



The role of hydrogen transport and storage infrastructure: An opportunity for industrial competitiveness.

A group of industrial players organised within the French Strategic Committee of the Industry New Energy Systems (Comité Stratégique de Filière Nouveaux Systèmes Énergétiques, CSF NSE) presents a study on the role of hydrogen infrastructure in increasing France's industrial competitiveness and decarbonising industry. Through an integrated whole-system model of the French energy system, the study compares the competitiveness of the cost of hydrogen delivered, investments required, and security of supply in different infrastructure configurations and under a range of hydrogen demand volumes in 2030 and beyond. The study sheds light on how hydrogen infrastructure can support and facilitate the French hydrogen strategy.

This techno-economic study indicates the emergence of a progressive, demand-dependent development path for hydrogen transport and storage infrastructure, capable of reducing the cost of hydrogen delivered to the consumer by optimising investment costs across the entire hydrogen and electricity value chains covering production, transport and storage.

By enabling **the expansion of production capacities**, the deployment of hydrogen infrastructure between industrial clusters could **reduce the cost of renewable and low-carbon hydrogen delivered by 10% by 2030** compared to a scenario without hydrogen infrastructure. In addition, connecting French infrastructures to the rest of Europe could reduce the cost of hydrogen by 32% by 2040, provided that the national hydrogen strategies of neighbouring countries are realised, and that demand grows accordingly.

Hydrogen infrastructure linking industrial clusters would **reduce cumulative investment costs by 9% in 2030**, or 300 million euros, and by 19% by 2040, or 3 billion euros.

These dedicated infrastructures are therefore an essential asset given that demand for hydrogen develops in accordance with the French strategy, which envisages renewable and low-carbon hydrogen to reach 670 kt per year by 2030 in France.¹ Sensitivity analysis reveals that the same trends manifest for an even more ambitious vision as promoted by the French industry.²

Implementing a dedicated infrastructure needed to create and maintain a liquid interconnected hydrogen market, connecting French infrastructure with the main hydrogen ecosystems in Germany, Belgium, and Spain, would require additional investment costs of around €3.9 billion by 2030 (670 kt/year) and €1.6 billion by 2040. These additional investments must be assessed in the light of the hydrogen consumption and production trajectories of France's neighbours.

The results of this study show the emergence of an optimal, progressive deployment trajectory for hydrogen infrastructure. It starts in and between industrial clusters by 2030, before interconnecting with neighbouring countries in the longer term. Considering the long deployment timelines for hydrogen pipelines and underground storage, optimisation of investment decisions will be greatly facilitated by

¹ 22 TWh per year assuming hydrogen's lower calorific value .

² The "Ambition+ 2030" scenario of France Hydrogène forecasts a renewable and low-carbon hydrogen demand of 1090 kt, or 36 TWh at ICP, per year in 2030. <https://www.afhypac.org/documentation/publications/>

developing—starting today—a shared vision of the future infrastructure and the associated planning to get there, based on the model of 10-year network development planning currently in place for electricity and gas.

Hydrogen infrastructure improves the competitiveness of French industry

By providing access to competitive hydrogen and by improving security of supply, hydrogen infrastructure can improve the competitiveness and attractiveness of French territories for industry. In addition, by pooling supply sources and enabling utilisation of large-scale underground storage facilities, it can enhance overall energy system resiliency and help to assert national energy sovereignty. Dedicated hydrogen storage facilities can play a dual role by providing both short-term flexibility for firming renewable energy generation profiles and strategic reserves to absorb extended periods of low renewable production.

By facilitating the rapid expansion of electrolysis-based hydrogen production projects, hydrogen infrastructure can also contribute to the development of a **competitive French electrolysis sector** as desired by the French hydrogen strategy and as reaffirmed by President Macron in the framework of the France 2030 plan.

Further work to maximise benefits

Following these initial results, the CSF NSE plans to deepen the analysis by involving industrial consumers identified around the French clusters as well as the electricity transmission system operator. This could enable integration of the subject of energy infrastructures within the implementation of the national hydrogen strategy, and even into the revision of the Multiannual Energy Programme (“Programmation Pluriannuelle de l’Énergie”) and the National Low Carbon Strategy (“Stratégie Nationale Bas-Carbone”).

"The project we are developing at the Dunkirk site aims to implement a Direct Reduced Iron (DRI) steel production process using hydrogen, with a capacity of 2 million tons, and emitting three times less CO₂ than a blast furnace. Considerable quantities of hydrogen will be needed, several hundred kt/year in the long term, which will have to be supplied to us in a secure and stable way, at a competitive cost. This is why the development of national supply infrastructures and international interconnections is absolutely vital to achieve this", says Eric NIEDZIELA, President of ArcelorMittal France and Vice President Climate Action ArcelorMittal Europe.

Jean-Baptiste CHOIMET, CEO of Elogen, adds: *"The network and storage infrastructures will be a key element in the structuring of the hydrogen industry and will contribute to improving its competitiveness. Elogen's PEM electrolyzers are the result of powerful R&D focused on performance improvement and will actively participate in their development in France and more globally on the European territory.*

The report can be found here: <https://systemesenergetiques.org/centre-actualites-ressources/>.

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**Nouveaux Systèmes
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Comité stratégique de filière

The study is not binding on all CSF members.

