Indicative investment plan Fluxys Belgium & Fluxys LNG 2021-2030

February 2021

Purpose

The indicative investment plan 2021-2030 sets out all investments needed to keep up with changes in Belgium's natural gas market, maintain and upgrade infrastructure, and achieve the aims of Fluxys Belgium and Fluxys LNG. The investments described in this document are provided for reference purposes only and relate to gas transmission and storage infrastructure in Belgium as well as the Zeebrugge LNG terminal.

Outlook for 2021-2030

Changes on the market in Belgium and in neighbouring countries lead to adjustments of Belgium's natural gas transmission infrastructure. This is especially true for the L/H conversion, which is needed as a result of the upcoming end of gas supplies from the Groningen gas field in the Netherlands; the construction of new power stations in light of the phase-out of Belgian nuclear power plants by 2025; and the market demand for more regasification capacity at the Zeebrugge LNG Terminal.

Given the maturity and age of the Fluxys Belgium and Fluxys LNG infrastructure, substantial amounts have also been earmarked for recurring investments in maintaining, adjusting and modernising the network. Furthermore, Fluxys Belgium needs to adapt its network in line with demand from public distribution (which sees between 55,000 and 60,000 new customers every year) and new industrial customers.

Annex: Hydrogen and CO_2 transmission systems

An annex detailing the outlook beyond the current framework of the Belgian Gas Act has been appended to the indicative investment plan 2021-2030, which was drawn up in accordance with Article 15/1, §5 of said Act. This annex sets out the future development of hydrogen and CO_2 transmission systems in Belgium, which will be based in part on the reuse of Fluxys Belgium's natural gas transmission infrastructure. The framework governing the development of such transmission systems will be devised in the years to come, and investments will depend on changes in needs as well as technical opportunities.

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1 The European gas market

1.1 Consumption trends in 2019

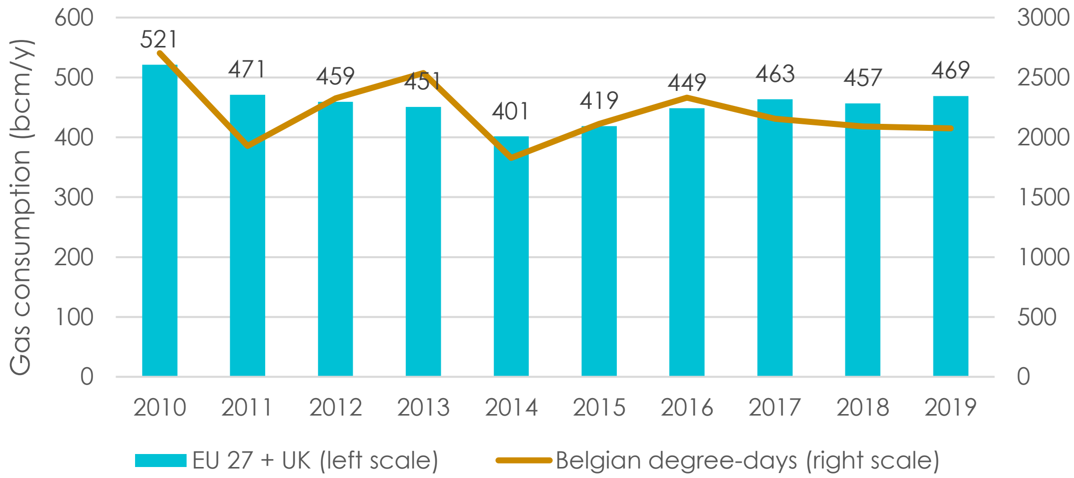
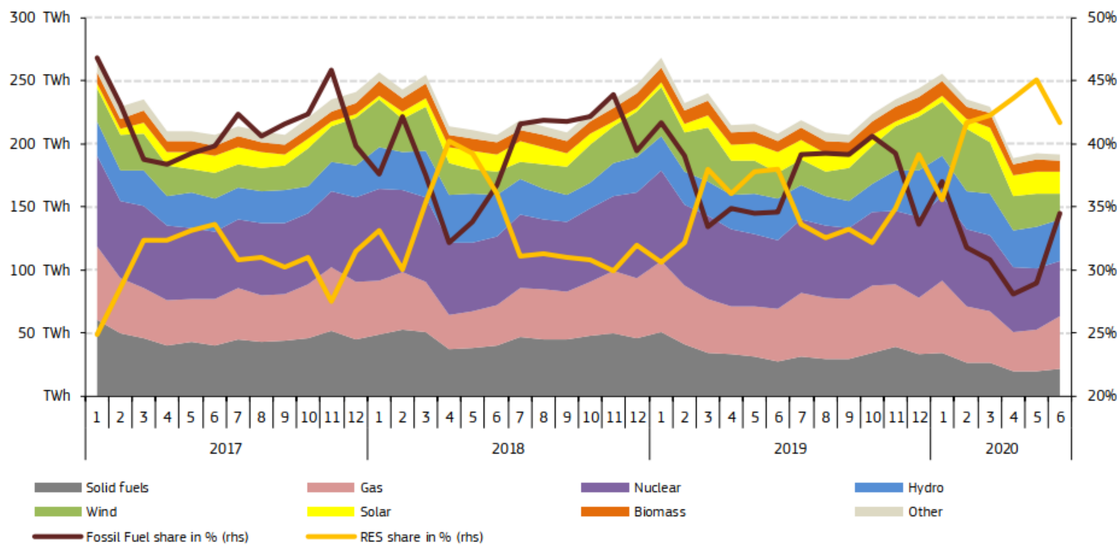


