



## NOUVELLE-AQUITAINE



Strategic Steering and Sectors Department Green sectors unit

nouvelle-aquitaine.fr



# NOUVELLE-AQUITAINE



## OBJECTIVE OF THE HYDROGEN ROADMAP

The aim and ambition of the regional roadmap is to respond to the objective of structuring and developing a hydrogen industrial sector in Nouvelle-Aquitaine throughout its value chain, the supply of which is aimed at all uses of green and recovered hydrogen

## **NOUVELLE-AQUITAINE** hydrogen ROADMAP

## summary

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## INTRODUCTION

#### Challenges

The Nouvelle-Aquitaine region aims to define the possible paths that it could take to become a leading actor in hydrogen by 2030, particularly in terms of production, storage, distribution and uses of green hydrogen, in line with the various plans drawn up in consultation with all the regional actors:

- SRADDET (Regional Plan for Spatial Planning, Sustainable Development and Equality). This plan makes it possible to determine the region's major objectives, particularly in terms of reducing energy consumption, greenhouse gas emissions and the integration of renewable energies by 2021, 2026, 2030 and 2050, as set out in the Climate Air Energy section.
- PRFB (Regional Wood Forest Programme). This programme sets out the guidelines for forestry policy, and in particular the policy of making forest resources available for energy purposes until 2027. The Nouvelle-Aquitaine region benefits from numerous wooded areas, which is an asset in terms of green hydrogen production.
- SRDEII (Regional Scheme for Economic Development, Internationalisation and Innovation). This scheme operates within the framework of support for sectors and innovation in companies and territories.
- Néo Terra regional roadmap. This roadmap was approved on 9 July 2019 and identifies the hydrogen sector as a strategic regional sector, in the same way as the battery sector; these two sectors are not in competition but complement each other and both provide solutions contributing to the energy transition. In this context, the energy transition constitutes our society's adaptation to environmental challenges through the development of hydrogen (see Annexes 1 and 2).

#### Regional scope: presentation of the regional hydrogen sector

#### THE POTENTIAL OF THE REGIONAL HYDROGEN SECTOR IN NOUVELLE-AQUITAINE

- Around 20 companies offering solutions and traditional actors in Nouvelle-Aquitaine's hydrogen sectors, such as STELIA Aerospace Composites in transport (Bordeaux, high-pressure tanks), NEXEYA (Angoulême, stationary), PRAGMA INDUSTRIES (Biarritz, bicycle transport and fuel cells), CESAME-EXADEBIT SA (Poitiers) etc. and major national industrial groups, representing a total of around 200 added-value jobs.
- Start-ups, VSE-SMEs and new entrants, such as: Hydrogène de France (HDF) (Bordeaux), AV2M (La Rochelle, hydrogen-powered maritime shuttles planned), PANGEA SAS (Bergerac, start-up, project for the design and production of ethanol and hydrogen fuel cells), GENEVOS (OCEAN LAB project, La Rochelle, small innovative boat equipped with PV panels, hydrogen fuel cell and hydrogen storage), etc.
- 6 laboratories that put forward a hydrogen and fuel cell strategy, and have progressively reinforced their visibility:



- Institute of Condensed Matter Chemistry of Bordeaux (ICMCB) in Bordeaux: 200 people, including teams dedicated to fuel cells (especially depleted silicon-based) and hydrogen, with regular discussions with the Limoges Ceramics Research Institute (IRCER)
- Institut P' in Poitiers: mechanics and physics of materials, applied to the fuel cell and hydrogen; joint projects with the French Alternative Energies and Atomic Energy Commission (CEA) Le Ripault on hyperbaric hydrogen storage
- Poitiers Institute of Environmental and Materials Chemistry (IC2MP) in Poitiers: pure hydrogen electrochemical production for energy and chemistry and catalysis
- Institute for Ceramic Research (IRCER) in Limoges: joint laboratory with the AIR LIQUIDE Group, joint patent applications (high-pressure tanks, technology for reforming methane into hydrogen)
- University of Pau
- University of La Rochelle
- actors in technological research, such as the CEA (CESTA laboratory), and technology transfer, including CEA-Tech
- around ten territories aiming to integrate hydrogen solutions into their development projects and strategy (La Rochelle, Les Landes d'Armagnac, Pau, Angoulême, Limoges, Bergerac, la Corrèze, Val de Garonne, to name a few)
- two major port projects (Grand Port de Bordeaux, La Rochelle) and a potential port equipment project in Bayonne.

#### PROJECTS AND PARTNERSHIPS ALREADY UNDERTAKEN BY THE NOUVELLE-AQUITAINE REGION

With regard to its own uses, the region's objective is to make the transport fleets it manages greener by 2030, primarily regional buses, the regional express transport (TER), connecting vehicles, port equipment (Port de Bayonne management), for which the modes of production and storage of energy using hydrogen are being studied, firstly by way of experimentation.

In addition, the region already supports corporate and regional authority initiatives in demonstrators and tests of transport and mobility solutions (land and maritime) and stationary applications. The Region also supports development projects for new technologies. The different networks in which the region is involved anticipate an increase in the number of projects over the years to come: AFHYPAC, on a national scale, and the FCH-JU (Fuel Cells and Hydrogen Joint Undertaking – a public-private partnership that supports research and development in the field of fuel cells and hydrogen) for European regions, with a view to creating a real global market for hydrogen in which Europe and its regions should play a major role.

Producing green hydrogen is a priority with a view to meeting the Néo Terra objectives: in fact, green hydrogen currently represents only a very small part (around 5%) of the total hydrogen used. This priority must be reasserted through, firstly, an increase in support for tests and current demonstrations, then making it accessible, especially for adding value to rural and forest zones, when the market conditions will become more favourable and make public support less necessary.



#### Methodology

The initial phase of defining the hydrogen roadmap has been established based on:

- the shared definition of the regional strategy for industrial, academic and regional tests of hydrogen to be recommended and promoted, then its collective implementation as part of the regional operational organisation
- the governance and organisation to be put in place to manage, organise and evaluate this strategy

Due to the relative "youth" of the hydrogen sector, which is considered to be emerging, and the persistently low number of regional actors as a result, the development of the roadmap was a piece of collaborative creative work that called on a specialist methodology consultant in a collaborative seminar, with a goal to:

- proposing a methodology for leading this project as part of a collaborative creativity seminar
- ensuring the preparation of collaboration time and organising the collaborative creativity seminar

To do this, this region invited a representative panel of around 20 regional actors in the sector, such as experts and professionals in the energy sector, particularly hydrogen. They participated in different stages of co-creating the strategic roadmap.

