



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

IPHE Country Update June 2021: FRANCE

Name	Laurent ANTONI
Contact Information	laurent.antoni@cea.fr
Covered Period	December 2020 - May 2021

1. New Initiatives, Programs, and Policies on Hydrogen and Fuel Cells

- **[Fourth Future Investment Program](#)**. Prime Minister Jean Castex presented on January the orientations of the fourth future investment programme (PIA 4). € 20 billion is mobilised over five years, of which € 7.5 billion is allocated to support the research, innovation and higher education ecosystem, and € 12.5 billion is channelled towards priority sectors and technologies. There are fifteen of them, including decarbonized hydrogen (cf. the National Hydrogen Strategy), decarbonisation of industry (process energy efficiency, deployment of decarbonized processes, carbon capture and its storage or recovery) or the decarbonisation of mobility. PIA 4 will devote at least 1/3 of its funds to the ecological transition and a general principle of investment is set so that none of its spending is unfavourable to the environment.
- **[Establishment of the French National Hydrogen Council](#)**. The National Hydrogen Council, which brings together major industrialists representing several industrial sectors, will have the task of evaluating the smooth running of the actions planned to identify, if necessary, any possible obstacles or new actions to be put in place. The [first meeting](#) took place on 25 February in presence of three Ministers.
- **Adoption of transposition orders for the European directive on Renewable Energies II**. The Council of Ministers on 3 March gave the Government the opportunity to adopt two transposition orders for the European Renewable Energy Directive 2018/2001 (RED II). The first, [Ordinance No. 2021-236](#) on the electricity market, allows the issue of guarantees of origin for electricity produced by any primary energy source or by cogeneration, in addition to the existing guarantees of origin of renewable electricity. Origin guarantees for nuclear electricity will now be possible.

The second, [Ordinance No. 2021-235](#), deals with the transposition of the sustainability component of RED II bioenergy. In addition to measures on biomass, it introduces in French law the category of "renewable liquid and gaseous fuels of non-biological origin intended for the transport sector" (ReFuNoBio), of the renewable hydrogen type, and recycled carbon fuels. ReFuNoBio must meet a GHG emission reduction criterion of -70% compared to a fossil comparator. On the 5th of May, the Government presented to the Council of Ministers a project of law to ratify the ordinance on hydrogen, published in February. Both orders come into force on July 1, 2021.
- **[The Parliamentary Office for the Evaluation of Scientific and Technological Choices \(OPECST\) has adopted and published a scientific note on hydrogen production](#)**. The note scans hydrogen production patterns, from natural gas stream reforming and coal gasification, to CO2 capture (CCS) techniques and water electrolysis from nuclear or



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

renewable electricity. Since investments are high, electrolyzers must be made more cost-effective by lengthening their load. In this respect, only nuclear power and hydroelectricity have the dual advantage of being controllable and low-carbon. Other modes of production are analysed, including two solutions considered operational: methane pyrolysis, and biomass thermolysis, that must continue, in terms of research and industry. A final recommendation calls for more research into materials and knowledge of natural hydrogen.