Figure 1: Gas consumption in the EU 27 and the UK, and the impact of the weather (sources: BP Statistical Review of World Energy, 2020 and gas.be)

In 2019, the European gas consumption (in the EU 27 (excluding Malta) and the UK) rose from 456.8 bcm in 2018 to 469.1 bcm, following a slight drop the previous year (BP Statistical Review of World Energy, 2020). The upward trend recorded between 2014 and 2016 was mainly linked to the increasing number of degree days. This trend has since reversed, with degree days falling since 2017 due to higher than normal temperatures in Belgium and across Europe, mitigating the demand for gas to heat buildings.

Figure 12 – Monthly electricity generation mix in the EU27



Source: ENTSO-E, Eurostat, DG ENER. Data represent net generation. Fossil fuel share calculation covers power generation from coal, lignite, gas and oil.

Figure 2: Monthly electricity generation mix in the EU 27 (source: European Commission, 2020)

In its Quarterly Report on European Gas Markets, the European Commission assesses gas demand in the power sector. In 2019, Europe's electricity generation mix had changed from the previous year, with gas accounting for a greater share of total electricity generation (23%) and partly offsetting the decline in lignite and coal (14%). Renewables (mainly wind power) compensated for this decline in coal.

The competitiveness of gas-fired power generation improved vis-à-vis coal due to lower prices for natural gas and relatively high prices for coal, aided by high prices for carbon emission quotas (€25/tonne CO_2 equivalent). In Belgium, gas production generally offsets the deficit in nuclear capacity.

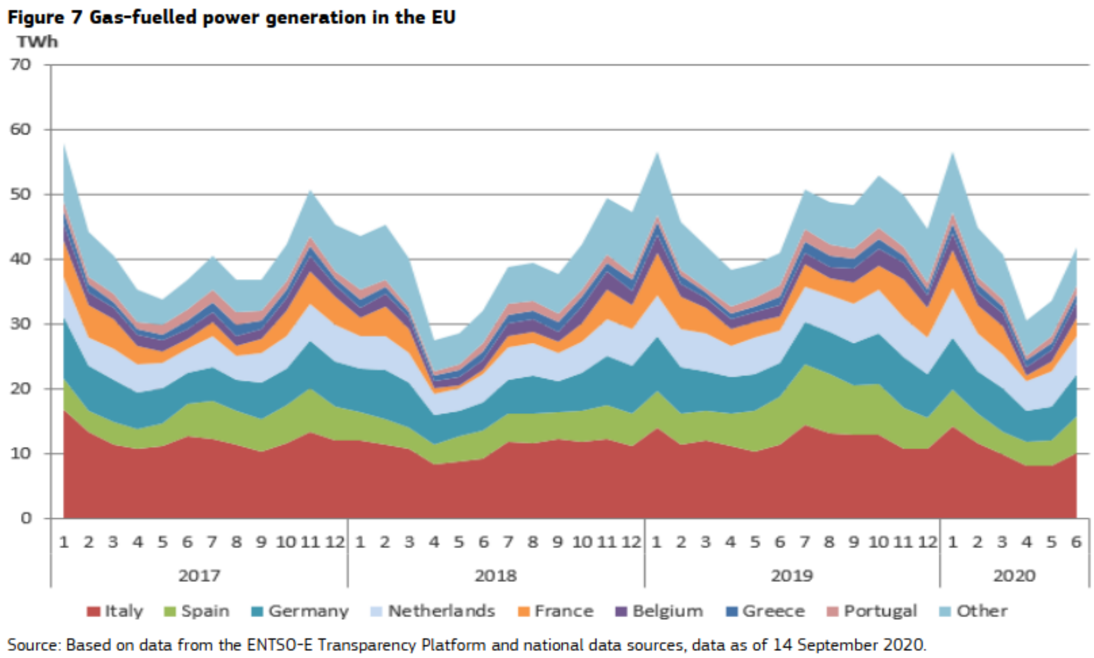


Figure 3: Gas supplies for power generation in selected EU Member States (source: European Commission, 2020)

1.2 Outlook for natural gas demand

The global commitment to limit climate change (Paris Agreement) as well as national and European energy and climate policies will impact gas demand in the future.

The European Network of Transmission System Operators for Gas (ENTSOG) – of which Fluxys Belgium is a member – defined three demand forecast scenarios in its Ten-Year Network Development Plan (TYNDP) 2020, including methane (natural gas, biomethane, synthetic gas) and hydrogen. The Global Ambition scenario, which envisages a rapid reduction in CO_2 emissions and alignment with the targets in the Paris Agreement, foresees the strongest gas demand. Demand would peak at around 2030 before gradually declining to just below 4,000 TWh in 2050. Under the Distributed Energy scenario, demand for natural gas would fall to 3,000 TWh by 2050.

