Shaping the gas system of the future

Q&A Webinar 26/01/2021

Table of Contents

Intro ____ 2

Questions & Answers ____ 3

Momentum is Now ____ 3

Step-wise approach ____ 5

Technical Orientations ____ 7

Commercial Approach ____ 9

Contact ____ 11

Intro

Thank you for your interest and participation in our webinar on January 26th, during which we broadly outlined our approach, the commercial process and the technical orientations. We were not able to respond to all your questions during the session, and therefore this document is made available with the remaining questions and answers. As multiple questions did overlap, we grouped and rephrased some of them. You will find all the answers below in this document. In case you have additional questions, please don't hesitate to contact us on info.hydrogen-carbon-transport@fluxys.com .

Questions & Answers

Momentum is Now

In the introduction it was mentioned that in the future roughly 50% of our energy would come from renewable electricity and roughly 50% from green molecules. Where are these estimates coming from? Why not more from electricity directly? Would this figure be different in different countries in Europe?

The presentation is available on our website under https://www.fluxys.com/-/media/project/fluxys/public/corporate/fluxyscom/documents/energy-transition/request-for-information/fluxys_belgium_h2_co2_infosession_presentation.pdf

On slide 4, the figures are based on the following Source: EU Hydrogen Strategy & Energy System Integration, July 8th, 2020.

In July 2020, the European Commission published the EU Strategy for Energy System Integration and a Hydrogen Strategy for a climate-neutral Europe. Both documents emphasize the role of hydrogen as a green or decarbonized energy carrier, together with biomethane and e-fuels, beside electricity. Green molecules and green electricity are projected to cover each around 50% of the final energy demand.

The projection is not specific for Belgium but at European level, and wide differences between countries are likely to exist.

The demand for H_2 exists/can be developed and Fluxys is capable to provide the infrastructure, but will the supply of affordable green/blue H_2 be present in a country with a high electricity price and with limited renewable electricity generation potential?

The balance between supply and offtake is key as well as access to affordable H_2. The purpose of the RFI is to map where H_2 is available from (potential) suppliers and where demand exists from (potential) offtakers. Where a balance appears, infrastructure can be proposed and offtakers and suppliers can get in contact to contract H_2 delivery/offtake. Studies show that the cost of green H_2 production will decrease over time and that availability will increase. In parallel, the CO2 price is expected to increase, making decarbonized alternatives more competitive. As the renewable power potential is limited in Belgium, and the need for green electricity to satisfy final electricity demand is significant, hydrogen import will be required as well. (cfr next question)

Do you plan to facilitate the import of H2 at Zeebrugge, Gent/Terneuzen or in Antwerp? What's the timing for the connection of the H2 industrial clusters with Zeebrugge (H2 pipeline)? 2030 or 2035?

If green hydrogen can be produced by electrolysis, among others, to provide the necessary flexibility to optimize the overall energy system, the potential of domestic production depends on the availability of green electricity and its price as well as the price of the to-be-imported hydrogen. As the renewable power potential is limited in Belgium, and the need for green electricity to satisfy the final electricity demand is expected to be significant, some hydrogen will most likely be imported.

Different possibilities are considered for the remote production and import of green hydrogen:

- Imports from European regions with higher renewable potential, either from Northern Europe where wind is blowing harder (e.g. North of the Netherlands) or Southern Europe where there is more sun (e.g. Spain, Portugal, Morocco). In this situation, import by pipelines or transport by ship are both considered;
- Regions farther away from Europe offer even higher renewable potential for the production of green hydrogen. H_2 will then be imported via ships. In this situation, there will be a need for import terminals and pipelines to transport hydrogen to the market.

Interconnections with adjacent countries are important to enable access to a larger market and to unlock sufficient hydrogen supplies. Large production in the North and the South of Europe is expected. Zeebrugge is definitely a good location to develop overseas import of hydrogen, as it has access from/to the sea, a direct connection with offshore wind energy production, direct pipeline connections with adjacent countries such as the UK and Norway, sufficient space and the necessary port infrastructure. Synergies with the existing LNG terminal infrastructure are also possible. Timing of such developments will depend on market evolution but could be possible as from 2030.