Furthermore, this work was fuelled by reflections from participants in the Etapes De l'Innovation (EDI - Steps to Innovation) event on hydrogen event held in Angoulême on 18 February 2020. It brought together 150 people, representing almost 40% of companies with a view to expanding to future users.

#### What is hydrogen?

Hydrogen is a gas that is 94% derived from fossil resources – oil, natural gas and coal. This is what is known as "grey" hydrogen. The three main industrial markets are the desulphurisation of petroleum fuels, ammonia synthesis (mainly for the production of fertilisers), and chemicals.

So-called "green" or "low-carbon" hydrogen, produced not from fossil fuels but by an electrolysis process using renewable energy sources, enables a real reduction in greenhouse gas emissions and fossil fuel consumption. Green hydrogen is produced either by electrolysis of water, which is directly connected to a renewable source of electrical energy such as wind or solar power, or by extracting it from methane by fermenting green waste.

Low-carbon hydrogen has a number of uses in France. With regard to transport, hydrogen provides clean and complementary solutions for electric transport and also makes it possible to develop clean transportation, which is one of the objectives of the energy transition.

In industry, hydrogen is consumed in large quantities, particularly by the chemical and refinery industries. The production of clean hydrogen is therefore a genuine alternative to hydrogen production that emits large amounts of greenhouse gases. With respect to energy, hydrogen offers a promising method for storing excess renewable electricity thanks to a process called "power to gas". Hydrogen is produced through a process of converting renewable electricity (wind or solar) and is then injected into gas networks to be stored or applied to other uses.

(source: https://www.nortonrosefulbright.com/en/knowledge/publications/c4693578/lhydrogene-enfranceetat-des-lieux-et-perspectives)



#### The hydrogen sector

Hydrogen is an energy vector that has the capacity to contribute to the rolling out of renewable energies by converting and storing renewable electricity, through the distribution of this electricity on a national and international scale and the creation of energy reserves.

#### THE HYDROGEN VALUE CHAIN

During the last HyVolution professional trade fair dedicated to hydrogen (February 2020, Paris), the AFHYPAC presented the hydrogen value chain:

- hydrogen production facilities (hydrocarbon, biomass, electrolyser, co-product hydrogen recovery)
- storage (gaseous, liquid)
- transport
- station operation (hydrogen supply, compression, storage, safety)
- fuel cells for light mobility or stationary usage

#### THE HYDROGEN MARKET

#### The national market

The hydrogen market is expected to see strong growth over the coming years: according to AFHYPAC's prospective study "Développons l'hydrogène pour l'économie française" ("Developing hydrogen for the French economy"), it can be seen that "by 2050, hydrogen could meet 20% of the total energy demand and could reduce annual CO<sub>2</sub> emissions by 55 million tonnes, which is the equivalent of achieving a one-third additional reduction of CO<sub>2</sub> to bridge the gap, on a national scale, between objectives in the Climate Plan and the current reference scenario. Hydrogen and fuel cells would also enable the creation of an industry in its own right that, in 2030, would represent turnover of around €8.5 billion, more than 40,000 jobs and would offset the potential loss of jobs that is currently threatening the automotive industry. In 2050, this could reach €40 billion and more than 150,000 employees."

This evolution in the hydrogen market could also represent an opportunity to develop the industrial sector that will produce the equipment, products and services needed to develop the market.

More than 900,000 tonnes of hydrogen are produced every year in France to cover the needs of French industry, primarily oil and chemicals, but this results in around 9 million tonnes of  $CO_2$  per year.

On the other hand, the French hydrogen sector has export potential that could reach  $\in 6.5$  billion by 2030 and  $\in 15$  billion by 2050.

#### The international market

The prospective study published by Bloomberg in March 2020 established that depending on the strength of public support, by 2050 hydrogen could represent between 7% and 24% of global energy needs, with the distribution of uses as follows:

transport: 33%

energy: 28%



#### THE MAIN NATIONAL ACTORS IN THE HYDROGEN SECTOR

#### The national networks for hydrogen research

#### The CEA (French Alternative Energies and Atomic Energy Commission)

The CEA developed national hydrogen competencies based, in particular, on its centres in Grenoble and Ripault and at regional level, it has the CESTA laboratories and the regional platform for technology transfer at CEA Tech, established in Gironde.

#### The CNRS (the French National Centre for Scientific Research)

The CNRS is currently establishing a national network of hydrogen laboratories. The main CNRS laboratories in the region involved in this network are the ICMCB in Bordeaux, IC2MP and P' in Poitiers and IRCER in Limoges.

#### **Professional networks**

The region joined the **AFHYPAC (French Association for Hydrogen and Fuel Cells)** in 2016. The services and the Nouvelle-Aquitaine Innovation and Development Agency (ADI-NA) are involved in the territorial working group and, more recently, in the regional working group (launched at the end of 2019). On 2 July last year, in the Nouvelle-Aquitaine region auditorium, AFHYPAC organised an event on the hydrogen energy storage sector, which brought together more than 100 people with French representatives of Hydrogen Europe (Michelin, Renault, Peugeot and their subsidiaries, etc.).

In Nouvelle-Aquitaine, the professional network of actors in hydrogen is led by the energy and storage cluster.

#### State support

#### The National Hydrogen Plan 2018

Launched in 2018, the National Hydrogen Plan already had ambitious objectives:

- I to 10 power-to-gas demonstrators in 2023 and 10 to 100 demonstrators in 2028
- to increase the share of decarbonated hydrogen in industrial hydrogen to 10% by 2023 and between 20% and 40% by 2028
- with regard to transport, to reach 5,000 light vehicles and 200 heavy vehicles fuelled by 100 local production stations in 2023 and 20,000 to 50,000 light vehicles and 800 to 2,000 heavy vehicles and 400 to 1,000 stations by 2028.

These goals have been integrated into the Multi-Year Energy Programme (PPE) in addition to calls for projects by ADEME (French Environment and Energy Mastery Agency) – annexe 2.

Furthermore, the French Energy Code (Code de l'énergie français) set the share that renewable gas should represent in global gas consumption by 2030 at 10%, an objective that some French public service companies are considering increasing to 30% for 2030 and 100% by 2050. In 2050, hydrogen (whether pure or as converted methane) could also represent almost a third of the gas mix and around 12% of the energy demand for buildings. The energy and climate law of 8 November 2019 defines an objective of developing low-carbon and renewable hydrogen and its industrial, energy and transport uses.



