increase in flow velocity, an increase in the rotor speed of the compressor is required, which is limited by regulatory requirements. When operating with hydrogen-containing mixtures, the risk of embrittle ment of the rotor material increases. The results of tests for estimation of resistance to hydrogen embrittlement of structural steels of different classes, which are characteristic materials of compressor station equipment, are presented. The main regularities of change of strength, ductility and crack resistance of steels at hydrogen concentration from 5 % to 100 % and pressure 10 MPa are established. In hydrogen-containing environment there is de-strengthening and strong embrittlement of high-strength steels.

3 Experimental and molecular dynamics study on the concentration distribution characteristics of methane-hydrogen mixtures under static conditions

S. Penget al., International Journal of Hydrogen Energy, vol. 136, pp. 321-331, 2025. **Link**

Abstract The methane-hydrogen mixture is an important clean energy, but whether the two gases stratify remains controversial. This paper explores it via full-scale closed pipeline experiments and molecular dynamics simu lations (MD). MD simulations show methane-hydrogen mixture has significant stratification only with a drop of at least 100 km, and weak stratification with a 10-km drop. Lower temperatures boost stratification, but at 250 K, the normalized partial pressure difference is only 24.13 %, and stratification is hard to see above 250 K. Ex periments find that even after long standing, stratification in 160-mm pipelines is mild. After 312 days, the concentration deviation is 3.4 % for SF6–H2 and 1.68 % for CH4–H2, indicating lateral diffusion and turbulent mixing can suppress stratification. Stratification is more obvious in 63-mm pipelines (26.82 % for SF6–H2 and 13.44 % for CH4–H2). Inclined pipelines reduce stratification more than vertical ones. This study helps under stand the stability and safe transport of hydrogen-enriched natural gas in pipelines.

4 Failure analysis of corroded hydrogen-blended natural gas pipelines based on finite element analysis and genetic algorithm-back propagation neural network

M. Xie et al., Reliability Engineering and System Safety, vol. 262, 2025. **Link**

Abstract Blending hydrogen into the existing natural gas pipelines is an effective way to reduce hydrogen transportation costs and facilitate the rapid adoption of hydrogen energy. However, the impact of hydrogen embrittlement on the burst pressure and remaining life of corroded pipelines is not well understood, which poses a significant challenge to pipeline integrity management. To overcome this challenge, this study examines the impact of hydrogen embrittlement on the mechanical properties of pipeline steel and utilizes finite element analysis to calculate the burst pressure of pipelines under varying corrosion geometrical parameters and hydrogen partial pressures. The results obtained are used to train a genetic algorithm-backpropagation (GA-BP) neural network model that predicts burst pressure for hydrogen-blended natural gas pipelines. Additionally, the corrosion maximum depth that can lead to pipeline failure is determined and the prediction of the remaining useful life is realized by integrating corrosion growth models. The findings indicate that the impact of hydrogen embrittle ment on the burst pressure of corroded X52 pipelines is negligible. However, for corroded X80 pipelines, hydrogen embrittlement results in a reduction in the burst pressure of approximately 6 %, leading to a remaining useful life loss of around 0.24 years.

5 Research progress on crack propagation and failure probability prediction of hydrogen-blended natural gas pipeline

W. Lin et al., International Journal of Hydrogen Energy, vol. 134, pp. 28-43, 2025. **Link**

Abstract The utilization and transportation of hydrogen energy hold strategic importance for China's hydrogen energy market. With technological advancements and supportive policies, market demand for hydrogen is rapidly increasing. Consequently, "long-distance, large-scale" hydrogen-blended natural gas pipeline transportation has emerged as a critical solution for efficient hydrogen delivery. However, hydrogen blending can significantly influence the performance of natural gas pipelines, potentially altering crack growth behavior and failure probabilities, thus posing challenges to pipeline safety. This paper reviews the mechanisms of crack growth, remaining life prediction, and failure probability assessment in hydrogen-blended natural gas pipelines. A comparative analysis of current technical standards for hydrogen pipelines across different countries is con ducted, with corresponding recommendations for pipeline material selection proposed. It examines the effects of hydrogen blending ratio, temperature, and pipeline materials on crack propagation, summarizes methodologies for evaluating failure probabilities, and highlights the distinctions between failure probability assessments in natural gas pipelines versus hydrogen-blended pipelines. The study concludes with a discussion on integrated research approaches for understanding crack growth mechanisms and failure probability in hydrogen-blended pipelines. The findings aim to enhance pipeline safety, optimize design and maintenance strategies, and contribute to achieving carbon neutrality goals.