- **Governmental Roadmap to Decarbonize the Chemistry Sector**. The French Government, in conjunction with the National Industry Council, published on the 7th of May a roadmap for the decarbonisation of the chemical sector. It sets a target to reduce its annual greenhouse gas emissions by 26% by 2030 (compared to 2015). The production of fossil H₂ by chemical companies in France amounts to 300,000 t/year and represents GHG emissions of about 2.7 MtCO_{2eq}/year. Its substitution by decarbonised hydrogen is considered under three penetration rate scenarios: -540,000 tCO_{2eq} with 20% decarbonized hydrogen in industrial hydrogen consumption in 2030, -900,000 tCO_{2eq} with 33%, and - 1,080,000 tCO_{2eq} with 40%.
- **Governmental roadmap for the decarbonization of the mining and metallurgy sector**. The Government, in conjunction with the National Industry Council, published on the 20th of May a roadmap for the decarbonisation of the mining and metallurgy sector. It sets a target to reduce its CO₂ emissions by 31% by 2030. The sector, which accounts for 24% of total industry emissions, will therefore have to reduce its emissions by 7.4 MtCO_{2eq} compared to 2015. This could be achieved by increasing the recycling rate of circular steel, reducing the use of coal in blast furnaces, carbon capture and storage or low-carbon hydrogen for the pre-reduction of iron ore. This last lever could represent a decrease estimated between -45 to -90 ktCO_{2eq}/year in 2030
- **The underground storage of hydrogen included in the law from the Citizens' Climate Convention**. Translating into legislative provisions the conclusions of the Citizens' Climate Convention, the law to combat climate change and strengthen resilience to its effects is expected to be adopted at the end of the summer 2021. The Law's Article 20 deals with the reform of the Mining Code and includes the Government ability to legislate by ordinance to take measures, in particular «subjecting the underground storage of hydrogen to the legal regime of underground storage» and “permitting the extension of existing underground storage permits to other substances, including hydrogen..., without changing the validity of the Mining Code”.
- **Creation of a clean bus financing platform**. The European Investment Bank (EIB) and the Bank of the Territories invest €100 million each in an investment platform to finance the transition bus fleets in the French territories. Managed by the Bank of Territories, this platform will offer innovative financing to local and regional authority's mobility organisers wishing to green their bus fleet and thus reduce their environmental impact. The "Clean Bus" platform is part of the Caisse des Dépôts's recovery plan and its action in favour of the environmental transition.
- **Hydrogen plan of Provence-Alpes-Côte d'Azur region**. The council of Provence-Alpes-Côte d'Azur region has adopted its Regional Hydrogen Plan, with the objective of boosting this sector in order to help achieve the objectives of its Climate Plan. The Plan sets four priorities: decarbonize mobility with a focus on hydrogen ports and ships, decarbonize industry (steel industry in particular), produce renewable and low-carbon hydrogen (with a



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

focus on biomass and Refused Derived Fuel potential) and finally, structure and manage a sector in the Region.

- **The UGAP purchasing centre integrates 3 hydrogen bus models into its catalogue for public transport operators.** The French Union of Public Purchasing Groups, UGAP, has selected two Businova bus models from the French company Safran (10 and 12 m long) and one A330 FC model from the Belgian company Van Hool (12 m), with autonomies of 350 km. It thus completes its range of nine battery bus models, one hybrid and six GNV.
- **Conditions and Requirements for the Technical Feasibility of a Power System with a High Share of Renewables in France Towards 2050.** This report, commissioned by France's Ministry for the Ecological Transition and written jointly by the International Energy Agency and RTE, the French power Transmission System Operator, examines the conditions and requirements needed to assess the technical feasibility of scenarios with very high shares of variable renewable energy in France's power system. RTE has chosen to pay particular attention to the place of hydrogen, reindustrialization and the impact of energy efficiency, with dedicated scenarios.
- **Government unlocks €47 million for 14 hydrogen train order.** In response to a call from the Occitanie, Bourgogne–Franche-Comté, Grand Est and Auvergne–Rhône-Alpes regions, engaged with the SNCF in the order of 14 Alstom hydrogen trains, Prime Minister Jean Castex has announced to the four regional authorities his agreement for the funding of the Train H2 project. The Regions will contribute the remaining €83 million for a total investment of €160 million. **On the 8th of April**, Alstom announced that it had received the order for 12 regional electric-hydrogen trains from SNCF Voyageurs.
- **French roadmap for the deployment of sustainable aeronautical biofuels.** This ambition and strategy is based on 5 fundamental principles: (i) the maintenance of an optimal level of flight safety (ii) the assurance of the sustainability of aviation fuels produced in France (iii) the economic viability of the sector (iv) the development of cost-efficient supply chains (v) consistency with supranational initiatives. In the short and medium term, an ambitious but realistic deployment path: 2% in 2025 and 5% in 2030. In the long term, a target of 50% substitution of conventional fossil fuel by sustainable aeronautical biofuels in 2050 consistent with the achievement of neutrality carbon in France on this horizon.