#### The national strategy for the development of decarbonated hydrogen in France 2020

On 9 September 2020, the French Government launched its national strategy for the development of decarbonated hydrogen. This strategy, calculated at €7 billion, is planned to work on 3 priorities:

- Ist priority: decarbonating the industry by developing a French electrolysis sector, with a target of 6.5 GW of electrolysers installed by 2030, and gradually replacing carbonated hydrogen in industry
- 2<sup>nd</sup> priority: developing heavy transport using decarbonated hydrogen, hydrogen offering storage capacity alongside batteries, by developing territorial projects to pool uses
- 3rd priority: supporting research and development and innovation, as well as the development of specific competencies

This plan follows on from Germany's hydrogen plan, which was presented in spring 2020 and valued at €9 billion.

#### **Regional support**

Several regions in France have outlined a strategy or a roadmap to promote and develop hydrogen in their territory:

- If or more than 10 years, the Occitania region, a pioneer in the field, has been involved in supporting the emergence and structuring of a regional sector and launched its Plan Hydrogène Vert (Green Hydrogen Plan), funded with €150 million, of which €50 million will come from Europe, for the 2019-2030 period. This plan outlines the construction of a hydrogen production factory and 20 green hydrogen production and distribution stations, as well as the acquisition of 600 vehicles, both heavy and light, and investment in TER carriages
- In the Auvergne-Rhône Alpes region took part in creating an SAS company dedicated to hydrogen, named Hympulsion, with up to 33% of capital with Caisse des Dépôts and Crédit Agricole and support from ADEME and Europe (subsidy of €10.1 million) for a global budget of €50 million. The aim of this special purpose vehicle is to establish and utilise 20 hydrogen stations that are 100% renewable and 1,000 vehicles as part of the ZEV project (Zéro Emission Valley)
- the Bourgogne-Franche-Comté region, another pioneer in hydrogen, is especially invested in a plan for training new professions as part of this industry
- the Pays de Loire region encouraged the establishment of port light transport projects (shuttle in Nantes) and local production units (Vendée, Loire-Atlantique)
- the Normandy region supported local light land transport projects (Kangoo for Saint-Lô firefighters) and also works in the maritime industry (hydrogen-powered trawlers)
- the Grand Est region is considering testing deep hydrogen storage by reusing decommissioned mines and quarries
- the Hauts de France region was the 1<sup>st</sup> region in France to support hydrogen heating and electric supply projects for a district (around 100 homes in Dunkirk)
- ♦ the PACA region has allocated €5 million to structure and develop the hydrogen sector in the area ("Jupiter 1,000" power-to-gas demonstrator, maritime sector with the Grand Port de Marseille that aims to add value to 7,000 tonnes of recovered hydrogen in the Fos-sur-Mer zone, 1,500 ha solar park in Manosque to produce green hydrogen and fuel 1,400 buses, etc.).
- In July, the Brittany region approved its roadmap that is primarily dedicated to maritime and port projects, including, in particular, support for the naval construction sector, targeting small and medium-sized boats for fishing, coastal navigation and



tourism (ferries linking islands, etc.)

• overseas territories and departments are testing electric supply solutions for isolated areas using hydrogen storage coupled with photovoltaic or wind production (Guiana, Réunion).

#### Support from Europe

The Nouvelle-Aquitaine region is planning to invest heavily on a European scale, in networks and partnerships focusing on hydrogen, on one hand, and in applying for the various tools of European funding, both current and planned for the future, on the other hand.

#### European networks and partnerships focusing on hydrogen

#### The FCH-JU network

This network, which responds to a joint technological hydrogen undertaking (FCH Joint Undertaking), published its hydrogen in Europe roadmap, "A sustainable pathway for the European energy transition", in February 2019.

The region joined this network of regions and territories specialised in hydrogen in April 2019 and, on an operational level, collaborates with the agency for development and innovation (ADI) by participating in several working groups as part of the S3 Hydrogen Valleys specialisation partnerships, including transport and maritime-port.

According to the FCH-JU study entitled "Hydrogen roadmap Europe: a sustainable pathway for the European energy transition" published on 6 February 2019, electricity is an essential element in the energy transition and could represent 24% of the overall energy demand and 5.4 million jobs by 2050. This study, developed with the participation of 17 leading European actors in industry, outlines the large-scale hydrogen and fuel cell roll-out by 2050 and measures the associated socio-economic impacts. It shows that hydrogen is essential to meet upcoming challenges. To accelerate the large-scale energy transition of key segments, such as gas networks and transport (especially in the case of heavy utility vehicles), industrial processes using high-quality heat and hydrogen as the chemical raw material require large quantities of hydrogen use. In addition, the electrification of the economy and the large-scale energy storage, enabling seasonal storage and effective transport of clean, low-cost energy. According to the study, hydrogen is very capable of responding to all of these challenges.

Furthermore, the study highlights that this roll-out will provide considerable socioeconomic and environmental advantages, including a  $\in$ 820-billion market per year and a total CO<sub>2</sub> reduction of 560 million tonnes.

https://fch.europa.eu/sites/default/files/Hydrogen%20Roadmap%20Europe\_Report.pdf

#### The Hydrogen Valleys Partnership

The key challenges of this partnership are: helping to make the European economy greener through the large-scale production of green hydrogen, strengthening hydrogen and fuel cell value chains, overcoming the lack of expertise and resources in this area and, lastly, promoting the creation of a funding model and European regulation.

Of the five major topics proposed (hydrogen production; hydrogen transport, storage and conversion; hydrogen for transport; hydrogen for industrial use and heating; hydrogen valleys and islands), the regions have clearly expressed much more interest in transport in their responses to the questionnaire. The production of



green hydrogen followed in second place.

Examples of projects:

- Public collective market for coaches
- Research and test project comprising several regional partners with, for example, one of the regions agreeing to be the demonstration site
- Carrying out a study (example of a study with local actors, given by Normandy)
- Creation of a hydrogen corridor with recharging stations along a set route

Hydrogen buses and coaches have attracted the interest of almost all regions that responded to the questionnaire. IT should be noted that the responding regions are also those that have, for the most part, already launched transport and hydrogen production projects.

#### European Clean Hydrogen Alliance

As part of the European industrial strategy launched at the start of 2020, the European Commission announced the creation of this alliance, which will make it possible to bring together public authorities and industrial actors as a precursor to an important new project of common interest (IPCEI) dedicated to the hydrogen value chain.

