1 June 2021

Market consultation

Low-carbon and renewable H2

FAQ

GRTgaz

Teréga

Questions summary

Background and challenges for the H2 rollout in France

Why are GRTgaz and Teréga addressing the question of hydrogen now?

Low-carbon and renewable H2 is a vector that plays a major role in both the ecological transition and French energy policy, with the goal of achieving carbon neutrality by 2050.

GRTgaz and Teréga have seen strong interest at local, national and even European levels in the production and use of the H2 vector, particularly as a substitute for fossil fuels.

GRTgaz and Teréga want to bring their know-how as a gas infrastructure manager to the market, as well as their well-established role as trusted actors working in the general interest and as planners of gas transport infrastructure expansion.

Furthermore, GRTgaz and Teréga believe that part of their existing gas infrastructure could be converted and made available to low-carbon and renewable H2. This system would co-exist with the transmission of methane and renewable or low-carbon gas to meet consumers' energy transition needs.

For several years, GRTgaz's R&D work has addressed these hydrogen issues. GRTgaz and Teréga are leading the JUPITER 1000 project, the first industrial-scale Power to Gas demonstrator connected to the French gas transmission network. This innovative technology consists of converting electricity into gas, hydrogen or synthetic methane, for injection into existing networks. It thus makes it possible to exploit surplus renewable electricity thanks to the massive storage and transmission capacities of the existing gas infrastructure.

From a regulatory standpoint, is the French network ready to transport H2?

There is currently no regulation specifically for hydrogen transmission such as the French Energy Regulation Commission (CRE) has in place for methane.

The current regulations, within the scope of the French Environmental Code, authorise the construction and operation of transmission pipelines specifically for hydrogen, in accordance with the procedures of Chapters IV and V, Title V, Book V of this code and the associated regulatory technical prescriptions defined by the Order of 5 March 2014, as amended, defining the procedures for the application of Chapter V, Title V, Book V of the French Environmental Code and setting out the safety regulations for pipelines transporting natural gas or similar, hydrocarbons and chemical products. However, the construction provisions for hydrogen pipelines are more restrictive than for natural gas.

From a technical standpoint, it is now possible to transport hydrogen in pipelines used to transport methane, subject to compliance with all the necessary technical precautions. Regulatory discussions are likewise forthcoming. Above a certain percentage of hydrogen, a new operating licence is required.

Finally, the Energy-Climate Act has amended Article L111-97 of the French Energy Code, giving low-carbon hydrogen producers a right of access to natural gas facilities on condition that they maintain the proper functioning and safety levels of the natural gas infrastructure. Consequently, the transmission of H2 within the existing methane transmission network in this type of mix is partly subject to the existing gas transmission infrastructure regulations.

When could we foresee a genuine, organised hydrogen market being established in France and Europe, as currently exists for gas?

It is too early at this stage to announce a set date for an organised hydrogen market. Creating a structured marketplace requires an infrastructure that allows a large enough number of producers and consumers to be connected. The quantities exchanged must also be substantial.

The aim of the consultation is to plan, as well as possible, the structuring of a low-carbon and renewable hydrogen transmission infrastructure that will be available to all stakeholders by 2040. It may begin to expand upstream of this, probably between large production and consumption areas. But to plan the network, and to assess its need and its route, we have to first find out the future needs of H2 producers and users, as well as the estimated quantities, their locations and their timeframes. This is the whole point of this consultation.

When can we expect the first connection requests from independent H2 producers?

It is possible to inject hydrogen into the gas network today. However, this remains a work in progress in terms of the economic model and its acceptability among our customers.

There are already connection requests from operators who propose injecting hydrogen, or a mixture of hydrogen and methane, into the existing gas network.

Some operators from adjacent countries have also expressed the need to address the issue of blending gases at interconnection points.

Gas TSOs also receive requests for the dedicated transport of hydrogen over small and medium distances (from 10 to 100 km).

Meeting these requests requires visibility for volumes and capacities, as well as for areas and timeframes. This is why GRTgaz and Teréga are launching the nationwide consultation.

How economically competitive is hydrogen compared to natural gas?

All forecasts (SNBC, French and European hydrogen strategies, etc.) include a high level of hydrogen in the energy mix as a means to "green up" certain uses that are otherwise difficult to decarbonise (industry, heavy vehicles, balancing energy systems including with adjacent countries). A reasonable H2 production cost is part of the equation, but the strength of this energy vector also lies in the chance it offers to decarbonise a portion of our economies.