6 A study on the leakage consequence and risk analysis of hydrogen-blended natural gas pipeline in different failure modes

C. Guo al., International Journal of Hydrogen Energy, vol. 134, pp. 100-112, 2025. **Link**

Abstract To transport hydrogen-blended natural gas with existing natural gas pipelines is a flexible and economical reutilization, but the flammability and explosivity of hydrogen bring more safe uncertainty to natural gas pipeline. The consequences and risk in leakage and explosion accidents of hydrogen-blended natural gas pipeline in different failure modes are studied in this paper. Results show that the trend of horizontal diffusion distance in rupture mode changing with hydrogen blending ratio is opposite to that of crevice and hole mode. The radiation intensity of hole and rupture modes decreases rapidly and positively correlates with hydrogen blending ratio in the initial part of jet fire, and the lower radiation intensity and shorter radiation distance are observed in crevice mode. Finally, the potential impacts radius formulas in different modes are modified with wind speed and hydrogen blending ratio as independent variables for the convenient risk assessment.

PUBLICAÇÕES

Mobilidade Terrestre com Hidrogénio

1 Techno-economic analysis of fuel cell trucks with different powertrain hybridization and hydrogen resources by 2040: case study of China

L. Nan et al., International Journal of Hydrogen Energy, vol. 132, pp. 174-182, 2025. **Link**

Abstract This study conducts a techno-economic analysis of fuel cell electric trucks with different hybridization factors (i. e., the power distribution ratio between batteries and fuel cells) by evaluating their life-cycle carbon dioxide (CO2) emissions and total cost of ownership (TCO) from 2020 to 2040. It integrates the energy consumption of trucks with varying hybridization factors under different driving cycles with China's hydrogen production, transportation models, and electric grid structure. Through this analysis, the TCO and emissions of individual trucks are examined across different scenarios. The study reveals that highly hybridized trucks offer advantages in both emissions reduction and cost savings across all hydrogen production and transport pathways. A 67% hybridization factor results in a 5%-9% reduction in emissions and a 34%-46% decrease in TCO compared to the lowest hybridization factor. The energy-saving and emission-reducing effects of highly hybridized fuel cell electric vehicles (FCEVs) also depend on the driving cycle, with optimal performance observed in the Urban Dynamometer Driving Schedule for Heavy-Duty Vehicles (UDDSHDV) cycle, while minimal advantages appear in the China Heavy-Duty Commercial Vehicle Test Cycle for Heavy Trucks (CHTC-HT) cycle. Furthermore, life-cycle emissions of trucks decrease gradually over time for all hydrogen production pathways, with the electrolysis of grid electricity showing the fastest decline. By 2040, trucks powered by hydrogen from grid electricity will have slightly lower emissions than those using coal, while green hydrogen remains the cleanest option. In conclusion, adopting fuel cell trucks with high hybridization factors, powered by green hydrogen, presents significant economic and environmental benefits for the future of transportation.

2 Hydrogen as a sustainable transportation fuel

T.J. Wallington et al., Renewable and Sustainable Energy Reviews, vol. 217, 2025. **Link**