#### Europe's financial support tools

#### The European Regional Development Fund (ERDF)

This European funding tool, which is managed by the regions, can be used to fund projects that are identified and supported as part of the roadmap.

#### Interregional INTERREG Europe programmes

In this area, the region has already been called on as a non-executive partner on a project introduced by the Spanish region of Aragon (which created a hydrogen cluster) and involving the Pau chamber of commerce and industry (CCI), as well as Portuguese partners. This is because the Spanish leader of the project left, meaning that it was unable to get started. Nevertheless, the connections exist and the option to relaunch this partnership could be entered into the roadmap.

#### Dedicated funds and European calls for projects

Horizon 2020 call for projects, special "Green Deal": with a declared budget of €1 billion, its approach is slightly different to that of traditional Horizon tenders. The objective has greater focus on supporting specific projects that produce rapid results "pilot applications and demonstrator projects, innovative products, tests and approaches that make it possible to ensure added value"

Two areas of work should be prioritised in the regional roadmap: green hydrogen and "green ports".

Annexe 3 presents the calls for proposals that concern transport and infrastructure.





## NOUVELLE-AQUITAINE'S REGIONAL STRATEGY FOR HYDROGEN

#### **Regional vision and ambitions**

The regional roadmap for hydrogen aims to encourage and develop an innovative industrial sector that makes possible Nouvelle-Aquitaine's vision for a zero-carbonemission society meeting the SRADDET objectives, as confirmed in the Néo Terra roadmap.

NOUVELLE-AQUITAINE

#### Challenges at regional level

As a reminder, the Nouvelle-Aquitaine region's medium-term climate-air-energy objectives (2030) are as follows:

- 1. Reducing energy consumption by 30% (energy efficiency of industrial processes, energy-related restructuring of buildings, etc.)
- 2. Reducing greenhouse gas emissions by 45% to combat climate change (especially by replacing fossil fuels) to achieve carbon neutrality by 2050
- 3. Intensifying the development of renewable energies by diversifying them so that 21.4% (2018) to 32% of the region's total energy consumption will come from renewable energies. This is an estimated target of 57 million MWh per year, taking into account the reduction in target energy consumption.

Looking more specifically at "green" (renewable) gases, including hydrogen, the SRADDET objectives encourage regional authorities to prioritise in their urban planning documents the establishment of energy storage solutions, whether on a scale of one building, a group of buildings, a district or a wider urban group, in addition to high-performing management of the energy loop (production, load management, storage, distribution, etc.) using digital tools, and to enable coupling renewable energy production units with electric, biogas and hydrogen mobility stations for individual vehicles and fleets in relation to geographic proximity.

Hydrogen is a vital part of the regional energy mix, especially with regard to biogas, as these two energy vectors are the object of strong public support, particularly in the region, as in the call for expressions of interest (CEI) for "innovative production of "green gases", "advanced" biofuels, using renewable resources".

(https://les-aides.nouvelle-aquitaine.fr/sites/default/files/2018-08/Re%CC%80glement-VF-AMI-SElproductioninnovante-gaz-verts-biocarburants-2G.pdf)

To this end, the region is aiming in particular to develop the hydrogen storage and production sectors, notably in light of hydrogen transport and the storage of excess electricity in gas networks on the principle of power-to-gas (energy transfer from electricity to gas): production, then methanisation of hydrogen with the value creation



of CO and  $CO_2$ , which also makes it possible to combat greenhouse gas emissions, which are responsible for climate change.

The challenges of developing the hydrogen sector in Nouvelle-Aquitaine are based on:

#### STRUCTURING ACTORS IN THE SECTOR

The hydrogen sector is emerging. Academic actors, regions and companies are already involved in developing technologies and projects. The energy and storage cluster brings these actors together by improving synergies between them, and by facilitating exchanges of information. The objective is to create an ecosystem of innovation and growth in the sector by supporting actors collectively and individually. It is a matter of working in parallel with project development to contribute to a form of industrial sovereignty.

#### THE DEVELOPMENT OF HYDROGEN CULTURE AND ITS POTENTIAL (APPLICATION, DEVELOPMENT)

Actors involved in hydrogen are still a relatively small community and, although the subject is interesting more and more people, it remains little known. The challenge is for the decision-makers and potential users to create and develop a real culture, as the opportunities that are opening up are vast. Therefore, there is a need to spread information and raise awareness beyond the sector to encourage the use of hydrogen. The general public's view of hydrogen is linked to safety issues. This cultural integration will also promote the assimilation and acceptability of projects, which is an essential condition for their success.

FOR this reason, the region launched a call for expressions of interest for the 2018-2021 period on the innovative production of "green" gases and "advanced" biofuels using renewable resources, targeting in particular the production of renewable hydrogen, known as "biohydrogen".

### MAKING HYDROGEN ACCESSIBLE AND COMPETITIVE (ECONOMIC MODEL OF THE SECTOR)

To make the sector economically viable and attractive, to unite and complete the industrial offer and achieve a sufficient scale, leading to a broadened market base to lower costs, to produce hydrogen and then store or export it. Cost reductions will naturally follow from making accessible hydrogen production and uses. However, there are also research and development challenges concerning output, materials and recycling.

The competitiveness of hydrogen will become one of the key factors of success in the energy transition. All transport sectors are now positioning themselves to use hydrogen to replace methods of propulsion using fossil energy. This is also the case for aviation, sailing and shipping and, of course, all methods of land transport.

Making hydrogen accessible involves not only economic conditions, but also the public making use of these technologies. This is a prerequisite before even examining the acceptability of projects. The current stages of development for all initial experimental projects should be integrated into these appropriation challenges in order to acclimatise the populations who will be living with these technologies as soon as possible.





#### DEVELOPING THE HYDROGEN VALUE CHAIN TO ENCOURAGE ACCELERATED DEVELOPMENT

The regional sector is part of a national and European context, which is looking to restore industrial sovereignty: to reintegrate into the region the research and development sector for materials, compounds, processes and the accelerated development of the hydrogen region, to roll out regional projects and industrial offers, to develop local ecosystems and ethical port hubs.

All actors need to swing into action in order to build up this industrial sector. First of all, the research laboratories must raise the technological barriers around the energy output of systems, and materials for these technologies that are still too often in short supply; in addition, costs must be reduced in order to meet the markets and equipment must be recycled.