As things stand, H2 production technologies are fully developed at the pre-industrial or industrial stage for small volumes (high-capacity electrolyser, hydrogen from gas steam reforming with CO2 capture and sequestration). These are largely supported by public funding, in particular by the French Recovery Plan. The sector's goals therefore involve significantly lower production costs in the coming years.

Do you have any evidence regarding the cost of H2 transmission?

The Joint Research Centre, the European Commission's internal scientific department, has published a study on hydrogen transmission and the cost of long-distance delivery for large quantities of renewable H2. The final cost of delivering hydrogen is determined by the "packaging", the transport distance, the quantity to be transported, the end use, and the availability of the infrastructure. The study concluded that at the European level, compressed and liquefied H2 transmission solutions, and more specifically H2 gas pipeline transmission, are more competitive than transmission by chemical vector. The current lack of hydrogen-specific infrastructures presents a problem for the delivery of large quantities of hydrogen over long distances. One option for long-distance hydrogen transmission is to reallocate the existing gas pipes for the use of hydrogen.

Chemical vectors such as ammonia or liquid organic hydrogen carriers (LOHC) are more economically competitive over longer delivery distances, creating import possibilities to suppliers located in, for example, Chile or Australia.

An estimate of the costs of transporting hydrogen has been published in the European Hydrogen Backbone. For an estimated investment amount of €64 billion, the transmission of 1 kg of hydrogen over 1,000 km could cost in the region of c€9 to c€17.

These cost elements may change depending on feedback from the consultation and future production and consumption volumes.

To decarbonise our gas consumption, do we have to adapt our process to hydrogen?

Biomethane is also an extremely flexible way to decarbonise with no need for a change of process. Gas TSOs are working on the full range of gas solutions, in consultation with our customers. Furthermore, the use of methane also enables the partial decarbonisation of activities that use coal or fuel oil as an energy vector, and which emit more greenhouse gases than does gas.

What research programmes are underway or planned in terms of H2 equipment and infrastructure?

Created in 2018, RICE is GRTgaz's Research & Innovation Center for Energy. RICE performs R&D for GRTgaz and also provides R&D services for other industrial partners in the areas of distribution, gas storage and liquefied natural gas. Its goal is to lay the groundwork, remove technological barriers, and drive the transformation of energy infrastructures towards a safe, efficient and carbon-neutral future.

In 2020, RICE had a portfolio of 74 patent families and more than 400 intellectual property titles in gas transport, storage and distribution. Its teams are spread over two R&D sites located in Alfortville and Villeneuve-la-Garenne.

In early 2020, RICE successfully led the first hydrogen injections produced by Jupiter 1000, the first industrial-scale Power to Gas* demonstrator, located in Fos-sur-Mer.

In 2018, with a commitment to the energy transition and a firm belief in R&D's importance for adapting the gas infrastructure, RICE came up with FenHYx, a platform project dedicated to hydrogen aimed at stepping up the adaptation of the infrastructure to renewable gas and hydrogen. In the long term. it will even replicate the operational features of gas networks, making it possible to carry out tests under pressure, temperature and hydrogen concentration conditions (0 to 100%) that are close to actual operating conditions. RICE's goal is to develop expertise and test facilities that are unique and tailored to renewable gases and hydrogen, paving the way for their expansion in Europe and worldwide. It will be one of the first R&D platforms in Europe dedicated to the impact of hydrogen on gas infrastructures.

Consolidation of French H2 market needs

Are there plans to build dedicated H2 networks or is the aim rather to use the existing gas network?

Converting the existing gas network for dedicated H2 transmission could offer significant savings for users compared to a new infrastructure. Ultimately, the aim is to keep two separate networks operational: one for methane and biomethane, the other for pure H2 to ensure customer supply. The extent to which existing pipes can be converted will therefore depend on the prospects of a fall in methane volumes over time.

Can we find out the positions of the convertible networks and their capacities with a view to using the hydrogen network to supply a customer?

To date, an initial vision of a dedicated H2 network – the so-called "European Hydrogen Backbone" – has been shared by European gas network operators. This vision gives an idea of the potential location of large-diameter pipes that can be converted.

The consultation will give us a more precise idea of the current capacities that could be made available for dedicated hydrogen transmission, as the rollout of an H2 network must be done alongside the ongoing transmission of methane and renewable and low-carbon gas.

Does the consultation also address the question of H2-natural gas blending? Are plans in place to separate hydrogen and methane on arrival at the point of consumption?

The focus of the consultation is on the future rollout of a dedicated H2 network.