As studied by Engie, DEME, Exmar, Port of Antwerp, Port of Zeebrugge, Waterstofnet and Fluxys, in the framework of a joint H2 import study, hydrogen import can be done under different forms: either pure liquid hydrogen or via a hydrogen carrier such as synthetic methane, ammonia, methanol or LOHC. Among them, synthetic methane, the result of a combination of CO2 and H2, is an efficient carrier and would allow to efficiently re-use the existing gas infrastructure – and the LNG terminal in Zeebrugge – while allowing to tap into the potential of hydrogen.

What's the expected size of the H2 market in 2025/2030/2040? Have you identified/contacted the future potential shippers and industrials?

Hydrogen is set to become a key decarbonised energy carrier and will also be used as decarbonized feedstock. The level of hydrogen demand in the near future and in the long term will depend on several socio-economic factors. A few examples are the evolution of industrial production, technological breakthroughs, customer demand for fuel cell vehicles, building renovation, evolution of electrolyser cost, and so on.

Different scenarios were analysed and have been published by the Federal Planning Bureau (*Fuel for the future – More molecules or deep electrification of Belgium's energy system by 2050*, October 2020) and the Fuel Cells and Hydrogen Joint Undertaking (*Hydrogen Roadmap Europe – A sustainable pathway for the European Energy Transition*, January 2019). The Federal Planning Bureau focuses on two distinct scenarios concerning the evolution of energy uses, called "Deep electrification" and "Diversified energy supply". The first scenario considers a far-reaching electrification of the final energy consumption while the second one considers a combination of electricity and gas. The Fuel Cells and Hydrogen Joint Undertaking has put forward its so-called "Ambitious scenario" in the Hydrogen Roadmap Europe report which represents the view of the industry represented by Hydrogen Europe. The results of the report have been recalculated for Belgium by applying the final energy demand ratio for the various sectors at Belgian and European level. The report of the Federal Planning bureau only provides an outlook for 2050, whereas the Hydrogen Road Europe looks at 2030 and 2050.

The scenarios show that the total anticipated demand for hydrogen in Belgium in 2050 ranges from 60 to 100 TWh/y in the different scenarios.

Step-wise approach

What timing does Fluxys consider for the developments?

Fluxys proposes to start the development of a hydrogen network in industrial clusters. In parallel, interconnections between those clusters will ensure the rapid development of a hydrogen market by allowing suppliers to access all customers and customers to access all suppliers. The developments will be market driven and follow a stepwise approach. Industrials need to make important investments and take important decisions on what decarbonization options are best suitable for their applications. The infrastructure will be offered at the rate of the conversion of the industry, taking into account several parameters such as the balance between supply and offtake, infrastructure costs, cluster density, etc.

The same market driven and stepwise approach is prosed for the development of a CO2 network, where emitters with carbon capture installations will be able to transport their CO2 to users of CO2 or to sequestration sites. It is our ambition to make hydrogen and carbon infrastructure operational as from 2025 through close collaboration with industry, market

players and neighbouring operators. The Green Deal for Europe increases its target from 40% to 55% of reductions of greenhouse gasses by 2030, while the EU Recovery plan offers a unique opportunity to invest in sustainable recovery and growth. The momentum is now to start to roll out infrastructure for H2 and CO2, infrastructure to be operational by 2025.

What geographic scope does Fluxys consider for the development of its H2/CO2 infrastructure?

The focus is on Belgium, but discussions with adjacent TSOs are ongoing or will be started to ensure interoperability and interconnectivity. Adding interconnections to the Netherlands, Germany and France will ensure more diversity, flexibility and security of supply and facilitate the emergence of a pan-European market.

H2 transport infrastructure already exists in Belgium. Why build a parallel one? Do you intend to collaborate with existing private H2 suppliers and existing H2 transport infrastructure to create more synergies?

Hydrogen volumes and applications are expected to increase and diversify, and additional infrastructure will be needed. The existing hydrogen pipeline infrastructure in Belgium has been designed to transport hydrogen to some industries using it as feedstock.

The hydrogen market for the future decarbonized economy, supported by a H2 backbone with open and non-discriminatory access to transport infrastructure is key to support the development of an efficient, competitive and liquid market for all stakeholders, not only for those using H2 as a feedstock but also for those willing to use it as energy. Repurposing natural gas pipelines will enable to achieve a H2/CO2 backbone cost-effectively. Fluxys fully supports the necessity of an adaptation of the legal and regulatory framework in order to enable the development of a H2 and CO2 backbone and ensuring a non-discriminatory open access, as mentioned by our Federal Minister of Energy during our webinar on January 26th .