#### Main issue

The regional hydrogen roadmap responds to the following issue:

Can hydrogen be a pillar of the energy, environmental and economic transition for the Nouvelle-Aquitaine region? If yes, how?

#### **Diagnosis**, findings

Studies from the collaborative creativity seminar made it possible to identify, in a collective manner, the primary findings that impact the regional hydrogen sector:

#### MAP OF HYDROGEN ACTORS AND TERRITORIES

Several committed actors (companies, territories, laboratories) are already involved in the regional sector, although this is still not enough.

These various actors are strengthened by an emerging political will at regional level and a certain number of elected officials in the territories and supported by two members of parliament from Nouvelle-Aquitaine at national level.

About ten territories are involved, three of which are certified at national level by the ADEME (La Rochelle, Pau, Les Landes d'Armagnac). In spite of all this, the hydrogen vector is still little known among decision-makers who thus show a certain level of "faint-heartedness", even caution, in their choices.

The projects are linked to geographic position, especially at trade ports on the Atlantic and near to structuring industrial fabric. Up to this point, the Nouvelle-Aquitaine region has appeared as more of a client than a supplier.



#### THE ECONOMY OF THE SECTOR

The regional sector is not yet financially independent, given that hydrogen has not yet achieved a level of profitability, which is expected from 2022-2025. One of the desirable objectives to support and drive forward the development of the sector is to be able to bring the costs of green hydrogen close to those in the fossil fuel market.

#### ASSESSMENT OF THE CURRENT REGIONAL SECTOR

There is still little awareness of production sites and hydrogen consumption sites at regional level. This is primarily due to a lack of knowledge and culture on the subject of hydrogen.

Many sites propose tests and want to establish demonstrators, but the industrialisation and market-broadening stages have still not been fully set in motion.

Vehicles are starting to appear, primarily for collective and industrial use (buses in Pau, bikes by the company Pragma Industries, forklift trucks, etc.), but the sector continues to be scattered.

#### THE POTENTIAL OF THE SECTOR

The transition to hydrogen transport involves a number of vehicles and potentially significant and recurring volumes of hydrogen. Therefore, a hydrogen industrial sector could replace the fossil fuel sector.

Several local ecosystems are conducive to innovation and can help to transform potential uses for a sector that is still in development.

#### The objective of the roadmap

The objective of the regional roadmap is to structure and develop an industrial hydrogen section across its entire value chain in Nouvelle-Aquitaine, the supply of which is aimed at all uses for green and recovered hydrogen.







## Strategic areas of development for the hydrogen sector in Nouvelle-Aquitaine



These areas of progress should make it possible to answer the following questions:

- How does hydrogen contribute to helping develop a territory with a medium-term zero-carbon objective?
- How can we develop a sector of excellence based on the development of new technologies and GreenTech industries for the benefit of hydrogen?
- How can we develop new applications, uses and new markets?





## ACTION PLAN OF THE NOUVELLE-AQUITAINE HYDROGEN ROADMAP

One priority action can respond to several strategic areas of progress.

ACTION PLANS	STRATEGIC AREAS OF PROGRESS			
	Energy transition	Zero-carbon territory	<b>GreenTech</b> <b>R&amp;D</b> innovation	<b>Transport</b> new uses
<ol> <li>Bringing together in the territories the market conditions for developing hydrogen sectors</li> </ol>	<b>~</b>	<b>\$</b> }		\$
2 Leading the sector to encourage the emergence of, and support for, hydrogen projects				a star
3 Use by citizens and citizen involvement				
4 Developing R&D, training and innovation				
5 Developing the hydrogen economic sector in the regional area by supporting viable industrial offers	4	4		
6 Developing local hydrogen hubs and ecosystems	<b>~</b>			
7 Developing uses (mobility, injection into gas networks, transport, energy ecosystems)				
8 Developing green, bio-sourced, local production to contribute to the energy independence of Nouvelle-Aquitaine				3.2 2,2





#### **DESCRIPTION OF 7 ACTION PLANS**

#### ACTION PLAN 1

#### BRINGING TOGETHER THE MARKET CONDITIONS IN THE TERRITORIES TO DEVELOP THE HYDROGEN SECTORS

#### 1/ Description

Hydrogen is an alternative energy solution for which market conditions are not yet totally in place in terms of its production, distribution, equipment and vehicles to enable rapid roll-out and broadening the market base of uses:

- the price of the H<sub>2</sub> molecule falls regularly but remains high compared to that of fossil fuels, which is the case for the green hydrogen molecule in particular
- Purchasing vehicles is a considerable additional cost compared to traditionally powered vehicles (from 1.5 to 3 times higher depending on the models and uses); this is primarily due to the still lower number of industrial offers (for example, for household wheelie bins) and the increase in sales of electric battery vehicles for both individuals and professional fleets.

First and foremost, the action of public authorities must aim to reduce these additional costs to allow an increase in the number of vehicles ordered, which will have a beneficial effect on the volumes consumed and thus will gradually lead to an alignment with the price of fossil fuels.

One of the objectives to prioritise in this action plan is support for funding production and distribution infrastructure.

#### 2/ Indicators

- Number of charging stations
- Number of vehicle fleets
- Number of individual vehicles
- Cost of hydrogen produced
- 3/ Identified partners
- The ADEME, by aiming for synergy between the provisions of this agency and those of the region by combining their calls for projects and calls for expressions of interest (CEI) with our regional tools
- Caisse des Dépôts
- Banque des territoires
- AFHYPAC

#### 4/ Actions already undertaken in this area

- Regional funding for the acquisition of vehicles (e.g. buses in Pau) by financing the extra cost
- Regional CEI for "innovative production of "green gases", "advanced" biofuels, using renewable resources"

#### 5/ Action to be launched

The launch of a regional call for projects dedicated to hydrogen that will be presented to the Permanent Commission on 16 October 2020.

In addition to the European (especially the FCH-JU public-private partnership) and national (ADEME) funding mechanisms, the Nouvelle-Aquitaine region wants to launch a new call for projects dedicated to the subject of hydrogen, which will be based on the regional sectors and assets to which hydrogen can bring real added value. This is why this call for projects emphasises:

#### Region-wide infrastructure for producing and supplying green hydrogen

The establishment of large road, rail and port axes should make it possible to arrange the network of green and low-carbon hydrogen production and distribution infrastructure in line with a coherent regional network.