About the French Strategic Committee of the Industry New Energy Systems (Comité Stratégique de Filière Nouveaux Systèmes Énergétiques, CSF NSE)

The French Strategic Committee of the Industry New Energy Systems aims to make the energy transition an opportunity to reindustrialise France.

Organised around structural projects that give a greater industrial dimension to the energy transition, it brings together the State, industrial players navigating the energy transition, trade unions, local authorities, and associations around shared priorities for which specific actions are defined and implemented jointly. These projects are set out in the 'industry contract', a common roadmap for all players in the industry over the next two years.

Launched under the impetus of the State and major industrial actors (EDF, ENGIE, TOTALENERGIES, SCHNEIDER ELECTRIC) joined by AIR LIQUIDE, BLUE SOLUTIONS, ENEDIS, GRDF, GRTGAZ, RTE, TEREGA, TECHNIP Energie, it ensures that companies of all sizes, and in particular SMEs, which are key industrial players in the sector, are properly represented.

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About GRTgaz

GRTgaz is Europe's second-largest gas carrier, with 32,500 km of pipes and 640 TWh of gas transported. The company has 3,000 employees and generated nearly €2.3 billion in turnover in 2020. The GRTgaz [core purpose is](#) : "Together, we enable an energy future that is safe, affordable and climate neutral". GRTgaz is an innovative company undergoing a major transformation to adapt its network to new ecological and digital challenges. It is committed to a 100% carbon-neutral French gas mix by 2050. It supports the hydrogen and renewable gas sectors (biomethane and gas from solid and liquid waste). GRTgaz carries out public service missions to guarantee the safety of gas transmission for its 945 customers (shippers,

distributors, industrial companies, biomethane plants and producers). With its subsidiaries [Elengy](#), the European leader in LNG terminal services, and [GRTgaz Deutschland](#), operator of the MEGAL transmission network in Germany, GRTgaz plays a key role in the European gas infrastructure scene. The company exports its know-how internationally, in particular services developed by its research centre, [RICE](#). Find us on <http://www.grtgaz.com/> and [Twitter](#).

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About HDF Energy

HDF Energy is a global pioneer in hydrogen energy. HDF Energy develops high-capacity Hydrogen-Power plants and is active, through dedicated project companies, in their operation. These plants will provide continuous or on-demand electricity from renewable energy sources (wind or solar), combined with high power fuel cells.

HDF Energy has integrated key fuel-cell know-how and has developed the world's first mass production plant for high-power fuel cells for energy, which will be commissioned in France (Bordeaux Metropole) in 2023. Through this activity, HDF Energy will also serve the maritime and data centre markets.

HDF Energy has positioned itself as a powerful accelerator of the energy transition by offering nonintermittent, grid-friendly and on-demand renewable power.

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About Soladvent

Soladvent is a pioneer in the development of large-scale green hydrogen production projects in Spain, France, and Luxembourg. The company was founded by a team of leading renewable energy entrepreneurs with the aim of supplying green hydrogen to energy, industry, and mobility customers at fossil fuel prices (€1.5/kg) by 2022. The company is currently developing projects with a capacity of 10 GW and is awaiting its first approvals (solar and electrolysis), which are expected in the summer of 2021.

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About Storengy

Storengy, an ENGIE subsidiary, is one of the world leaders in underground natural gas storage. Drawing on 60 years of experience, Storengy designs, develops and operates storage facilities and offers its customers innovative products. The company owns 21 natural gas storage sites with a total capacity of 12.2 bn m3 in France, Germany and the United Kingdom. Storengy is positioned today as a key player in the development of geothermal energy (heat/cold production and power generation), as well as in innovative production and storage solutions for low carbon energy (biomethane, hydrogen, etc.).

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About Teréga

A major actor of the energy world in Europe, Teréga has been established in South-West France for over 75 years. The company operates over 5,000 km of pipelines and two underground storage facilities, representing 16% of the French gas transport grid and 26% of national storage capacities. Meeting its public service obligations, Teréga ships natural gas to over 400 delivery stations, under optimal conditions of safety, cost and reliability. In 2020, the company generated revenues of €460 million and it has more than 660 employees.

Teréga enjoys a strategic position in Europe, where the company provides the interconnections which guarantee security of supply and with Spain in particular. Recognising that renewable gas has a vital role to

play in the energy transition, Teréga wishes to establish itself as an accelerator of this green revolution through increasing its involvement in the biomethane, hydrogen (including Power-to-Gas) and natural gas for vehicles sectors. For more information, visit www.terega.fr. You can also find Teréga on [Twitter](#) and [LinkedIn](#).

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About TotalEnergies

TotalEnergies is a global multi-energy company that produces and markets energies on a global scale: oil and biofuels, natural gas and green gases, renewables and electricity. Our 105,000 employees are committed to energy that is ever more affordable, cleaner, more reliable and accessible to as many people as possible. Active in more than 130 countries, TotalEnergies puts sustainable development in all its dimensions at the heart of its projects and operations to contribute to the well-being of people.

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About Elogen

Elogen, a technological expert at the service of green hydrogen, develops advanced technologies to design and produce PEM (Proton Exchange Membrane) electrolysers to meet new uses of hydrogen in mobility, industry and energy storage. Elogen, a GTT technology group company, relies on a powerful R&D and a robust manufacturing process to provide its customers with competitive, reliable systems tailored to their needs. The technological solutions developed by Elogen, particularly suited to renewable energies, demonstrate superior efficiency and competitiveness.

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