Abstract This review examines the potential direct and indirect (synthetic fuels) uses of hydrogen in road, rail, air, and marine transportation. Key physical properties of hydrogen (e.g., energy density) are presented and contrasted against conventional fuels. The costs and emissions of current and future hydrogen production methods are characterized, and the challenges of transporting, storing, distributing, and dispensing hydrogen are highlighted. The sustainability of hydrogen use is evaluated in terms of CO2 and other air pollutant emissions, energy effi ciency and intensity, critical material use, and water consumption. Electrification is much more energy efficient than using hydrogen in transportation. Hydrogen should be used strategically where electrification is impractical due to range, refueling times, or energy storage requirements. Electrification is already well advanced, making hydrogen unlikely to play a significant role in the light-duty road sector. Hydrogen can play a role in long-distance rail and heavy-duty road transportation, where electri fication is problematic. Electrification is impractical for deep ocean shipping and aviation due to volume and weight constraints (except for ranges below approximately 200 miles). Hydrogen can be used, either directly or indirectly (in e-fuels), to fully decarbonize these sectors. Currently, the high costs of clean hydrogen production, storage, and distribution make it prohibitive for transportation. Major reductions in these hydrogen infrastruc ture costs, the cost of e-fuel synthesis, or both are needed to make hydrogen competitive with other fuel options. Strong policy measures such as the Bipartisan Infrastructure Law and the Inflation Reduction Act are funding R&D and technology demonstration to support this goal.

3 Long short-term memory time series modelling of pressure valves for hydrogen-powered vehicles and infrastructure

P. V. Madhavan et al., International Journal of Hydrogen Energy, vol. 124, pp. 67-83, 2025. **Link**

Abstract Long-term reliability and accuracy of pressure valves are critical for hydrogen infrastructure and applications, particularly in hydrogen-powered vehicles exposed to extreme weather conditions like cold winters and hot summers. This study evaluates such valves using the Endurance Test specified in European Commission Regu lation (EU) No 406/2010, fulfilling Regulation (EC) No 79/2009 requirements for hydrogen vehicle type approval. A long short-term memory (LSTM) network accelerates valve development and validation by simu lating

endurance tests. The LSTM model, with three inputs and one output, predicts valve outlet pressure re sponses using experimental data collected at 25 ◦ cycles. At 25 ◦ C, 85 ◦ C, and 40 ◦ C, simulating a 20-year lifecycle of 75,000 C, the model achieves optimal performance with 40,000 training cycles and an R 2 of 0.969, with R values exceeding 0.960 across all temperatures. This efficient, robust approach accelerates testing, enabling real- time diagnostics and advancing hydrogen technologies for a sustainable future.

4 Hydrogen leakage risk analysis of hydrogen fuel emergency power vehicle multi-scenario based on dynamic Bayesian network

B. Gu et al., International Journal of Hydrogen Energy, vol. 136, pp. 173-185, 2025. **Link**

Abstract In order to address the uncertainty, dynamic change characteristics and unknown influencing factors of risk associated with hydrogen leakage accidents in the context of multiple scenarios involving hydrogen fuel emer gency power vehicles, this study proposes a dynamic risk assessment method based on dynamic Bayesian net works. Firstly, a database of risk events related to hydrogen leakage is constructed through an investigation of multiple application scenarios. Subsequently, a fault tree is created based on the identified causal relationships between events, with the objective of elucidating the potential pathways for hydrogen leakage. Subsequently, dynamic Bayesian network models are constructed, and the probabilistic parameters of the network are deter mined by integrating expert experience and case data. The model is then analyzed through dynamic reasoning. The dynamic change curve of multi-scenario hydrogen leakage risk over time is obtained through forward reasoning, while the key risk factors affecting multi-scenario hydrogen leakage and high-risk scenarios are identified through reverse reasoning. This enables a comprehensive assessment of multi-scenario hydrogen leakage risk in hydrogen fuel emergency power vehicles to be conducted. The findings indicate that the risk probability of hydrogen leakage fluctuates over time, exhibiting an upward trend. This outcome substantiates the efficacy of the dynamic approach in comparison to the conventional static assessment methodology. The analysis of multiple scenarios demonstrates that hydrogen pipeline rupture and valve rupture are the primary risk factors influencing hydrogen leakage. Furthermore, the risk of hydrogen leakage is higher during driving and refueling scenarios, which compensates for the limitations of risk analysis conducted in a single scenario. The research f indings provide a theoretical basis for the development of targeted risk management strategies, reducing the risk level of hydrogen leakage and ensuring the safe and stable operation of hydrogen fuel emergency power vehicles.