2. Hydrogen and Fuel Cell R&D Update

- **ADEME LCA study on light hydrogen mobility.** In December 2020, ADEME, French Energy Agency, published its study on life-cycle analysis of the environmental performance of light hydrogen mobility, carried out with Sphera and Gincko 21. Two case studies, a sedan and a utility vehicle, are analysed. The study shows that hydrogen mobility, subject to a supply of low-carbon or renewable hydrogen produced by electrolysis, has a 69% to 75% lower life-cycle carbon footprint than a diesel vehicle, performance comparable to a battery-powered vehicle (-78%). This performance falls to 11% if hydrogen is of fossil origin. Transport of hydrogen at 200 bar to the station has a significant impact, estimated at 1.12 kgCO₂/kgH₂/100km, but can be reduced to 0.35 for transport at 500 bar. The hydrogen vehicle manufacturing stage has a similar impact to that of the battery vehicle (10.3 tonnes of CO₂), with emission stations for the vehicle



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

platform (61%) followed by the production of the tank (15%) and the mobilization of the fuel cell plate (7%).

- [ADEME study on the potential of the hydrogen train](#). The use of decarbonised hydrogen produced by electrolysis reduces CO₂ emissions in use by 80% to 95% compared to a diesel engine. This solution is complementary, in particular, to that of the electrification of railways, both because of its economic relevance on regional lines with less dense traffic, by its ability to stimulate local hydrogen ecosystems. Among 52 priority greening lines identified by the French regions, 34 lines could be relevant for hydrogen compared to railway electrification, representing nearly 200-250 trains.
- [CNRS inaugurates its Hydrogen Federation](#). Created on the 1st of January 2020 and formalised early March, CNRS Hydrogen Federation brings together more than 270 researchers and 28 CNRS laboratories, in partnership with universities, research organizations and engineering schools. It will coordinate the research efforts of these numerous teams on the major issues of decarbonized hydrogen, ranging from its production, purification, storage, to the production of systems for its use as fuel cells. The Federation has defined four main research areas: hydrogen production (for example, high-temperature electrolyzers), storage (in gaseous and solid forms), mobility and stationary uses. In addition, the CNRS is currently preparing the setting up of a Scientific Interest Grouping (GIS) entitled French Hydrogen Initiative (IFHy) to bring together its former partners, the CEA and a club of industries.
- [Plastic fuel cells](#): The plastics manufacturer Novares from Monaco, which specializes in the manufacture of technical parts for the automobile as well as heat exchangers, has produced a plastic PEM fuel cell (Plastic Fuel Cell Stack). The weight gain is 35% compared to a stack of the same metal power. No further information available yet on the materials used, the performance in electrical and thermal conductions and in terms of lifetime span.

3. Demonstration, Deployments, and Workforce Developments Update

- France Hydrogen, the French hydrogen national association, has launched a new version of [Vig'Hy, the Hydrogen Observatory](#) presenting all the key figures of the hydrogen deployment in France.
- [Hydrogen gigafactory in Béziers: Europe's green light for the creation of GENVIA](#). The European Commission has just approved the creation of a joint venture between Cameron-Schlumberger (Béziers site), CEA, Vinci Construction, Vicat and AREC Occitanie. The objective is the industrial deployment of a technology for disrupting the production of decarbonized hydrogen by high-temperature solid oxide electrolyzers, which will be manufactured in Béziers.
- [SAFRA and SYMBIO partner to produce 1,500 hydrogen buses](#). Already partners in the design of the first French hydrogen buses, Safra and Symbio have signed a contract for the development of 1,500 buses equipped with an optimised hydrogen system and a range of services adapted to the latter.
- [Dijon, Le Mans and Angers share an order for hydrogen powered household waste dumpsters](#). On the 4th of May, at a meeting in Le Mans, a group order for 29 hydrogen-powered refuse collection bins was made official. Dijon will obtain 20 hydrogen refuse



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

collection bins in five years; Le Mans will buy 6 in three years and Angers 3. The objective of this grouping of orders is to limit the investment costs (vehicle price between €450,000 and €850,000) for local and regional authorities and to interest more production chains on the industrial side. The first delivery will take place in early 2023 and will benefit from subsidies from Europe, ADEME and the Regions.