#### Maritime uses and ecosystems

With a large coastline and a well developed and dynamic maritime industry in Nouvelle-Aquitaine, especially with its four ports for goods transport, hydrogen can be a vector for making maritime transport and the maritime ecosystem more environmentally friendly.

### Uses in heavy transport (coaches, buses, heavy goods vehicles, refuse collection vehicles)

The roll-out of the hydrogen mobility solution can be supported by the significant regional road axes and, in particular, traffic for goods transport between Northern Europe and Spain, as well as regional industrial pillars that provide equipment (Heuliez Bus, Semat, etc.).

More generally, this call for projects seeks to simplify both the establishment of the first production and distribution units for hydrogen on a regional scale and all of the uses (clean transport, making greener the gas networks, storage and production for preproduced electricity or in isolated sites, making industrial uses more environmentally friendly, etc.).





#### ACTION PLAN 2 LEADING THE SECTOR TO ENCOURAGE AND SUPPORT HYDROGEN PROJECTS

#### 1/ Description

The hydrogen industry is organised by the energy and storage cluster, which is in turn led by the ADI-NA. Alongside this cluster, the Avénia competitiveness hub aims to work on its subsoil speciality.

All of the actors in the sectors are regularly and actively involved, with the aim of creating the spirit of a "hydrogen community"; two workshops specifically dedicated to hydrogen were held in 2018 and 2019 and brought together more than 1,660 participants from the regional sector. In the same spirit, the innovation stages in Angoulême were dedicated to hydrogen in February 2020.

This organisation programme will be led by the region, the ADI-NA and actors in the sector as part of the energy and storage cluster.

#### 2/ Indicators

- Number of actors per category participating in the energy and storage cluster studies: companies, laboratories, territories, ports, electrification unions, financiers, agencies and organisations
- Number of meetings, workshops and events, number of participants
- Number of projects in the study and development phase
- Number of projects completed
- Size of projects by volume of hydrogen, number of vehicles, jobs created, qualification of jobs
- 3/ Identified partners
- Energy and storage cluster
- 💠 ADI-NA
- S2E2, AVENIA competitiveness clusters
- 4/ Actions already undertaken in this area
- List of actors
- Annual hydrogen workshops as part of the energy and storage cluster
- Stages of innovation
- 5/ Actions to be launched
- Creating the H<sub>2</sub> Nouvelle-Aquitaine regional brand
- Organising national days for "hydrogen in the territories" with AFHYPAC from 2022.
- Consolidating and developing actions for organising the sector
- Mapping the sector

#### ACTION PLAN 3 USE BY CITIZENS AND CITIZEN INVOLVEMENT

#### 1/ Description

In order to structure the regional tools and involve citizens, this action aims to raise awareness, inform and involve citizens in their projects, offers support in organising local events and launching studies of usage by users and the population.

Determining the acceptability of projects by users and citizens: studies on impact and acceptability led by specialist consultants.

The success of sector and project development is determined by two essential stages: appropriation, then acceptance. The appropriation of hydrogen technologies and uses is to be encouraged in the territories even before the appropriation of projects. This stage requires mobilising the largest number of actors who will be affected by the new uses linked to hydrogen.

#### 2/ Indicators

- Number of territories involved
- Number of participants per action
- Number of participative funding operations for projects ("crowdfunding")
- 3/ Identified partners
- Territories
- User associations
- 4/ Actions already undertaken in this area
- Positive energy areas (TEPOS) in Nouvelle-Aquitaine
- Regional CEI for "innovative production of "green gases", "advanced" biofuels, using renewable resources"
- 5/ Actions to be launched
- Organising workshops and topical meetings in the territories in order to encourage appropriation by future users
- Encouraging the use of participative funding
- Sociological studies on the acceptability of projects will be proposed.





#### ACTION PLAN 4 DEVELOPING R&D, TRAINING AND INNOVATION

#### 1/ Description

Innovation is an important challenge that involves companies, laboratories, territories and ports.

**R&D and innovation:** supporting studies by existing teams in national (CNRS, CEA) and European networks for Nouvelle-Aquitaine's laboratories at ICMCB Bordeaux, the P' and IC2MP Poitiers Institutes, IRCER Limoges, the University of Pau and the University of La Rochelle, CEA and CEA Tech with **regional, national and European funding**.

**Training:** developing a training offer to meet the challenges of the hydrogen value chain (maintenance roles, etc.), which will be run by universities, university institutes of technology, secondary schools, training centres (GRETA, AFPA, etc.), with funding from the region, the national government and joint bodies.

Collaborative programmes will be established with universities and laboratories, clusters and competitiveness hubs, CNRS, CEA and CEA Tech and will be supported by departments from the region, ADI-NA, ADEME and Europe.

One of the research and development challenges for this sector is very directly concerned with the aspects of materials, processes, energy outputs and the recycling of equipment.

Digital technology is a vital link in the upcoming success of projects through the steering of energy networks and energy systems.

#### 2/ Indicators

- Regional indicators for supporting sectors
- Impact on the volumes of water used; particular attention shall be paid to water resources, which are limited and cannot be substituted.

Furthermore, the regional observatory for research now being designed and prepared will be able to provide additional information and point out the indicators for the hydrogen sector.

#### 3/ Identified partners

- The laboratories at ICMCB, IRCER, the P' and IC2MP Institutes, Universities of Pau and La Rochelle, CEA and CEA Tech.
- Actors in the chemical-materials sector, listed by the regional Chemical-Materials roadmap and those in renewable energies, led by the energy and storage cluster, will come into action.
- The regional observatory for research will be called on to provide statistics so as to give information on the indicators in this area.
- The VIA INNO monitoring platform, as part of its new agreement with the region, can provide clarification on the composition and follow-up of the roadmap.

#### 4/ Actions already undertaken in this area

- Regional support for research is currently given through doctoral grants, allocated to manufacturers and universities (more basic level) or by university-manufacturer joint programmes and by support as part of the call for research projects responding to support and certification requests by competitiveness clusters in Nouvelle-Aquitaine, such as the AVENIA and S2E2 clusters or technology transfer centres.
- The regional call for projects entitled "technological innovations for the energy transition" can be used to support projects.
- The ERDF is taking action as part of European joint funding.
- 5/ Actions to be launched
- The launching of a regional call for projects focused on the hydrogen sector, taking into account environmental restrictions and, in particular, the impact on the volumes of water used in electrolysers.
- European joint funding for projects through an ERDF measure that is standardised across all three former regions (joint inquiry responding to shared criteria).
- A Mobilisation of the VIA INNO monitoring platform, as a support to follow up and manage the roadmap, which can be formalised as part of the agreement with the region.
- Support for the organisation of a global scientific congress in Nouvelle-Aquitaine bringing together researchers specialising in hydrogen.