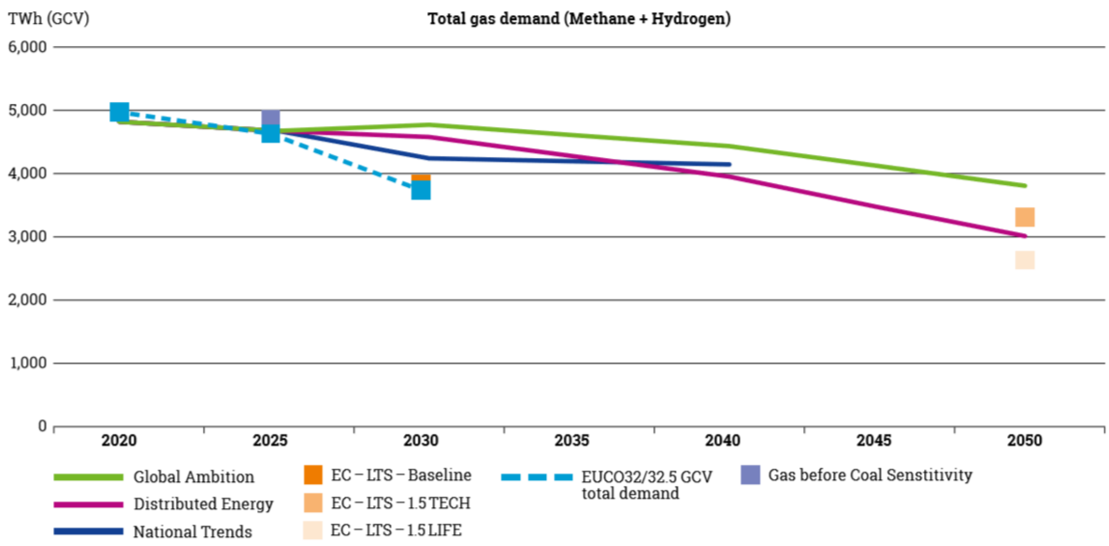


Figure 4: Projections for total gas demand (methane and hydrogen) (source: ENTSOG, 2020)

Despite the impact of energy efficiency measures on gas demand, there are also ways to use gas in highly energy-efficient technologies. Combined heat and power (CHP) technology, including fuel cells, shows great potential in small and medium-sized applications as well as for residential use. This technology falls within the decentralised power generation segment, and has the added benefit of using existing gas infrastructure and avoiding congestion on the electricity distribution system. Gas-fired heat pumps can halve energy consumption by using 50% renewable heat. Hybrid heat pumps (comprising a small electric heat pump and a gas condensing boiler) combine the use of renewable electricity with the security of gas supply.

The transport sector is seeing some growth in compressed natural gas (CNG) and, in particular, liquefied natural gas (LNG) as alternative fuels for vehicles and ships. As far as maritime transport is concerned, analysts expect LNG to amass a market share of 3% to 10% between 2025 and 2030, i.e. equal to approximately 15 to 45 million tonnes/year.

The L/H conversion could lead to a short-term collapse in demand in some markets. In the wake of declining exports of Dutch L-gas, the conversion of Belgian, German and French L-gas markets to H-gas may lead to some end users switching to alternative energy sources and electric heat pumps. In Belgium, however, where appliances are compatible with both L and H gases, this risk can be mitigated by all gas-sector players taking appropriate action, and as yet there have been no signs of a collapse in natural gas demand.

1.3 Supply trends in 2019

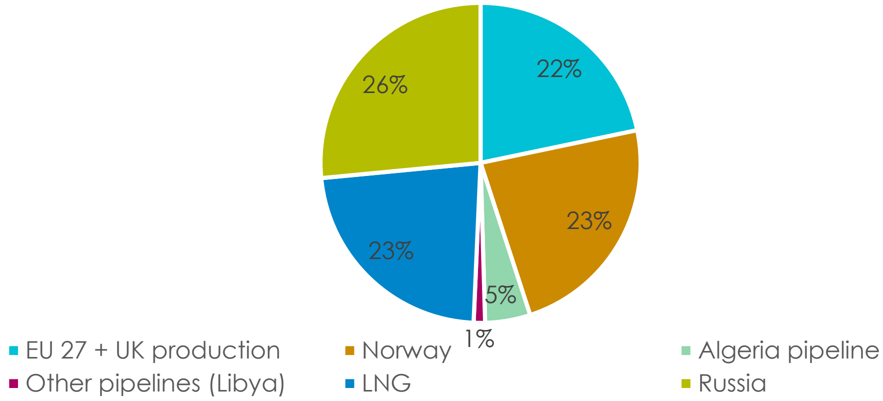


Figure 5: Gas supply mix in 2019 (EU 27 and Russia) (source: BP Statistical Review, 2020)

In 2019, Russia was Europe's biggest supplier of natural gas (market share of 26%), followed by Norway and LNG imports (23%), and European production (22%). Imports via pipeline from outside Europe (Algeria and Libya) accounted for 6% of supplies.