- **[ENGIE announces collaboration to carry out the feasibility study on South Africa's hydrogen valley](#)**. ENGIE, announces the signing of an agreement together with South Africa's Department of Science and Innovation, South African National Energy Development Institute, Anglo American and Bambili Energy, the clean energy solutions provider, to carry out a feasibility study to create a "Hydrogen Valley" located on the Bushveld Complex and more broadly around Johannesburg, Mogalakwena and Kwazulu Natal.
- **[HYPE raises €80M to create the world's first fleet of hydrogen taxis](#)**. This amount will first be used to buy the taxi company Slota, which holds 600 Parisian licenses. The vehicles, mainly diesel, will gradually be replaced by hydrogen cars. It will also be used to create two new charging stations.
- **[30 applications to connect Power-to-gas and hydrogen projects to the GRTgaz network in 2020](#)**. In the context of the publication of the European and French hydrogen strategies, the year 2020 was particularly active in the area of hydrogen. The power to gas Jupiter 1000 demonstrator has been injecting hydrogen molecules into the natural gas transport network since February 2020. GRTgaz has received up to the end of last year 30 applications for the connection of projects of all kinds for the injection of synthetic gas derived in particular from pyrogasification and/or hydrogen.
- **[Hydrogen stations: McPhy to build a new plant in France](#)**. Announced on the 9th of March, this new site will enter into service from 2022. McPhy intends to increase its production to 100 hydrogen stations per year, which is 5 times more than it currently produces.
- **[Elogen announced the signing of a contract with the German energy company E.ON](#)**, as part of its major SmartQuart project. Elogen will supply E.ON with a plug-and-play modular electrolyser with a capacity of 1 MW and a production capacity of 200 m³ of H₂ per hour.
- **[Referential of skills of the hydrogen sector](#)**. France Hydrogen has published a White Paper on the skills and professions of tomorrow in the field of hydrogen. As more than 100,000 jobs will be created in this sector, by 2030, stakeholders are trying to develop a strong national sector. The association has identified a total of 84 professions. It turns out that 27 of them require hydrogen expertise and 41 need basic technical knowledge. The remaining 16 do not require specific technical knowledge.

4. Events and Sollicitations

- 8 -10 September 2021 **[8ème édition des Journées Hydrogène dans les Territoires](#)** Le Kursaal, Dunkerque



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

5. Investments: Government and Collaborative Hydrogen and Fuel Cell Funding

Two Calls for projects have been published in October 2020

1. “[demonstration and technology bricks](#)” with a budget of €350 M for the next three years
2. “[territorial ecosystems](#)” with a budget of €275 M for the next three years. Among the candidates, [seven have just been pre-selected](#). They are organized around production, distribution and consumption sites to create both supply and demand.

6. Regulations, Codes & Standards, and Safety Update

- [Publication and entry into force of the Hydrogen Ordinance](#). This ordinance from 17 February 2021 defines the terminology of the different types of hydrogen, various provisions concerning its production, transport, storage and traceability, a support mechanism for the production of renewable and low carbon hydrogen (latter only if produced by electrolysis), and guarantees of origin and guarantees of traceability (physical traceability) for renewable and low carbon hydrogen pursuant article 52 of the Energy-Climate law. The terminology uses three categories of hydrogen, respecting technological neutrality (renewable, low-carbon, high-carbon). It establishes a general framework that will be completed in the coming months by two decrees, one concerning the traceability and planned in the first semester 2021, the other concerning the support mechanism to the production for the second semester, after its notification to the European Commission.
- [Publication of the decree on the metrology of hydrogen stations](#). The French Administration has published a decree of 18 December 2020 relating to compressed gas mass measuring systems for vehicles, in order to adapt specific provisions to the metrology of stations delivering compressed hydrogen. The Order defines a required accuracy class for hydrogen measuring systems that must not be greater than 2 (plus or minus 2% of the measured quantity). The decree allows all station architectures to be admissible for certification, and reviews the periodicity of audits to 12 months.
- [Decree Implementing the LOM on Reporting of Low-Emission Vehicles](#)
A decree adopted pursuant to the Mobility Guidance Act (LOM) was published concerning the publication of the percentage of low- and very low-emission vehicles of public fleets. Under the LOM, the State, public institutions, local and regional authorities and national companies are subject to low and very low emission vehicle quotas when renewing their fleets. Article 79 of the LOM establishes a reporting obligation for these targets from 2021: the actors concerned must make public the percentage of low- and very low-emission vehicles acquired or used during the previous year. These numbers include hydrogen passenger vehicles, light duty vehicles, heavy duty vehicles, bus and coaches.