5 Development, application and optimization of hydrogen refueling processes for railway vehicles

S. Wieser et al., International Journal of Hydrogen Energy, vol. 124, pp. 331-344, 2025. **Link**

Abstract In recent years, numerous hydrogen-powered rail vehicles have been developed, and their deployment within public transport is steadily increasing. To avoid disadvantages compared to diesel vehicles, refueling times of 15 min are stated in the industry as target, independent of climate zones or vehicle configurations. As refueling time varies with these parameters, this work presents the corresponding refueling times and defines optimization potentials. A simulation model was set up and parametrized with a reference vehicle and hydrogen refueling station from the FCH2RAIL project. Measurement data from this station and vehicle were analyzed and compared to simu lation results for model validation. The results show that at high ambient temperature pre-cooling reduces refueling time by 71 % and type 4 tanks increase refueling time by 20 % compared to type 3. Overall, optimized tank design and thermal management reduce the refueling time for rail vehicles from over 2 h to 15 min.

6 Life cycle environmental impact assessment and review of hydrogen fuels obtained from various sources for vehicles

S. Ayca and I. Dincer, International Journal of Hydrogen Energy, vol. 127, pp. 265-274, 2025. **Link**

Abstract This paper focuses on the Life Cycle Assessment (LCA) of passenger car (CAR) heavy duty vehicle (HDV), and sport utility vehicle (SUV) which are hydrogen fueled Fuel Cell Vehicles (FCVs), and various production methods of hydrogen fuel used in these vehicles are considered for analyses and comparative evaluations. In addition, this study includes recommendations for selecting the production method and vehicle type with economic data from

the National Renewable Energy Laboratory (NREL). Eight renewable and non-renewable hydrogen production options are identified, using proton exchange membrane (PEM) electrolysis driven by the electricity obtained from solar, biomass, nuclear, chlorine plants, coal, natural gas, coke oven gas and pet coke. This study is designed to utilize the LCA method for examining the use of hydrogen fuel produced from these plants in 3 different vehicle types. The Greenhouse Gases, Regulated Emissions and Energy Use in Transportation (GREET), which is a potential LCA software, is employed to analyze the carbon dioxide (CO 2), methane (CH sulfur oxides (SOx), particulate matter pollutants (PM10), nitrous oxide (N 2 4), nitrogen oxides (NOx), O) and particulate organic carbon (POC) emissions. According to the results of the analysis, the lowest emission value is obtained for the passenger car using hydrogen fuel produced by PEM electrolysis method as given in Pathway 1. The results further indicate that the highest emission value is 42.86 g/km CO 2 , and the lowest is 0.00065 g/km POC for the passenger car as presented in Pathway 1, where the best data are obtained. In contrast, the highest emission value of the HDV vehicle type using hydrogen fuel produced in Pathway 8 is 1921.53 g/km CO 2 , and the lowest emission value is 0.0076 g/km POC.

7 Design and Development of a Small-Scale Green Hydrogen Vehicle: Hydrogen Consumption Analysis under Varying Loads for Zero-Emission Transport

P. Y. T. Hunn and H. N. Afrouzi, Energy Engineering, vol. 122, 2025. **Link**

Abstract With growing interest in its potential applications across both stationary and transportation sectors, hydrogen has emerged as a promising alternative for environmentally responsible power generation. By replacing traditional fuels, hydrogen can significantly reduce greenhouse gas emissions in the transportation sector. This study focuses on the design and downsizing of a green hydrogen fuel cell car, aiming to scale the concept for larger vehicles. Key components, including fuel cells, electrolysers, and solar panels, were evaluated through extensive laboratory testing. The findings reveal that variations in sunlight impact the solar panel's hydrogen production rate, with differences of approximately 4.9% attributed to changes in time and date. Analysis of consumption rates showed that a 17.4% increase in current consumption leads to a significant reduction in operational time. Further testing under varying loads demonstrated that higher current demands, such as those from a DC motor, accelerate hydrogen depletion, whereas lower currents extend operational duration. These results underscore the importance of maximizing solar energy efficiency, reducing reliance on conventional energy sources, and regulating consumption rates to optimize fuel cell performance. Since hydrogen is produced using renewable energy, fuel cell technology is virtually emission-free. Additionally, the study highlights the viability of powering vehicles with renewable energy, emphasizing the potential of green hydrogen fuel cell technology as a sustainable transportation solution.