What about industries located outside the cluster zones?

The borders of the clusters are not defined yet. Dense industrial areas with high demand where supply and offtake can be balanced have most chances to develop faster. Nevertheless, the infrastructure proposals will be market-driven, and the stepwise approach will be driven by the requests of the market.

If you are located outside the initially proposed clusters, please come forward and share your plans with us through the RFI. In this way, we can investigate together how we can adapt our plans.

You mentioned CO2 "terminals" for CO2 transport. Does this mean that Fluxys will organize liquefaction ?

Transport of CO2 over longer distances can be achieved by shipping CO2 in liquid form and adds additional destination flexibility for usage or sequestration. Terminalling sites will collect in clusters the CO2 from industrials through pipelines in gaseous phase. The CO2 will then be liquefied before being transported by ship over longer distances to their final destinations. Fluxys has expertise in terminalling activities. If there is a need, Fluxys is willing to offer the infrastructure solutions needed to transport CO2, including terminalling activities.

How will you handle multiple vectors at the same time, except by doubling/tripling networks? Would it not be better to take the step immediately to a hydrogen economy?

We aim to build and reconfigure the infrastructure that is needed to enable the decarbonization of the industry. Transition will be progressive and each industry and company will develop the most adequate solution to its activities. For some applications carbon capture might be a better or even the only possible option while for other applications hydrogen might be preferable. Fluxys proposes to provide the required infrastructure at the right time to enable the decarbonization of the economy. By having a good view on the markets needs through the RFI, we will be able reallocate flows of natural gas and free up well-dimensioned pipelines for H2 or CO2. It is therefore important to have as soon as possible a clear view on the demand for H2 and CO2.

Technical Orientations

What about H_2 blending into natural gas? Will a connection to a "pure" natural gas (i.e. without blending) network still be possible in the future?

Blending H_2 into the natural gas network is considered in parallel with pure H2 network development. Regular interactions take place with neighboring TSOs to align specifications and evolutions. Due to the existing high interconnectivity of natural gas grids, it is important that all countries use the same specifications.

Blending may support a progressive decarbonisation of the current natural gas consumption where and when it's technically and economically possible. However, limitations on quality and interoperability exist.

Accessibility to a reliable supply of natural gas of constant quality as today will be maintained while alternative offers for connections to H2 and CO2 transmission infrastructure will increase over time.

Storage has not been mentioned. Is there also storage of hydrogen included to balance changes in supply/offtake?

The best option for bulk storage of H2 is to use salt caverns, which are not present in Belgium. The storage of H2 in aquifer storages is under investigation but not yet available in the short run. Flexibility therefore should come from alternative options such as line-pack (pressure variations in the pipelines), cross-border interconnections with adjacent countries to access their H_2 underground storages, interconnections with natural gas network (blending, methanation) and balancing between supplies and offtakes. Modulating production on demand or modulating offtake are considered options that we challenge with the market through the RFI.

Is there no issue with H2 metal embrittlement? Can the existing steel piping be reused without issues of hydrogen embrittlement?

Studies and operational tests are ongoing and show that H2 embrittlement could take place but that it can be fully contained by taking additional measures. Just as for the transport of other products, safety requirements exist and will be applied for the transport of hydrogen. Safety is our top priority. Measures that can be taken to reduce the impact of H2 embrittlement consists of specific operational constraints on pressure and pressure variations, or of presence of inhibitors such as CO and O2 the H2 quality specifications.

You propose 2 gas quality standards. Which one will be selected and how?

We propose different gas quality specifications for orientation purposes, based on existing applicable norms, production applications or constraints and operational considerations. The pipelines can be repurposed provided that the gas transported does not contain liquids and that corrosion is avoided. The proposed specifications aim at challenging the market and are not final. The final specifications will be established in order to find the largest common denominator. We highly invite you to share your points of view via the RFI .

Shouldn't hydrogen only be used if temperatures above 105°C are required while industries requiring low heat temperature (<105°C) should use heat pumps and hot water buffers (electrification)?