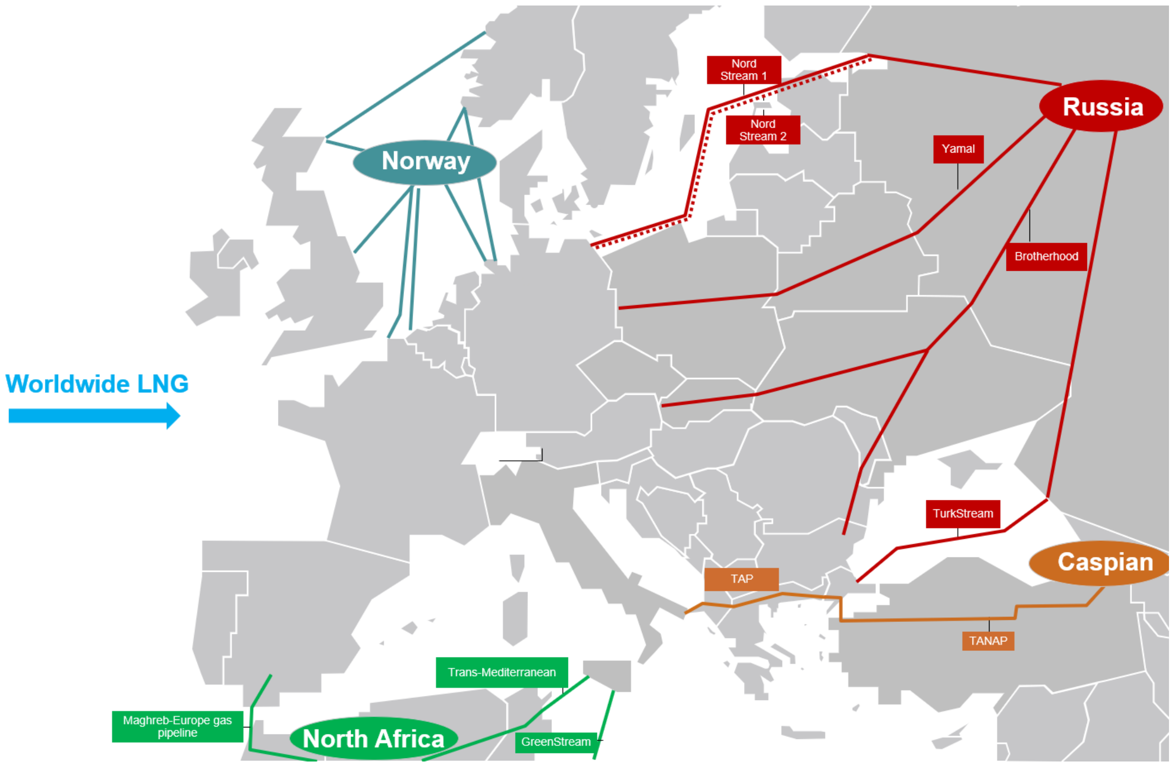


Figure 6: Europe's current and future supply routes

Russian pipeline gas supplies to Europe in 2019 came via Ukraine (45% in 2019 vs 41% in 2018), Nord Stream (33% vs 34%) and Belarus (22% vs 25%). The commissioning of the TurkStream gas pipeline on 8 January 2020 also affected the distribution of Russian imports in 2020.