Nevertheless, for information purposes, the consultation addresses the questions of injecting blended gases into the existing network, particularly in the context of large volumes from an H2 producer seeking to sell its production on a complementary market. Requests for blended H2 injection are already being handled by GRTgaz and Teréga.

In terms of separation, technologies currently exist as part of purification processes, i.e. for blends with a very low H2 percentage or vice versa.

European network operators are currently performing R&D work to increase the maturity of these technologies.

Would it be possible to create or adapt local networks, apart from large infrastructures, to create local ecosystems with lower levels of production/consumption?

It is entirely possible to envisage local networks being set up that are tailored to lower consumption. This type of request has already been made in the regions, as illustrated by the MosaHYc project.

The hydrogen system will be built gradually, with local beginnings followed by more widespread integration as H2 costs are optimised and to meet increasingly nationwide needs. Local networks will probably need to be connected to a broader market as local consumption and production increase.

Hence the need for visibility on when to respond to the need for connection between local and national networks.

Will the H2 transmission network be exclusively for low-carbon and renewable H2, or will it include grey hydrogen?

As part of ongoing French and European hydrogen strategies, and to contribute to the decarbonisation of the economy, gas TSOs are working on the rollout of a low-carbon and renewable hydrogen network. Furthermore, the grey hydrogen produced in France already has its own logistics.

How can we ensure that the H2 injected into the network is not grey hydrogen?

Gas TSOs are strongly advocating for a guarantee of origin system for all categories of hydrogen injected into the network. This is to ensure that everyone knows the type of hydrogen they are consuming.

The Hydrogen Ordinance was published in the Official Journal on 18 February 2021. It defines the different types of hydrogen: renewable, low-carbon and carbon intensive. It also provides for two low-carbon or renewable hydrogen traceability systems. A support mechanism will also be implemented for these hydrogen production channels. Several provisions address injection into natural gas networks. The network managers are charged with the balance, security and continuity of the routing and delivery service. A specific guarantee of origin scheme for renewable gas injected into the natural gas network is also planned, and renewable hydrogen will be eligible for this.

Does low-carbon hydrogen include hydrogen from gas steam reforming with CO2 capture and sequestration and hydrogen made from nuclear electricity?

Hydrogen is considered renewable when it is produced from renewable energy sources and if it meets a threshold of CO2-equivalent emissions per kilogram of hydrogen produced. This category includes electrolysis using renewable electricity (solar, wind, hydro-electric power), as well as any other production process using renewable energies that is "not in conflict with other uses enabling their direct recovery" (pyrogasification or thermolysis of biomass, steam reforming of biogas).

Hydrogen is considered low-carbon when it is produced from non-renewable energy sources (natural gas, nuclear) and if it meets the same kgCO2eq/kgH2 threshold. Hydrogen from natural gas steam reforming with sequestration of CO2 emitted can be considered low-carbon.

Will hydrogen from biomass gasification have a place in the energy mix?

It is indeed necessary to anticipate the production of hydrogen from biomass which, as for other production methods, may or may not be pure. However, its production cost must be taken into account compared to other types of production, starting with hydrogen as an industrial by-product and hydrogen produced in a slightly more large-scale way. The most cost-effective answer is not entirely clear as things stand.

Spain has provided information about its hydrogen plan. What about Italy?

Italy has published a first draft of the *National Hydrogen Strategy Preliminary Guidelines* road map, which provides for the installation of 5 GW of electrolysis by 2030, with H2 making up 2% of the energy mix in 2030 and 20% by 2050.

The final document summarising the Italian strategy is expected to be published in 2021.

What would be the emission factor of H2?

The emission factor of H2 depends on its production process. Currently, the most widespread of these is natural gas reforming. However, data are also being produced for biomethane reforming and water electrolysis. All these data can be found in the ADEME Carbon Base® tool.

The emission factors given by the ADEME Base Carbone® tool are taken from *Life Cycle Analysis for Hydrogen Mobility* – a 2020 study by ADEME, Sphera and Gingko21. The values entered in the Base Carbon® tool are from "Cradle to Gate", i.e. from upstream emissions and infrastructures until leaving the production unit.

Emission factors do not take into account the transport of hydrogen between its place of production and its place of distribution. If these are not one and the same, the transport impact must be added according to the distance between the two sites, given in kgCO2/kgH2/100km.

What hydrogen imports are you anticipating in Nantes, Fos or Dunkirk? Where would it come from and in what form?