Belgium and Europe are facing challenges to get to carbon-neutrality by 2050 in line with the EU Green Deal. In July 2020, the European Commission published an EU Strategy for Energy System Integration and a Hydrogen Strategy for a climate-neutral Europe. Both documents emphasize the role of a mix of vectors putting forward the importance of energy efficiency and (green) electrification, together with the importance of molecules such as hydrogen as a green or decarbonised energy carrier and biomethane and e-fuels. Each energy carrier should be used in applications where it has the most added

value considering cost, technical feasibility and security of supply. High temperature applications will preferably require hydrogen as combustion fuel as alternatives such as heat pumps or hot water buffers are not suited. These technologies may be used for lower temperature applications and smaller appliances.

Norway has started with the first European project of CO2 storage. What about Belgium ? Will Fluxys be an actor in CO2 storage? Where do you expect CO2 emitted in Belgium to be stored at sea?

Belgium's geological structure has a lower potential for CO2 storage than some other neighbouring countries with depleted gas fields. CO2 sequestration is typically developed in such depleted fields. The aim is to make these sites accessible through the development of infrastructure by developing the required transmission infrastructure (incl. terminalling activities and pipelines) to enable access to CO2 utilization and sequestration sites on an open-access basis. Fluxys is also interested to know whether an integrated service offer (incl. sequestration capacity) should be considered, and invites you to notify this potential need via the RFI.

How will Fluxys guarantee the safety of hydrogen pipelines and how can we convince the general public that hydrogen is safe?

Just as for the transport of other products safety requirements exist and will be applied for the transport of hydrogen. This is our top priority. In that perspective transporting hydrogen is not different from the transport of natural gas or electricity. The transport of hydrogen is not new, and the safe conditions will be guaranteed through our expertise and with respect of the safety requirements as specified in the "Codes techniques" of the Gas Law.

Commercial Approach

Will we, like the transport of natural gas, move more towards a specific form of monopoly on the transport of hydrogen? Will the transport of H2 and CO2 be regulated?

This is not defined today. The Federal government is willing to implement a legal and regulatory framework to enable the energy transition (cfr. Federal Minister of Energy during the webinar of January 26th). Fluxys is willing to contribute and develop transparent and open access services as in the current regulatory framework for natural gas transport.

Can Fluxys ensure two separate regulatory accounts will be kept for gas and H2/CO2? Is there a cross-subsidization/transition plan with natural gas?

The actual regulation for natural gas transport is very strict and avoids any cross-subsidization, even between transmission, storage or LNG activities for natural gas. The Federal energy regulator CREG will monitor that the applicable legislation and regulatory rules are applied. We expect also to have a separate regulation for H2 transmission and therefore two separate regulatory accounts will probably be maintained.

Who will pay the transport fee? The shipper (if any) or the end user?

This is not defined yet. The commercial model and commercial roles will be defined through market consultations. The commercial model for transport of CO2 might differ from the model for transport of H2 or from the transport of natural gas. Future regulation might also change commercial roles.

Which color would the hydrogen flowing in the Fluxys network have?

All hydrogen molecules, independent of their production method/color will be able to flow through the network as long as the gas quality requirements are met. Nevertheless, the goal is to have an increasing part of carbon-neutral hydrogen over time and to achieve 100% carbon-neutral hydrogen horizon 2050.

How do you see the role of Universities and Research Centers in your approach?

All stakeholders together have their role to play and Fluxys offers part of the solution as market facilitator. Fluxys is also keen to work together with universities and research centers since academics are frontrunners in the development of new technologies which are essential to make the energy transition succeed.

Will there be different tariffs for natural gas and hydrogen? What will be the tariff for hydrogen transport?

As we expect to have a separate regulation for H2 transmission, we expect hydrogen to have its own set of transport tariffs. The transport services can also be defined differently from natural gas where services are based on a mature entry-exit system and set in accordance with very detailed and precise tariff regulations (e.g. EU tariff network code) leaving little flexibility to accommodate an emerging and developing market. The level of tariffs is not known yet but the tariff set up will be designed to support the emerging and developing market. The aim is to have the transport system supporting the market and not being a barrier in project developments.

Contact

Should you have any additional questions, feel free to contact us via info.hydrogen-carbon-transport@fluxys.com.