#### ACTION PLAN 5 DEVELOPING THE HYDROGEN ECONOMY IN THE REGION BY SUPPORTING VIABLE INDUSTRIAL SUPPLIES

#### 1/ Description

The development of the regional economic sector is based on two pillars:

- the referencing, mobilisation and support of companies offering solutions: start-ups, VSE-SMEs and ETIs at regional level
- support and backing for existing industrial actors in their development stage and start-ups in their early stages.

Actions in combination with, initiated and supported by the region and ADI-NA, with funding from territories, the State (Banque des Territoires), ADEME and the region will be carried out with actors in the sector and territories. The final objective is to achieve a territorial network across the entire region.

For example, the transformation of petrol stations into multi-energy stations, as part of tests should be mentioned.

#### 2/ Indicators

- Number of existing industrial companies
- Number of start-up projects, number of start-ups created
- Number of jobs in the sector
- 3/ Identified partners
- Energy and storage cluster
- 💠 ADI-NA
- Region
- ADEME
- Europe
- Industrial actors in hydrogen production and energy distribution

#### 4/ Actions already undertaken in this area

Regional support can be mobilised to support projects by existing companies and start-ups, in line with the type of company.

For issues related to funding at the top of the assessment, the Nouvelle-Aquitaine Co-Investissement (NACO) and the Nouvelle-Aquitaine Capital Investissement (NACI) regional funds can be called on.

The Terra Energies fund will be used to finance projects.

#### 5/ Actions to be launched

- The organisation of the working groups and workshops will be arranged to bring together companies on the themes of "sectors" as part of the energy and storage clusters.
- The creation and regular updating of the existing infrastructure map will make it possible to identify the needs in this area.



#### ACTION PLAN 6 DEVELOPING LOCAL HYDROGEN HUBS AND ECOSYSTEMS

#### 1/ Description

Several territories have already asked the region to study the opportunities and feasibility conditions of local hydrogen ecosystems, with a view to responding to the objectives of economic development in the context of the energy and environmental transition. This support and backing from the Region, ADI-NA, ADEME and Europe could be offered to other areas of testing.

Of these areas, several already benefit from target markets in hydrogen industrial production to add value to land or port uses.

A subgroup for maritime and port hubs and ecosystems will be created to identify and support these projects, which differ from land-based ecosystems.

#### 2/ Indicators

- Number of projects in territories
- Number of ecosystems organised
- Number of territories certified by ADEME
- Number of maritime and port projects
- Investment in hydrogen volumes
- Added value hydrogen volumes
- 3/ Identified partners
- The region
- 💠 ADI-NA
- The state (Banque des Territoires)
- ADEME
- 🌣 Europe
- 💠 Urban areas
- Local authorities
- Certified territories
- Testing areas
- Commercial ports represented by the Regional Conference of Ports

#### 4/ Actions already undertaken in this area

Territorial contracts

#### 5/ Actions to be launched

- Identifying and mapping the needs of territories and ports
- Supporting the development of hydrogen uses in the territories and ports
- Implementing certification for the type of hydrogen area in Nouvelle-Aquitaine
- Creating the H<sub>2</sub> Nouvelle-Aquitaine regional brand





#### ACTION PLAN 7 DEVELOPING USES (MOBILITY, INJECTION INTO GAS NETWORKS, TRANSPORT, ENERGY ECOSYSTEMS)

#### 1/ Description

The objective of this action is to mobilise and support, at a regional level, start-ups, VSE-SME and ETI companies that offer solutions, with support services from the region, ADI-NA, ADEME and Europe, in order to address all of the green and recovered hydrogen uses, given that hydrogen is not at a competitive level with other technologies and energy solutions, but rather on a complementary level.

At national level, the General Directorate for Energy and Climate (DGEC) is currently leading consultations to define a traceability mechanism for hydrogen and, more globally, the government is planning to publish a ruling at the end of the year, aiming, on the one hand, to define the different types of hydrogen (renewable, low-carbon, fossil, co-produced) and, on the other hand, to outline a support framework.

#### 2/ Indicators

- Mobility: number of private vehicles, number of professionally owned vehicles, kilometres travelled, volume of hydrogen consumed, equivalent tonnes of CO<sub>2</sub> avoided, number of supply stations for H<sub>2</sub>
- Injection in gas networks: total length of networks used, volume of hydrogen transported, average rate of hydrogen transported, equivalent tonnes of CO<sub>2</sub> avoided
- Transport: modes of transport concerned, number of lines supplied with hydrogen, number of vehicles/modes of transport/cars/boats/aerial objects (drones), equivalent tonnes of CO<sub>2</sub> avoided
- Energy ecosystems: number of ecosystems, volumes consumed, rate of green hydrogen, conversion into the equivalent amount of carbon avoided
- 3/ Identified partners
- The region
- ADI-NA
- Testing areas
- The state (Banque des Territoires)
- ADEME and Europe
- Fédération des Transporteurs routiers (Federation of Road Transporters)
- Technicentre SNCF de Saintes
- 4/ Actions already undertaken in this area
- DGEC support for funding studies: business cases, mobility fleet outputs, making gas networks greener
- Support for innovation from the Department for Industrial Performance

#### 5/ Actions to be launched

- Launching a regional call for projects dedicated to hydrogen, in addition to European and national support measures (ADEME). This call for projects will be presented to the Permanent Commission on 16 October 2020
- Structuring an offer adapted to the needs of regional actors and territories, by combining with the main sectors concerned (aviation, sailing, rail, chemicalmaterial, automotive, etc.)
- Supporting the renewal of local authority fleets
- Supporting the development of light hydrogen mobility
- The "Nouvelle-Aquitaine hydrogen circuit" in the territories
- Structuring programmes, such as the North-South European Corridors





#### ACTION PLAN 8 DEVELOPING GREEN, BIO-SOURCED, LOCAL PRODUCTION TO CONTRIBUTE TO THE SUSTAINABLE ENERGY INDEPENDENCE OF NOUVELLE-AQUITAINE

#### 1/ Description

In this context, where hydrogen presents many attractive traits but also costs, its use should relate to two sectors as a priority, "raw material" hydrogen for industry and "energy" hydrogen for heavy transport (maritime and goods).

