When Hydrogen Becomes a Geopolitical Imperative for France

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Today, fossil energies are the primary energy source in Europe. Oil and its derivatives, gas, and coal represent more than 65% (75% in 2021)[1] of overall energy consumption. In addition to contributing to climate change, these fossil energies do not allow Europe to secure its energy independence: in 2020, even before Russia's invasion of Ukraine, 96% of oil supplies came from imports (26% of which came from Russia, though this has since gone under 5%), 84% of natural gas was imported (43% from Russia, now below 15%), and 36% coal (out of which around 50% come from Russia). In 2023, EU countries' energy reliance on imports of fossil resources will still be significant and should represent more than 90% of oil resources and above 80% of natural gas resources are imported. The suspension of fossil fuel imports from Russia was compensated for by increased imports from the United States, Norway and the United Kingdom, with a particular increase in liquefied natural gas imports[2].

The challenge of moving away from fossil fuel consumption is therefore threefold: energy sovereignty, decarbonization and sustainability. Using hydrogen has been clearly identified as indispensable for meeting sustainability objectives. Indeed, large sectors of the economy cannot be electrified, and require a substitute for fossil fuels in liquid and gas form, for uses that electricity (and batteries) cannot efficiently support. The global hydrogen market is already a reality as it currently represents more than €100 billion and 80 million tons (MT)[3], mainly for the refining and production of fertilizers. In this sense, hydrogen has many advantages, as it can help to decarbonize energy-intensive industries – by replacing, alone or in derivatives forms, natural gas, coal and oil – as well as intensive, heavy-duty transportation in cases where battery-powered electrification is too cumbersome (2.5 to 3 times more), too heavy (increasingly so as the load increases) and too long to recharge (a few minutes versus tens of minutes or a few hours). Hydrogen also allows Europe to increase its energy sovereignty and to partially reuse existing gas (or oil) infrastructure. It enables us

1 — Data for European energy situation in this first paragraph are mostly extracted from Eurostat available figures(databrowser /view / NRG).

2 — Servet Yanatma, Europe's 'energy war' in data: How have EU imports changed since Russia's invasion of Ukraine?, Euronews, 24/02/2023.

3 — Demand in Europe is currently estimated at 8.5 MT.

to take advantage of the wide availability of renewable resources and property in certain regions of the world, and to import them into countries with strong demand (Europe, Japan, Korea, etc.), in the form of hydrogen or its derivatives (ammonia and methanol for example), thereby broadening our sources of supply and strengthening our ability to develop energy's «friend-shoring» moves. In this respect, strategic choices concerning the evolution of our energy mix, and in particular the hydrogen component, are becoming new geopolitical levers, clearly identified as such by our major European partners and the North-East Asian region.

This substitution by hydrogen (and its derivatives) and electricity the electron of our fossil fuels is a systemic one as it offers a path towards a functional, low-carbon energy model. This paradigm shift requires us to act now – on production, usage, and distribution infrastructure – in order to allow this shift over the next two decades. Between now and 2050, the trajectory of European energy independence could mean using 40 to 60 MT[4] of hydrogen, with 2 to 4 MT for France alone (2 to 6 times that of current consumption), according to predictions by the European Commission.

Russia's invasion of Ukraine revealed the weaknesses inherent in the European Union's energy model. This is why, starting in May 2022, the European Commission proposed a plan whose objective is to put an end to our dependence on Russian hydrocarbons before 2030 and to achieve carbon neutrality by 2050. In order to meet that objective, REPowerEU intends to act on several fronts: energy conservation, diversifying supply sources, accelerating the rollout of renewable energies, and reducing fossil energy consumption in industry and transportation. This plan includes accelerating European hydrogen production and establishing import strategies with our partners in the Mediterranean region (pipelines) and beyond (ammonia). The Commission's plan aims to use 20 MT of low-carbon hydrogen by 2030, from both European production (50%) and imports (50%). These 20 MT of renewable hydrogen will replace, depending on use, between 25 and 50 billion m3 of natural gas[5] (between 10-15% of the natural gas consumed in Europe). Even if its agenda remains optimistic, this ambition is bolstered by the energy, geopolitical, and climate context.

The development of a multi-source strategy for accessing hydrogen resources seems to be a sustainable way of strengthening European and French energy sovereignty, and preserving the competitiveness of the old continent's energy-intensive industries. Beyond the raising of awareness, this strategy's success depends on strong, decisive decisions. It will also enable us to re-deepen our strategic dialogue with some of the major countries in the Mediterranean region and the Middle East.

4 — The possible variation in demand depends on the share taken by hydrogen in the transport segment in particular, as well as the share of energy-intensive industry that will remain located in our territories.

5 — According to European Commission figures in RepowerEU.