As things stand, the technology for H2 maritime transport in liquefied form does not seem mature enough to be rolled out on a large scale. Nevertheless, the IEA has identified ports and in particular LNG terminals as potential entry points for H2 maritime trade routes by 2040.

Apart from imports in the strict sense of the term, these ports and seaboards more generally are often close to the envisaged offshore wind farms, which, coupled with electrolysers, could enable the significant production of renewable H2 to meet demand in these areas.

In their study of 15 June 2020, the Gas for Climate consortium (made up of 10 large European gas transmission companies and two renewable gas industrial associations) concluded that hydrogen transmission by pipeline would be more competitive than maritime transport and power lines in the case of cross-border flows. The report also points out that hydrogen imports by sea may increase for longer-distance supplies.

How will the converted pipes carrying hydrogen be sealed?

Existing equipment such as valves are subject to leak tests. The carriers Teréga and GRTgaz will continue to conduct their maintenance programme, as for the natural gas network. Conversion techniques are used to seal pipes carrying hydrogen. We do not currently see any particular problems with regard to sealing. The MosaHyc project will allow for full-scale testing of the converted equipment from both a technical and economic standpoint.

How would connections between private networks (e.g. Air Liquide) and new hydrogen networks be structured?

No structuring of this type is planned. Private networks are currently functional for grey hydrogen.

Might H2 be stored in the French natural gas storage facilities?

Current natural gas storage facilities could be used to store H2.

In Europe, there are three types of underground formation with cyclical and seasonal capacities for large-scale H2 storage: salt caverns, aquifers and depleted reservoirs. The various underground formations each have specific technical features such as pressure, injection capacities, drawing, cushion gas and cycling.

The flexibility and storage needs identified through this consultation could contribute to the planning of storage infrastructures.

H2 consultation procedures and schedule

Are consultations of this type being held simultaneously in Germany, the Netherlands, Belgium, Luxembourg and the southern European countries to arrive at a vision for the whole of Europe?

GRTgaz and Teréga are working with adjacent TSOs to coordinate the planning for the European H2 network of tomorrow. Since mid-2020, FNBGas (Germany), Gasunie (Netherlands) and Fluxys (Belgium) have launched similar initiatives.

With regard to a consolidated European vision, the European Commission, through its revision of the TEN-E regulation, is planning to give ENTSOG the task of drawing up a ten-year vision for the development of the H2 network. Consolidated feedback from national consultations could thus feed into a European plan.

Does the CRE (French Energy Regulation Commission) have a specific role in this consultation?

For the time being, the CRE has no particular role as the hydrogen market is not currently regulated. As regulated gas entities, GRTgaz and Teréga have, of course, informed the CRE of this initiative prior to the consultation. And we will be giving it regular updates of feedback from the low-carbon and renewable hydrogen market.

To what extent can a local authority respond about projects being implemented in its territory (volumes and timescales) by industrial companies?

Local authorities are invited to encourage companies with regional projects to respond to the consultation. This does not prevent the local authority from responding to more "macro" aspects of the questionnaire or by returning the volume and timescale data when it has them. This data will be aggregated anonymously, and we invite you to contact us if confidentiality issues are ongoing. Optimal planning requires as many respondents as possible, so we look forward to your full participation.

What is the guaranteed level of confidentiality for the data communicated?

GRTgaz and Teréga have overseen this consultation process, which is being launched today for hydrogen, for over a decade in the field of gas. It is also codified at the European level. Gas TSOs are therefore experienced in collecting needs data, which is often confidential on an individual level, and in guaranteeing its confidentiality while aggregating it anonymously to perform network calculations and communicate about the possible networks of tomorrow.

Does the consultation also address a possible pipeline infrastructure for CO2 transmission?

The consultation includes some questions relating to the capture and storage of CO2 and its recovery. Depending on the qualified responses to these questions, a consultation specifically for the CO2 network of tomorrow could be considered.

What information will be available in the end-2021 report? Will there be more consolidated routes, perhaps with intermediate timeframes around 2030 or before? What are the key components concerning the costs of this transmission?

The consultation aims to collect information from French producers and H2 users about the locations of H2 production and consumption, its scheduling over time, and finally information about the expected volumes for the production and consumption sites.

All this information will allow us to offer an adjusted vision for the planning of the future H2 network at end-2021. Depending on the answers given, the TSOs will be able – or not – to announce this planning with a timeframe of 2030, 2035, 2040.

The cost of transporting H2 by pipeline will probably be adjusted based on the responses to the consultation. It will be specified at a later date.