8 Exploring the nexus between sustainable energy tokens, electric vehicles, and the hydrogen economy

M. Mbarek, Research in International Business and Finance, vol. 77, 2025. **Link**

Abstract The aim of this research is to explore the transmission of tail risk between energy tokens and sustainable equity sectors, specifically focusing on the electric vehicle industry (EVI) and the hydrogen economy (HEI). To achieve this objective, we combine the Conditional Autoregressive Value at Risk (CAViaR) model with the Time-Varying Granger-Causality (TVGC) method and the Wavelet Coherency approach, over the period from April 8, 2020, to February 16, 2024. The TVGC results reveal unidirectional causal relationships from energy tokens to these equity sectors. However, bidirectional causality exists between SNC and HEI. These causalities predominantly occur during significant events such as the Covid-19 pandemic, the cryptocurrency bubble, the Russian-Ukrainian conflict, and the collapses of FTX and SVB. These findings are consistent with those identified by the Wavelet coherency method, which shows variability in the frequency of causality between energy tokens and equity sectors. Additionally, the assessment of portfolio implications based on CAViaR's 5 % VaR for pairs of markets demonstrates the ability of energy tokens to mitigate tail risk transmission when incorporated into portfolios of electric vehicle and hydrogen economy equities. These insights are valuable for crypto managers and investors in adjusting and optimizing their hedging strategies.

PUBLICAÇÕES

Corredores de Hidrogénio: Aspetos Normativos e de Promoção

1 Integrating safety management systems in hydrogen production facilities

H. Li et al., International Journal of Hydrogen Energy, vol. 128, pp. 345-358 2025. **Link**

Abstract This paper explores integrating a comprehensive safety management system into hydrogen production facilities, emphasizing the critical importance of safety given the associated risks, including high pressures, flammability, and potential for leaks. A robust chemical safety management system (CSMS) tool is introduced, which is designed to significantly enhance safety protocols by providing structured frameworks for hazard identification, real-time onitoring, predictive analytics, and regulatory compliance tracking. Quantitative analyses conducted at actual hydrogen facilities demonstrate a 60 % reduction in safety incidents, a 16.7 % improvement in regulatory compliance scores, and a 42.5 % enhancement in operational response efficiency following CSMS implementa tion. This paper establishes the superiority and critical improvements provided by integrating this advanced CSMS through detailed case studies, real-world applications, and comparative analysis. The results underscore the tangible benefits, including improved incident management, reduced operational risks, and more substantial alignment with national and international safety standards, highlighting the system's essential role in sustainable hydrogen production.

2 Europe's way from natural gas to green hydrogen: Modeling and simulation of the transforming European gas transport infrastructure

T. Mielich et al., International Journal of Hydrogen Energy, vol. 135, pp. 156-171, 2025. **Link**

Abstract Achieving the EU's 2050 climate neutrality target requires rapid energy system transformation, with hydrogen expected to play a central role. This study presents a high-resolution modeling framework to support the tran sition of Europe's natural gas infrastructure into a cost-efficient hydrogen network while maintaining residual gas transport capabilities. Using the Steiner tree algorithm, optimized hydrogen network topologies were derived by repurposing existing pipelines and selectively building new corridors. Scenario data were spatially and temporally disaggregated to NUTS-3 and hourly resolution. Fluid-dynamic simulations for 2030, 2040, and 2050 validate the technical feasibility and identify infrastructure bottlenecks. Results show that by 2040, 98 % of the projected 38,000 km hydrogen network can be repurposed infrastructure, requiring an estimated € 72.5 billion investment by 2050. The proposed methodology enables scalable and adaptive planning and offers critical in sights into hydrogen corridor prioritization, infrastructure phasing, and cross-border coordination, supporting policy and investment decisions across the EU energy landscape.