Producing decarbonized hydrogen in Europe and France

The ability to produce 10 MT of hydrogen on European soil by 2030 requires the construction and installation of 100 GW[6] of electrolysis capacity as well as extensive use of renewable and nuclear energies in order to guarantee hydrogen's sustainability, which can only be done by overcoming numerous challenges.

Large-scale production of electrolyzers is the first obstacle to developing a strong and autonomous European industry. Planning the rollout of electrolyzer manufacturing sites with a total capacity of 20 GW/year, equivalent to a 10-fold increase in manufacturing capacity by 2025 is already in the works. At the same time, in order to support supply, electrolytic hydrogen production capacity will need to be doubled every year until 2030, assuming we have already reached 2 GW of installed capacity by 2024. Achieving this objective has long been dependent on IPCEI (Important Project of Common European Interest) decisions, whose validation procedures and national iterations have taken a very long time in these initial phases.[7] In order to win this race, France can take the lead in strengthening support for the most ambitious "giga factory" projects. Alongside planned investment support, financing could take the form of guaranteed access to CCFDs[8] in order to give a competitive advantage to actors who decide to establish production sites in France.

European regulation remains unclear as to the transformation of existing hydrogen production, even if it does foresee a switch to decarbonized hydrogen for future industrial needs or sustainable transport fuels. It could be strengthened by national regulations which, as part of a clear timetable, would make the operation of natural gas-based hydrogen production units conditional on the operational implementation of the necessary carbon capture and storage projects. For operations moving towards electrolysis technologies, support mechanisms in the form of multi-year contracts which, over the first 10 years of operation of the first large-scale units installed (100 MW or more), cover all or part of the extra cost of green hydrogen as compared with grey hydrogen, using a mechanism indexed to a rising price of avoided CO2[9], are clearly vital. Such mechanisms, which are currently being discussed, are in fine similar to the one put in place in the United States (IRA) in their effects and could be even more easily limited in terms of financial burden for public authorities, as long as European and national regulations are simultaneously forcing the switch to a green or low-carbon hydrogen benchmark.

Strengthening decarbonized electricity production infrastructure

6 — European Commission, https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2829.

7 — Pierre-Etienne Franc, Hydrogène : l'Europe au ralenti, Les Échos, January 2023.

8 — Carbon contract for difference - support mechanisms to offset the additional cost of green hydrogen, indexed to the price of avoided carbon, which ultimately amount to a fixed premium for green hydrogen of €2 to €3/kg over a defined period.

9 — A joint study by Shearman & Sterling revisits the various PPP models in the context of the hydrogen economy (https://www.shearman.com/en/perspectives/2022/12/incentivising-investment-in-european-renewable-hydrogen-production).

Demand for hydrogen reinforces the need for renewables and nuclear power. Indeed, support for the production of decarbonized hydrogen on European soil cannot be truly virtuous unless it is accompanied by an increase in decarbonized electricity production capacity. In particular, this acceleration of electricity production means simplifying authorization procedures and accelerating the development of offshore production capacity.

In 2030, the production of decarbonized hydrogen will require almost a third of new installed solar capacity, nearly 10% of onshore wind power, and 50% of offshore wind power, assuming that Europe sticks to its renewable energy capacity deployment program[10], which involves deploying almost 3 times installed solar capacity (+ 420 GW), more than 2.5 times installed onshore wind power capacity (+ 420 GW) and more than 5 times installed offshore wind power capacity (+ 60 GW). The timetable is very tight, projects are often complicated to implement, and the cost of the electrons(kWh) is not always as competitive as it should be.

Importing what is not available in Europe by making France a hub of green and low-carbon energies

It seems unlikely that our continent's progressive transition away from a fossil-based energy model could lead to a complete break from any form of energy dependence. The opportunity is nevertheless before us to diversify and renew our supply sources, because hydrogen and its derivatives allow for the stocking and transporting of renewable energies produced in abundance at low cost in the appropriate geographical areas. Accordingly, REPowerEU plans to import 10 MT of hydrogen through three corridors: the North Sea (Norway, United Kingdom), North Africa and the Gulf Coast Countries, and – potentially – Ukraine.

France will also have to find replacement resources to meet the needs of its transportation and industry sectors by progressively replacing a portion of oil and gas. For reasons of time and competitiveness, the nuclear energy base does not appear to be strong enough in the foreseeable future to replace a growing share of our fossil fuel needs, when we already need to bolster the transmission, distribution, and production network in order to support increased electrification (transport, residential, certain industries), even before taking into account hydrogen-related needs. This implies planning to use alternative, more competitive sources of hydrogen from geopolitically diverse and favorable areas.