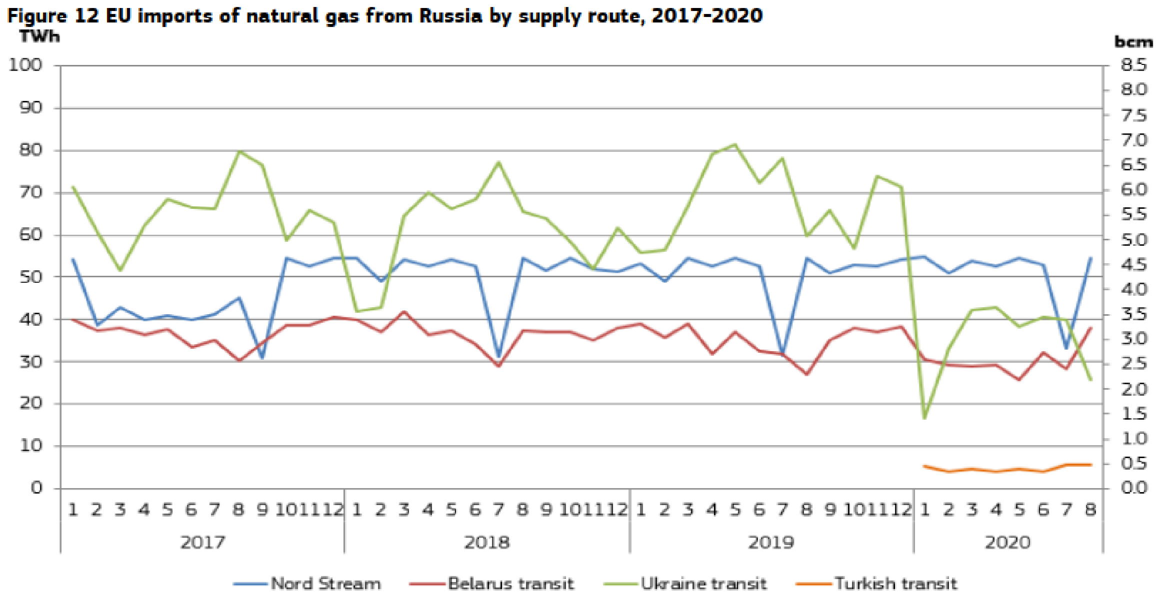


Figure 7: EU imports of gas through Russian supply routes (source: European Commission, 2020)

Supplies from LNG imports to Europe have witnessed incredible growth since Q4 2018, as illustrated by the figure below. From a stable average of 50 bcm/year from 2013 to 2018, the cumulative send-out of all terminals increased significantly from October 2018 onwards, reaching 80 bcm/year in winter 2018/2019 and 120 bcm/year in April 2019, at the beginning of the storage period. After falling by around 80 bcm/year in summer 2019, it rose to 150 bcm/year in December 2019 and reached approximately 120 bcm/year in the first five months of 2020. It then dropped sharply to around 80 bcm/year due to the COVID-19 pandemic and the very low gas prices worldwide. Depending on the economic recovery, the global oversupply of LNG could last until 2022-2025.

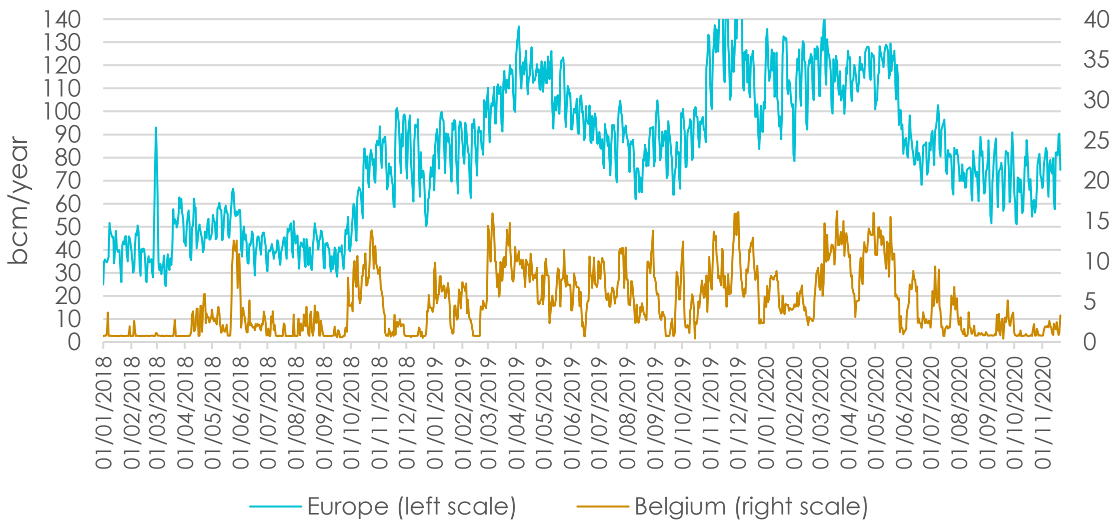


Figure 8: Send-out from LNG terminals in the European Union (source: GLE transparency platform)

Following the development of liquefaction capacity in the United States and Russia, Europe's LNG market is dominated by Qatar, Russia and the United States. However, the level of LNG imports depends very much on global LNG dynamics, in which LNG demand in Asia plays a key role.