3 Mapping the hydrogen transition in the Netherlands: A sociotechnical multi-system event sequence analysis

J. Bakhuis et al., Environmental Innovation and Societal Transitions, vol. 56, 2025. **Link**

Abstract Hydrogen is considered a promising energy carrier that can potentially contribute to low-carbon energy systems and achieving climate goals. Its introduction, however, is complex, involving multiple emerging niches and developments across various sociotechnical systems. Despite its significance, the multi-system nature of hydrogen has received limited attention in sustainability transition scholarship. This paper addresses this knowledge gap by examining the emerging hydrogen transition in the Netherlands from a multi-system sociotechnical perspective. To ach ieve this, we adopted a framework that considers multiple niches and sociotechnical systems in parallel, using Event Sequence Analysis (ESA). The analysis provides a systematic reconstruction of (niche-)processes as networks of events for analysing hydrogen niche formation from 2001 to 2020 across four sociotechnical systems: industry, electricity, transport, and the built environ ment. The results reveal that, despite positive discourse and ambitious plans, investments and implementation remained limited. We provide possible explanations for this progress through a multi-system lens.

4 Analysis of barriers for hydrogen-fueled logistics under integrated sustainability: A DEMATEL-TOWS framework

J. Niemsakul et al., Journal of Cleaner Production, vol. 513, 2025. **Link**

Abstract The renewable energy supply chain is emerging as a critical component in the transition toward sustainable energy, with hydrogen-fueled vehicles offering significant potential to reduce carbon emissions in logistics and heavy industry. However, the adoption of hydrogen-fueled industrial trucks in logistics is hindered by various barrier criteria. This study employs an integrated Decision-Making Trial and Evaluation Laboratory (DEMATEL)- SWOT-TOWS Matrix framework to systematically assess barrier criteria relevant to techno-socio-economic sus tainability and formulate strategies for advancing hydrogen-powered industrial trucks. Initially, DEMATEL is employed to analyze and quantify the interdependencies among barrier criteria for hydrogen-fueled industrial trucks in logistics, identifying the most critical obstacles. Next, SWOT is used to analyze open-ended interview responses, uncovering strengths, weaknesses, opportunities, and threats associated with adopting hydrogen fuel in logistics. Finally, the TOWS matrix is used to translate these findings into actionable strategies. Finally, in sights are gathered from experts across academia, industry, and government to address challenges and to ensure a balanced perspective on future policy considerations of hydrogen-based industrial trucks in the Thailand context.

5 Economic analysis of solar-hydrogen energy industry in China: A PLS-SEM approach to financial performance and input-output dynamics

J. Song et al., International Journal of Hydrogen Energy, vol. 136, pp. 546-562, 2025. **Link**

Abstract Achieving This research analyses the input-output dynamics of the solar-hydrogen energy industry (SHEI) in China, investigating the relationship between production and consumption to promote green energy alternatives. The study used Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine financial data from 2011 to 2019, evaluating the influence of variables such as fixed assets, operational expenses, and R&D investment on SHEI output metrics, including earnings per share and net profit margin. The results reveal significant correla tions between inputs and outputs (coefficient = 0.86, $p < 0.001$), with state-owned enterprises showing higher f inancial input capabilities (SHEII1 = 2.80 vs. 2.48, $p < 0.001$) but lower performance outcomes (SHEIP1 = 9.24 vs. 26.68, $p < 0.001$) compared to private enterprises. Geographical disparities were identified, with stronger input-output relationships in non-BSGS regions (coefficient = 0.86 vs. 0.46, $p < 0.001$). The research delineates the roles of company age, total assets, and intangible assets as mediators, while ownership structures and equity concentration serve as moderators, affecting the correlation between input and output. The novelty of this study lies in its comprehensive quantitative assessment of SHEI financial dynamics using structural equation modeling, providing empirical evidence of the effects of corporate characteristics on performance outcomes in China's emerging hydrogen economy. This study offers a theoretical and practical framework for governments, com panies, and academics aiming to incorporate solar-hydrogen technology into global urban energy systems, facilitating initiatives to enhance sustainability and decarbonization.