Given this context, and in order to be sure that France also benefits from this dynamic that is already picking up speed in the North and South of Europe, an expanded role for H2 Global – the German agency that is financing the import of hydrogen – within European territory would be appropriate. It could also involve enhancing the resources and scope of the «European Hydrogen Bank». Plans for the progressive conversion of Europe's gas (and possibly oil) networks, which form the backbone of our industrial and transport supplies,

10 — According to RepowerEU figures.

are important in this context, alongside widespread electrification, for which network resizing is already planned. The development of infrastructure to access hydrogen/ammonia resources is the primary means of opening up access to the energies of tomorrow as widely as possible, so that we are not dependent on just a handful of countries and a single electricity grid. The aim is to prepare industry for the energy that will complement gas, liquefied natural gas and oil using existing networks, and to ensure that the primary and secondary processing activities of energy-intensive industries continue to be located for the most part on French and European soil.

In this context, France could benefit from its geographical position to develop access sovereignty. As such, France could therefore play a particular role between producers and consumers. Located at the heart of Europe, France could become a supply and distribution hub for the competitive green energies found in its south or its ports. This strategy would accelerate the united European energy strategy and strengthen France's ability to retain its energy-intensive industries. Access sovereignty must meet three criteria, which France is lucky enough to have: 1. the ability to produce its own substitutes in the event of a crisis (local nuclear or renewable production and expertise in hydrogen technologies), 2. diversity of access infrastructure – pipelines and port terminals on the Atlantic, North Sea, and Mediterranean coasts – as well as accelerated implementation of trans-European corridor projects (H2 Med, Bar Mar and upstream to Germany) and, finally, 3. The large diversity of potential supply sources of decarbonized energy in close vicinity (Southern, Eastern and Northern Europe, North Africa and the Middle East) which could be connected to France, enabling it to become a European hub for supplying access to these energies. This approach is currently being actively developed by major port facilities in Northern Europe, with demand developing in parallel with a very active effort to structure supply sources.

Price variations for renewable or low-carbon hydrogen range from €3 to €7/kg depending on the sources and vectors used. Existing nuclear assets could achieve very competitive prices, depending on the pricing and allocation strategies chosen for these electrons/kWh. But the conflict of usage for low-carbon electrons/kWh becoming the next big issue for our energy mix, in addition to the conflict over land use which already limits our territories in their development options, it seems pertinent to ease these constraints by maintaining targeted import strategies from nearby countries. The combined renewable sources (wind and solar) of Southern Europe and the Mediterranean region currently offer the most competitive prospects.

This is the challenge facing the steel, fertilizer and ammonia/methanol industries in the coming decade. They all must now choose between importing affordable green energy or potentially relocating their entire production process to where that energy is found, taking with them sizable skill, technology and employment pools. The future will bring a gradual replacement of labor costs by green energy as a key factor in relocating value chains. If tomorrow European RED III directives were to make heavy industrial production conditional on the use of low-carbon energy (confirming the importance of nuclear power as a complement to renewable energies, and the transitional role of CCS technologies in facilitating the transition from fossil fuels to decarbonized energy), large energy-intensive sites would have to switch to hydrogen processes or begin green primary transformation (ammonia, HBI in steel, methanol) in the most competitive countries.

If Europe and France help to keep these transformations on European soil (following Spain's example with its large integrated sites in Asturias), with a portion of energy being imported (which will most likely remain in fine less than our current fossil fuel dependence), the entire production sector could remain based on European soil in the long term. The capability to produce hydrogen domestically for strategic industries and for needs that cannot be relocated (long-distance heavy and light transport in particular) is consistent with the development of a sovereignty of access and provides energy-intensive French industries with diversified supply sources.

The use of hydrogen fuel chains enables us to broaden our sources of imports beyond the USA/Russia/Middle East/Norway zone, because renewable energy is always possible at home, although with the risk of cost. This is a major difference from fossil fuels. Under the fossil fuel regime, sovereignty of access is more delicate, since fossil fuels cannot be created, limiting the diversity of supply sources to certain countries. Renewable energy (together with nuclear power when the ability and expertise to harness it are available) significantly broadens the field of possibilities, and hydrogen (along with its derivatives, notably ammonia) is the vector that makes this possible. By opening its borders, France opens up its sources of sovereignty by controlling its access to renewable energy through the use of hydrogen: it unlocks its sovereignty by multiplying its options. It removes some of the constraints on the development of electricity supply without disrupting it. It makes this approach a source for deepening or revitalizing bilateral relations with its major partner states in the South and Middle East, which are also particularly well positioned and mobilized on these issues.

Preparing distribution infrastructure

If the entirety of the non-fatal grey hydrogen currently used in refining and ammonia production were to be replaced by low-carbon or green hydrogen,[11] and if a part of the integrated steel industry were to also move towards green hydrogen-based DRI (this could represent several million tons), the industrial sector would absorb almost half of the hydrogen supply envisaged in REPowerEU, around 9 MT.