Cumulative LNG imports from the United States to the EU

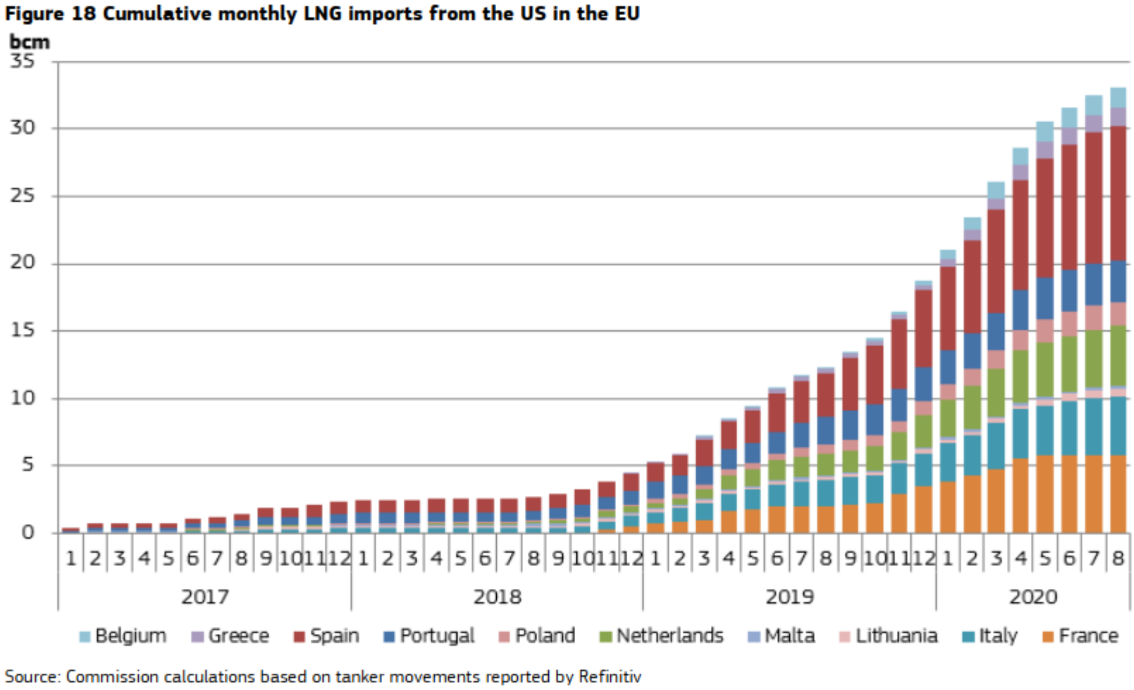


Figure 9: Cumulative LNG imports from the United States to the EU (source: European Commission, 2020)

1.4 Outlook for European domestic production

In the long term, Europe's domestic natural gas production will continue to decline. Domestic gas production in Europe is falling as North Sea gas fields (UK and the Netherlands) are depleted, and Dutch L-gas production is declining due to natural depletion and regulatory measures taken as a result of earthquakes in the region. In some countries, the decline in production will be offset by the development of green gas production (biomethane, power-to-gas) up to 2040. No major development of shale gas is currently foreseen.

The supply of L-gas to Germany, Belgium and France will gradually decline, ending completely by 2030 at the latest. As a result of an increasing number of earthquakes in the surrounding area, caps on gas production from the Groningen field have been systematically lowered, with the most recent cap being reduced to 8.1 bcm/year (gas year 2020-2021). However, the Netherlands intends to fulfil its contractual obligations to Belgium, France and Germany by producing synthetic L-gas by injecting nitrogen into H-gas, despite the high cost of this solution.

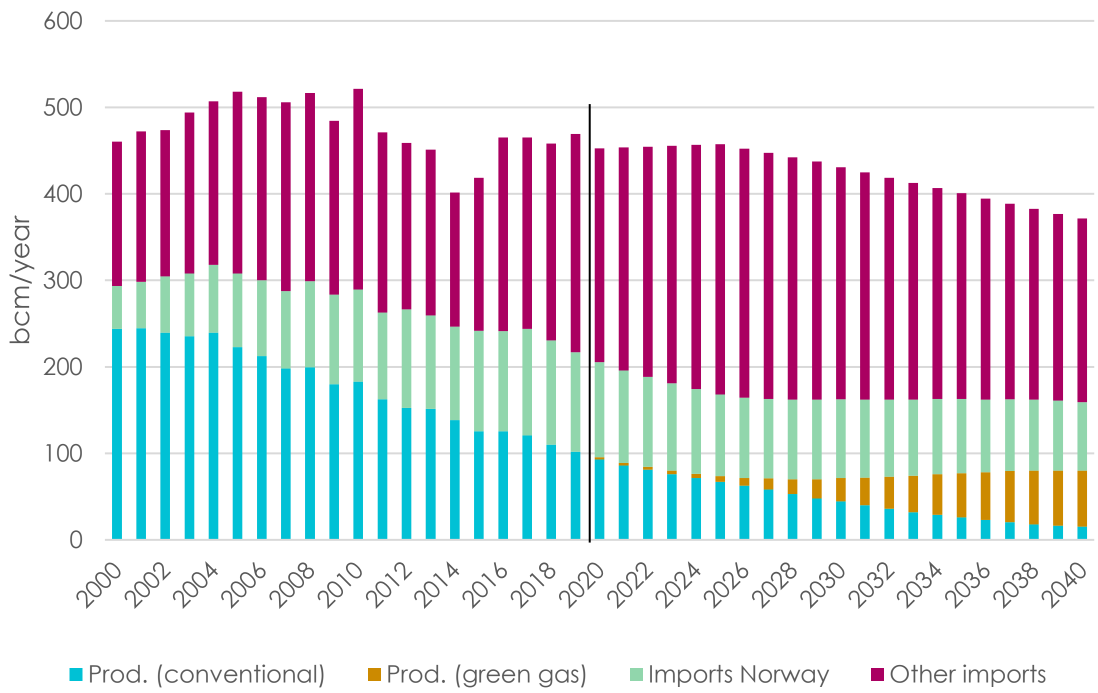


Figure 10: Evolution of indigenous European gas production and imports (source: BP Statistical Review, 2020 and the ENTSOG TYNDP)

1.5 Outlook for supply

EU imports are expected to rise in the coming years to offset the decline in EU gas production coupled with stagnating or decreasing Norwegian and Algerian supplies.