6 Quantification of the explosion risk of biogas-hydrogen-air mixtures with various hydrogen fractions in a 20 L chamber

J. Kim et al., Process Safety and Environmental Protection, vol. 199, 2025. **Link**

Abstract The explosion risk and severity of biogas-hydrogen-air mixtures are investigated by measuring the explosion parameters—namely, the maximum explosion pressure, maximum pressure rise rate, deflagration index, and laminar burning velocity—using a 20 L spherical explosion chamber. Accurate deflagration indices are calculated using the maximum pressure rise rate derived from a smoothed pressure–time curve. The values of all parameters increase monotonously with increasing hydrogen fraction in biogas-hydrogen-air mixtures: the maximum ex plosion pressure increases by up to 1.33 times, the maximum pressure rise rate and deflagration index increase by up to 2.54 times, and the laminar burning velocity increases by up to 1.7 times. Hydrogen addition shortens the deflagration duration and accelerates pressure build-up. The addition of a small amount of hydrogen leads to an explosion risk close to that of pure methane. In summary, the addition of hydrogen into biogas-air mixtures significantly increases the explosion risk and severity.

7 Energia em números, 2025

Observatôrio da Energia, DGEG, ADENE, 2025. **Link**

Abstract O Observatório da Energia apresenta a sétima edição do Energia em Números, edição 2025, com os principais indicadores energéticos de Portugal. Esta é uma publicação desenvolvida em colaboração com a Direção-Geral de Energia e Geologia (DGEG), que agrega os dados e os indicadores mais relevantes sobre o setor da energia produzidos pela DGEG e outros dados sistematizados pela ADENE – Agência para a Energia. O Energia em Números contempla uma vasta quantidade de informação estatística que permite fazer o ponto de situação de Portugal face às metas estabelecidas no Plano Nacional de Energia e Clima, sendo uma ferramenta de apoio à definição e implementação de políticas públicas.

Grande parte da informação que consta da presente publicação refere-se ao ano de 2023 e anteriores, ainda que, quando disponível, se apresentem também dados relativos ao ano de 2024. O Energia em Números compara os dados e os indicadores energéticos dos anos mais recentes com os do ano anterior e com os valores obtidos há uma década, de modo a conhecer-se melhor a evolução do setor energético de Portugal num período alargado.

É de salientar que a DGEG introduziu, pela primeira vez no Balanço Energético de 2018, o contributo de energia renovável proveniente das bombas de calor, o que levou à revisão dos balanços energéticos relativos ao período 2014-2017.

Neste contexto, chama-se particular atenção do leitor no que respeita à evolução dos valores do Balanço Energético, em que não é afetada a comparação dos valores de 2023 com os valores dos anos anteriores até 2014. Contudo, quando se comparam valores de 2023 com valores de 2013, deve ter-se em consideração que o Balanço Energético de 2013 não contém a energia proveniente da tecnologia das bombas de calor.

EVENTOS

18-19 JUN

Connecting Hydrogen Europe

Connecting Hydrogen Europe 2025 (CHE2025) is Europe's Leading and Most Influential Hydrogen Event, bringing together the entire hydrogen value chain to accelerate the hydrogen industry and drive Europe's new energy economy.
CHE2025 will be held in Madrid from June 18-19, 2025, marking the largest edition in the event's history. It serves as a premier platform that unites over 6,000 attendees, influential leaders, and visionaries from Europe and around the world. The event provides a unique opportunity for partnerships and innovation, featuring 200+ speakers and 100+ exhibitors.

Link

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24 JUN

Hydrogen Europe Summer Market 2025

Taking place in the heart of Brussels, this in-person event offers a unique networking opportunity, fostering collaborations that will shape the future of hydrogen innovation.

Link

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25 JUN

Consortium Building Roundtables

Creating a successful R&D&I proposal takes time, yet many engage too late in the process. To help members take early and active steps toward the upcoming Clean Hydrogen Partnership 2026 calls, and other hydrogen-related Horizon Europe opportunities, Hydrogen Europe is organising an in-person pilot consortium-building event.
This session will bring together members in a roundtable format aligned with specific call topics. Members of the HE Team will introduce the sessions and provide support throughout the day. They will also be available for bilateral meetings during the event or for follow-up sessions that can be booked at a later stage.