The most likely scenario is that only a portion of existing uses will be switched over, as it may be more profitable for manufacturers to start by developing and implementing the carbon capture and storage projects already in the pipeline, provided their implementation is sped up. The remaining 3⁄4 (15 MT) will need to be met by injecting hydrogen into the gas grid (a potential of 1 to 3 MT), the transformation of hydrogen into electricity (gas/electricity trade-offs, «co-firing» in thermal power plants), potential in the steel industry (several million

11 — Current regulatory provisions do not really require this switchover, for either refining or ammonia, given the latest political arbitrations. Our analyses put the quantities that could be switched over within the decade, often through CCS solutions, at a total of around 3 MT, most part of remaining fossil production being the integrated part of industrial processes.

tons) and through an ambitious rollout of hydrogen in transport, which presents the other main opportunity, particularly in intensive and heavy transport. Over the long term, these transport segments, which are difficult to convert to battery-powered electricity, could require almost 30 million MT of hydrogen.

It is against this backdrop that the European transport regulation project, AFIR (Alternative Fuel Infrastructure Regulation), which calls for a mandatory minimum rollout of major alternative charging infrastructures (electric charging stations, hydrogen and compressed natural gas & LNG stations), and which has been under discussion between member states for more than a year, has finally reached a consensus, albeit on a figure that is still insufficient, but one which makes it possible to get started. It is essential that it be implemented right away for these three complementary technologies.

This is crucial for manufacturers to be able to plan the transition of large production runs (buses, trucks, commercial vehicles), as its adoption would entail an irreversible shift and would eliminate technological and market uncertainties. It is also a means of ensuring a viable outlet in Europe for heavy investment in fuel cells and tanks, financed in particular by the government. It also represents an extension of France's industrial policy across the entire value chain, from logistics to distribution (hydrogen stations and supply). Finally, it is a requirement for preparing major land-based infrastructure before equipping ports and airports to accommodate new maritime and aeronautical fleets running on hydrogen or its derivatives (ammonia and green methanol for maritime freight). European leaders in the aeronautics industry have made no secret of their interest in accelerating the development of distribution and usage infrastructures for future hydrogen-powered aircraft.[12]

The ongoing discussions around AFIR may lead to compromises on the pace of implementation for the countries furthest from the major European corridors, or on the initial minimum capacities of stations (at least greater than 500 kg/J), but it is essential to build this momentum as quickly as possible throughout the course of this decade.

To ensure the rapid and massive financing of these infrastructures,[13] it is essential to put in place the foundations of a public-private partnership (notably in the form of a capacity contract)[14] as quickly as possible, guaranteeing the State the investment and availability of distribution assets following a clear timeline. This would enable institutional investors to benefit in the early years from a support that would limit the risk of lower station load factors and provide vehicle manufacturers with the basic distribution infrastructure to offer a

12 — Hydrogen is essential to the future of aviation, whether we're talking about enriching existing fuels with hydrogen, developing SAFs (based on green hydrogen) or developing hydrogen aircraft for medium-haul flights.

13 — The Hy24 investment firm was designed also to help roll out these infrastructures.

14 — A joint note with the European Think Tank CEPS explains this approach (https://www.ceps.eu/ceps-publications/exploring-cost-effective-support-mechanisms-for-hydrogen- mobility-infrastructure/). Numerous initiatives involving all key players in the sector are underway with member states and the European Commission.

scaled solution to major logistics operators.

In this area, a Franco-German initiative would strengthen our ambitions. Hydrogen is the measure of progress in the energy transition in that it enables the most critical and difficult applications to be decarbonized, and these are also the ones that demonstrate the continuation of an intensive industrial and business base. The rapid development of decarbonized hydrogen would therefore ensure the survival of sustainable industrial activity throughout the territory.

The rollout of the hydrogen economy has begun. The proliferation of inter-country political agreements to supply this abundant source of decarbonized energy (in all its forms), marks the emergence of a new geopolitics of energy around new, clean vectors.[15] It significantly increases the sources and distribution of access potentials, which should benefit the negotiating positions of demand zones (Europe, Japan, Korea, Taiwan, Singapore), provided, of course, that positions are taken. It reshuffles the cards when it comes to the major relocation vectors for green energy-intensive industries, making it as important a parameter as labor costs were in previous decades. Thanks to its extensive energy networks, its optimal geographical position at the core of European import challenges, and its internationally recognized industrial players, France can use green energy as a tool to strengthen its sovereignty and mobilize its major energy and geopolitical allies in the South around a new industrial, energy and environmental project. Finally, its ability to seal a win-win agreement with Europe's founding heart (nuclear, renewable and carefully considered imports) could lay the foundations for a new European energy alliance, building on the founding treaty of the ECSC (CECA).

15 — The 50 or so announced projects, particularly in North Africa and the Middle East, represent a total investment of almost 150 billion euros, and are among the most advanced in terms of size and scope, with a focus on exports to Europe and North-East Asia.