The Nord Stream 2 pipeline, which is currently under construction, will double the volume that can be imported from Russia to Germany. However, US economic sanctions on some companies and investors involved in the project are currently affecting the completion of this pipeline. The TurkStream pipeline, which has been operational since 8 January 2020, allows Russia to divert its gas currently transmitted via Ukraine to Turkey (TurkStream 1) and Central Europe (TurkStream 2).

Furthermore, the South European Gas Corridor links the EU to Azerbaijan via the TANAP and TAP pipelines, operational since November 2020, and this may also unlock other sources in the Caspian region (Turkmenistan, Iran and Iraq). It may also be possible to connect new resources in the Eastern Mediterranean (Cyprus, Israel, Lebanon, the Zohr gas field in Egypt) via the EastMed project. However, the construction of infrastructure for gas production and transmission would require long-term commitments from European market players.

Nevertheless, LNG and Russian gas are expected to make up the bulk of additional imports. New liquefaction and regasification infrastructure is being built, which will increase the quantity of LNG available for trade and pave the way for the diversification of supply.

Turning to Northern Europe, studies into three LNG terminal projects in Germany (Brunsbüttel, Stade and Wilhemshaven) are currently under way. Meanwhile in Poland, the Świnoujście LNG terminal (commissioned in 2016) is being expanded. Studies into the construction of a terminal at Gdańsk are also ongoing. PGNiG has signed short- and long-term contracts to buy LNG from the United States.

In Southern Europe, Croatia made a final investment decision on a planned floating storage and regasification unit (FSRU) in Krk in February 2019, with commissioning scheduled for 2021. In Greece, Gastrade, in which DESFA has just purchased a 20% stake, has rolled out plans to construct an FSRU at Alexandroúpoli, bolstered by progress on the IGB interconnection between Greece and Bulgaria. A third storage tank was constructed at the Revithoussa LNG terminal in 2018. In December 2019, Cyprus concluded a contract to construct the country's first regasification terminal, while Turkey commissioned the Dörtyol FSRU in 2018. The capacity of the Etki FSRU has been expanded to 2 million tonnes/year.

Liquefaction capacities continue to grow worldwide, with the United States, Canada and Australia leading the way. In 2017, Qatar lifted the moratorium on North Field natural gas production that had been in place since 2005 to 77 million tonnes/year, boosting its production capacity to 100 million tonnes/year in 2027 and 126 million tonnes/year in 2029. In September 2019, Qatar Terminal Limited, a subsidiary of Qatar Petroleum, and Fluxys LNG signed a long-term LNG services agreement (running until 2044) for the Zeebrugge LNG terminal.

European LNG imports will be determined by price differentials between the United States, Europe and Asia, the decline in domestic production, and competition between pipeline gas, coal, LNG and the development of renewables. LNG supplies will compete with pipeline gas supplies from both Russia and Norway in European gas networks.

2 The ENTSOG TYNDP 2020 and regional investment plans

2.1 The ENTSOG/ENTSO-E 2020 Scenario Report

Given the success of their initial cooperation on the TYNDP 2018, ENTSOG and the European Network of Transmission System Operators for Electricity (ENTSO-E) once again worked together to devise scenario storylines for the TYNDP 2020, with joint scenarios serving as the cornerstone for an interconnected model. **Three storylines** were adopted, all in line with the climate targets set by the European Commission.

- **Distributed Energy:** in line with the Paris Agreement's target of limiting any rise in temperature to 1.5 °C, based on a decentralised approach to the energy transition through small-scale solutions and circular approaches.
- **Global Ambition:** in line with the Paris Agreement's 1.5 °C target, based on the economic development of centralised generation such as offshore wind power and power-to-X production.
- **National Trends:** based on National Energy and Climate Plans (NECPs) and therefore in line with the EU's 2030 climate and energy framework and the Commission's 2050 long-term strategy.

While the National Trends scenario is based on data collected using a bottom-up approach among gas and electricity transmission system operators (TSOs), the Global Ambition and Distributed Energy scenarios have been quantified using a recently developed top-down approach, taking into account the entire energy mix and therefore making it possible to calculate estimated CO_2 emissions, which in turn can be compared with an EU-wide carbon budget.

Based on the data provided by electricity and gas TSOs, ENTSO-E conducted simulations of the EU-wide electricity market, which resulted in scenario-specific production mixes at national level. Gas demand for power generation was used as input for ENTSOG's gas network simulations in its TYNDP 2020.

The final version of the Scenario Report for gas and electricity for the TYNDP 2020 was published in June 2020.[1] It comprises a visualisation platform[2] displaying the detailed simulation results of the electricity market modelling.

As regards the role of gas in the energy system, the ENTSOG and ENTSO-E TYNDP 2020 Scenario Report highlights the key elements outlined below.