Link

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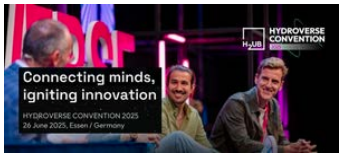
26 JUN



HYDROVERSE CONVENTION 2025

The HYDROVERSE CONVENTION 2025 edition, is H2UB's flagship event and Europe's largest H2 innovation happening, bringing together over 600 start-ups, corporates and investors from across Europe, Asia, the USA, MENA and beyond.
As the leading open innovation platform for the whole hydrogen value chain in Europe, H2UB highlights innovation and puts startups at the center of its activities to support the development of the hydrogen economy.

Link

EVENTOS

7-8 OCT

Hy-fcell 2025 – International Exhibition and Conference for Hydrogen and Fuel Cells

The hy-fcell is one of the world's leading international trade fairs and conferences for hydrogen and fuel cell technology. Combining a high-level exhibition and conference, it brings together experts from industry, research, and policy to drive innovation and explore new business opportunities.
Focal topics 2025:

- Production technology – manufacturing fuel cells and electrolysers
- Hydrogen mobility – applications from lorries to aviation
- European Single Market – Strategies for Europe as a business location
- International networking – cooperation and knowledge transfer

Link

12-13 NOV

Wood Mackenzie Hydrogen Conference

With the low-carbon hydrogen economy struggling to move at pace, a boost is needed in the market to reconcile the supply and demand challenges. As the market looks to break the pattern of announcing capacity whilst demand remains relatively small-scale, questions remain around government policy and support, funding and costs, project delivery and end market requirements.
There is also a need to understand market dynamics, conditions and project specific drivers taking projects to FID while stalling others. All these challenges and more, need to be addressed to scale-up the low-carbon hydrogen sector allowing it to play a critical role in delivering as part of the energy transition.

Link

PROJETOS FINANCIADOS

Horizon Europe: EUR 144 million available for projects supporting sustainable, secure and competitive energy supply

Deadline date: 02/09/2025

Link

Following the adoption of the Horizon Europe 2025 work programme, the European Commission has launched a new call for project proposals to support research and innovation in the area of sustainable, secure and competitive energy supply.
The total indicative budget available is EUR 144 million. The deadline for submissions is 2 September 2025.
You can find all the information and documentation required, including the call text and application forms on the Funding and Tenders Portal using the call reference: HORIZON-CL5-2025-02-D3 (12 topics).

CEF Transport Alternative Fuels Infrastructure Facility (AFIF) call for proposal

Deadline date: 11/06/2025

Link

The objective of the Alternative Fuels Infrastructure Facility (AFIF) call for proposal is to support the deployment of alternative fuels supply infrastructure, contributing to decarbonising transport along the TEN-T network.
This second phase of AFIF (2024-2025) will support the objectives set in the new Regulation for the deployment of alternative fuels infrastructure (AFIR) regarding publicly accessible electric recharging pools and hydrogen refuelling stations across the European Union's main transport corridors and hubs, as well as the objectives set in the ReFuelEU aviation and the FuelEU maritime Regulations.

LIFE Preparatory Projects (PLP) in the field of Clean Energy Transition

Deadline date: 23/09/2025

Link

On 24 April, the European Commission launched the LIFE Programme Calls for Proposals 2025.
This year, €600 million is available to support projects in the areas of nature conservation, environmental protection, climate action, and the clean energy transition.

PROJETOS FINANCIADOS

LIFE Calls for proposals 2025

Link

Deadline date, see link

The EU LIFE Programme is launching the 2025 Call for Proposals, and once again we want to help you take your green ideas to the next level. As the #ForOurPlanet campaign gets under way, there's never been a better time to turn your vision into action! If you've got an idea for conserving nature, protecting the environment, taking climate action or transitioning Europe to clean energy, your project could be in for a share of the €600 million just announced for 2025.