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

Summary Country Update June 2021: FRANCE

Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fuel Cell Vehicles ¹	5,000 by 2023 20,000 – 50,000 by 2028	381 (May 21)	National Implementation Plan based on a cluster model approach	• Subsidy for purchase (national government initiative on electrical vehicle, European projects)
Fuel Cell Bus	200 by 2023 800 - 2,000 by 2028	22 (April 21)	2 buses in test, 60 buses in deployment phase and 307 in plan European projects 3E Motion + Jive 2. Current H2 mobility France initiative of 1,000 buses by 2024	• Subsidy for purchase (European project + national and regional funds)
Fuel Cell Trucks ²				
Forklifts	No target	325 (Nov 20)	Within European and national projects	• Subsidy for purchase (European project)
H ₂ Refueling Stations	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
70 MPa On-Site Production	100 HRS by 2023 400 - 1,000 by 2028	As of November 2020: 4	National Implementation Plan based on a cluster model approach HRS are dual 350/700 bar	• Subsidy for installation and operation (European and national projects)
70 MPa Delivered		As of November 2020: 4	National Implementation Plan based on a cluster model approach HRS are dual 350/700 bar	• Subsidy for installation and operation (European and national projects)
35 MPa On-Site Production		As of November 2020: 13	National Implementation Plan based on a cluster model approach	• Subsidy for installation and operation (European and national projects)

¹ Includes Fuel Cell Electric Vehicles with Range Extenders

² As above



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

35 MPa Delivered		As of November 2020: 11	National Implementation Plan based on a cluster model approach	Subsidy for installation and operation (European and national projects)
20 MPa On-Site Production		As of November 2020: 5	HRS for bikes	
20 MPa Delivered		As of November 2020: 2	HRS for bikes	
Stationary	Target Number³	Current Status	Partnerships, Strategic Approach	Support Mechanism
Small ⁴	No target	112 (April 20)	European (Ene.field 35, PACE 66) and national (ADEME & GRDF) funded projects for residential and small tertiary 1 system r-SOC in demonstration	• Subsidy for purchase (European and national projects)
Medium ⁵	No target	1	GRDF & Air Liquide	
Large ⁶	No target			
District Grid ⁷	No target			
Regional Grid ⁸	No target			
Telecom backup	No target			

³ Targets can be units installed and/or total installed capacity in the size range indicated

⁴ <5 kW (e.g., Residential Use)

⁵ 5kW – 400 kW (e.g., Distributed Residential Use)

⁶ 0.3MW – 10 MW (e.g., Industrial Use)

⁷ 1MW – 30 MW (e.g., Grid Stability, Ancillary Services)

⁸ 30MW plus (e.g., Grid Storage and Systems Management)



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

H ₂ Production	Target ⁹	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fossil Fuels ¹⁰	No target			
Water Electrolysis ¹¹ (PEM, Alkaline, SOEC)	6.5 GW by 2030	5 MW	French national strategy	Subsidy for installation and operation (European and national projects)
By-product H ₂	No target			
Energy Storage from Renewables	Target ¹²	Current Status	Partnership, Strategic Approach	Support Mechanism
Installed Electrolyser Capacity				
Power to Power ¹³ Capacity	No target	100 kW	Myrte platform in Corsica	Subsidy for installation and operation (European and national projects)
Power to Gas ¹⁴ Capacity	No target	1 MW	<ul style="list-style-type: none"> • Jupiter 1000 project (1 MWe of electrolysis) • GHRYD: 20% hydrogen in a local gas distribution network • MethyCentre 	Subsidy for installation and operation (European and national projects)

⁹ Target can be by quantity (Nm³, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target

¹⁰ Hydrogen produced by reforming processes

¹¹ Please indicate if targets relate to a specific technology (PEM, Alkaline, SOEC)

¹² Can be expressed in MW of Installed Capacity to use the electricity from renewable energy generation, and Annual MWh of stored energy capacity

¹³ Operator has an obligation to return the electricity stored through the use of hydrogen back to electricity

¹⁴ Operator has the opportunity to provide the stored energy in the form of hydrogen back to the energy system through multiple channels (e.g., merchant product, enriched natural gas, synthetic methane for transportation, heating, electricity)