The more obvious and immediate requirement is to replace carbonised hydrogen sourced from reforming processes with hydrogen produced using electrolysis. This could be done quickly for the diffuse chemical industry, which pays for hydrogen at a higher price because of the lack of real competition between suppliers and the high cost of packaging and transport. In addition, new uses should be promoted to "make greener" certain industries (steel industry and perhaps cement works). Support for industrial sites will be provided as part of the "Energy competitiveness of companies" measure.

Hydrogen-powered transport provides a level of autonomy that is not achieved with exclusively battery-powered electric transport. Some forms of transport (boats, lorries and buses) cannot be replaced by electric batteries, because the energy density in terms of mass and volume is too low. It is reasonable to believe that hydrogen transport will at first only develop from a limited number of distribution points, which would effectively limit its use to heavy transport and local fleets. Lastly, boats (over short distances, but also stationary in ports) could use hydrogen as a substitute for hydrocarbons and, in particular, heavy fuel oil.

The General Directorate for Energy and Climate is currently leading consultations to define a traceability mechanism for hydrogen and, more globally, the government is planning to publish a ruling at the end of the year, aiming, on the one hand, to define the different types of hydrogen (renewable, low-carbon, fossil, co-produced) and, on the other hand, to outline a support framework.

#### 2/ Indicators

- Number of tools for producing hydrogen
- Annual tonnage produced
- A Rate of green hydrogen produced/total volume of hydrogen
- Water consumption in hydrogen production and transformation processes; this will be a point to be aware of in the governance of the roadmap
- 3/ Identified partners
- Energy groups
- Industrial producers
- 4/ Actions already undertaken in this area

Support for business studies

5/ Actions to be launched

Launching a regional call for projects "Road and maritime hydrogen mobility hub",



in addition to European (FCH-JU, ERDF) and national (ADEME) support measures. This call for projects aims to facilitate the implementation of a regional ecosystem for road and maritime hydrogen mobility that integrates hydrogen production in demonstrators and in the industrial unit, depending on the level of maturity.

- Major programmes for green hydrogen production in Nouvelle-Aquitaine, in collaboration with energy groups
- Oreating consortiums to respond to national and European calls for projects.





## STEERING AND GOVERNANCE, ORGANISATION, COMMUNICATION IN THE INDUSTRY

#### **ORGANISATION, STEERING AND GOVERNANCE**

#### **Steering committee**

The steering committee will be set up by the region and will bring together the energy and storage cluster, the S2E2 and Avénia competitiveness clusters, representatives of companies in the sector and certified testing areas and, as technico-economic partners, ADEME, CNRS and CEA.

The steering committee will meet at least once a year, and then as needed.

The role of the steering committee is to confirm the progress of the roadmap in accordance with the project presented to elected officials and approved. This will be done by monitoring indicators and confirming the draft programme and budget for the following year.

The committee will also proceed to launch a process for evaluating the roadmap and to choose and set up bodies for evaluation.

#### Technical committee for monitoring the roadmap

The technical monitoring committee will bring together representatives of all socioeconomic actors in the regional hydrogen sector.

The steering committee will meet at least once per quarter, and then as needed.

The technical committee will be responsible for monitoring the programme and carrying out the actions in the roadmap, the launch and monitoring of the communication and promotion tools and operations in the sector.

#### Organisation of the hydrogen roadmap

The hydrogen roadmap will be organised by the region, with the support of the energy and storage cluster and competitiveness clusters.

#### Communication

A communication plan will be established for three years and can be renewed depending on the progress of the roadmap and its results.

#### Events to be planned:

Events will be virtual as far as possible and organised in line with health regulations in force since the COVID crisis, as will participation in these events. The following events have been identified:

application to host hydrogen days in the territories, organised by AFHYPAC

- energy and storage cluster: 2 hydrogen workshops per year
- support for events organised by the scientific community
- participation in trade fairs in the form of collective stands, conference presentations, participation in business meetings (HyVolution trade fair in Paris, etc.)



#### BUDGET

The creation of the hydrogen roadmap will make it possible to launch medium/ long-term funding dedicated to its operation and to support for industrial projects, tests in territories, research and development, company creation and staff training. Depending on the topics and objectives, partnerships will be sought with the State (industrial areas) and its agencies (ADEME), national research networks (CEA, CNRS) and the various sources of European funding (cf. above and annexe 4).

Regional funding for projects will be on the basis of its intervention tools: subsidies, refundable advances, calls for projects, investment and joint investment funds.

These ten years should be an opportunity to start structuring programmes that make it possible to both reduce the costs of the hydrogen molecule through an increase in the volumes produced and to reduce the additional cost of vehicles, equipment and infrastructure through intensified use.

Making use of European funding has turned out to be indispensable to supporting the region's efforts in launching its roadmap for developing the hydrogen sector in Nouvelle-Aquitaine. This funding can take the following forms: the inclusion of hydrogen (with its various terminologies and ranges) in the ERDF operational programme at the drafting stage, support for cross-border initiatives with Spain and Portugal using the INTERREG SUDOE programmes (support for regional development in south-west Europe by funding cross-border projects), applying to calls for projects and calls for expressions of interest as part of Horizon 2020, and participating in Europe's hydrogen plan, which is currently at the preparation stage.

#### TIMETABLE

The timetable for the proposed roadmap has been established in 3 phases over a total period of 10 years:

**Short-term actions, within three years (2023)**, with the primary objectives of: launching the roadmap, with its internal communication and external communication and promotion plans, establishing an organisation committee and its work programme, creating and launching thematic working groups.

**Medium-term actions, within five years (2025)**, with the following objectives: continuing to structure the sector, its communication and promotion to professional and individual users, industrial companies in Nouvelle-Aquitaine and beyond, as well as with investors (attractiveness programme) and to accelerate and develop the programme of demonstrations and tests.

Long-term actions, within ten years (2030), with the objectives of: commitment to a phase of selecting the greatest demand and most promising uses in terms of volume, innovative technologies that are most likely to meet these requirements, then to duplicate and broaden the market base for these technologies according to the ethical economic models, with a view to establishing and developing the hydrogen sector in Nouvelle-Aquitaine in the long term.







## RECOMMENDATION

The region and its partners also aim to incorporate a recommendation with regard to the market price of hydrogen and suggest that the market could offer attractive and competitive conditions.



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creation internal communication

> printing reprographics

**credits** Région Nouvelle-Aquitaine freepick

Région Nouvelle-Aquitaine October 2020

nouvelle-aquitaine.fr