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[1] https://www.entsog.eu/sites/default/files/2020-07/TYNDP_2020_Joint_Scenario%20Report%20ENTSOG_ENTSOE_June_Final.pdf
[2] https://www.entsos-tyndp2020-scenarios.eu/visualisation-platform/

Excerpt from the ENTSOG/ENTSO-E 2020 Scenario Report (NB: emphasis added):

- "Quick wins" are essential to reduce global temperature warming. **A coal to gas switch** in the power sector can **save at least 85 MtCO_2 by 2025**.
- To optimise conversions, the direct use of electricity is an important option – resulting in progressive electrification throughout all scenarios. **Gas will continue to play an important role in sectors such as feedstock in non-energy uses, high-temperature processes, transport or in hybrid heating solutions to make optimal use of both infrastructures.**
- […]
- Wind and solar energy will play an important role in the European energy system, however, the scenarios point out that the decarbonisation of gas will have a significant part to play as well. The scenarios show that the **decarbonisation of the gas carrier is necessary, employing technologies to increase the share of renewable gases**, such as bio-methane and Power-to-Gas, and decarbonised gases associated with Carbon Capture and Storage (CCS).
- At present gas as an energy carrier is mainly based on methane, as the main component of natural gas. However, in the longer-term **hydrogen could become an equally important energy carrier towards full decarbonisation of the gas carriers** in 2050.
- Sector Coupling enables a link between energy carriers and sectors, thus it becomes key in contributing to achieve the decarbonisation target. **In the long-term, Power-to-Gas and Power-to-Liquid will play a key role in both the integration of electricity from variable renewables and decarbonising the supply of gas and liquid fuels.** [...] **Gas-fired power plants will continue to provide peak power flexibility to support an energy mix based on increasingly variable electricity generation.**
- Today, the EU28 imports most of its primary energy (ca. 55%[...]). Decarbonisation will also change this pattern. **In a way, the "insourcing" of energy production will reduce the import dependency to ca. 20% to 36%.** However, imports remain an important vector in the future energy supply making use of competitive natural resources outside the EU territory. **For gas in particular, import shares increase in all scenarios until 2030 due to the declining natural gas production in the EU.**

The last point listed above is illustrated by the following figure, which shows the primary energy mix in the Distributed Energy scenario. As is clear from the figure, imports (oil, nuclear power and gas) will still account for around 20% of the 2050 energy mix.

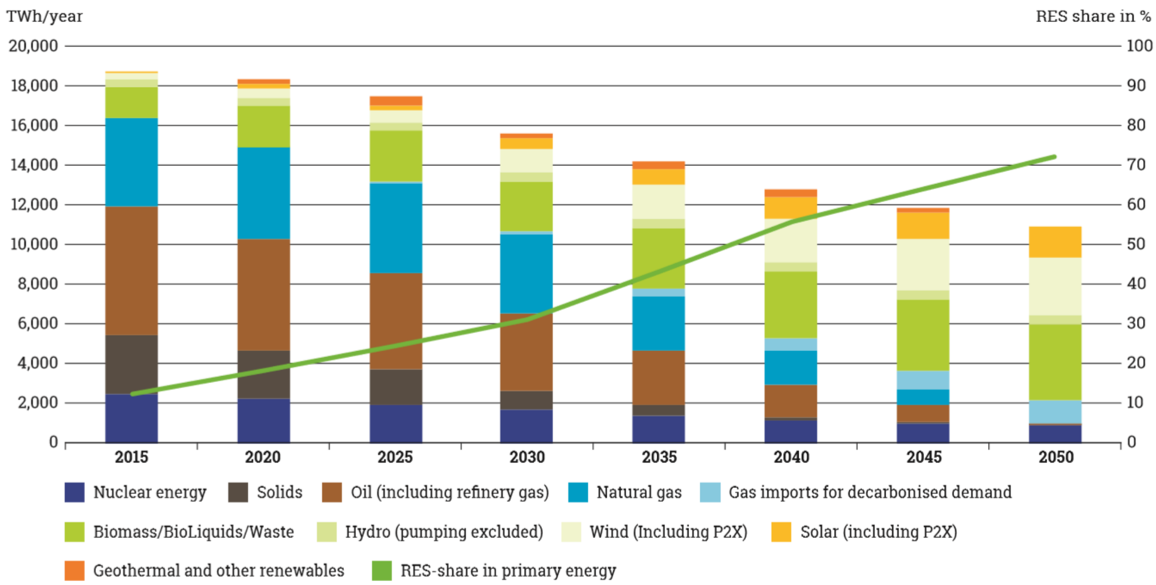

Figure 11: Primary energy mix in the Distributed Energy scenario (source: ENTSOG/ENTSO-E 2020 Scenario Report)

ENTSOG and ENTSO-E projections for gas demand are illustrated in the figure below. It shows that the two scenarios compatible with COP21 requirements, namely Global Ambition (GA) and Distributed Energy (DE), result in higher demand in 2030 than the National Trends scenario. This is due to a faster transition from carbon-rich fuels like coal and oil to gas as well as to higher shares of renewable and decarbonised gases in the energy mix.

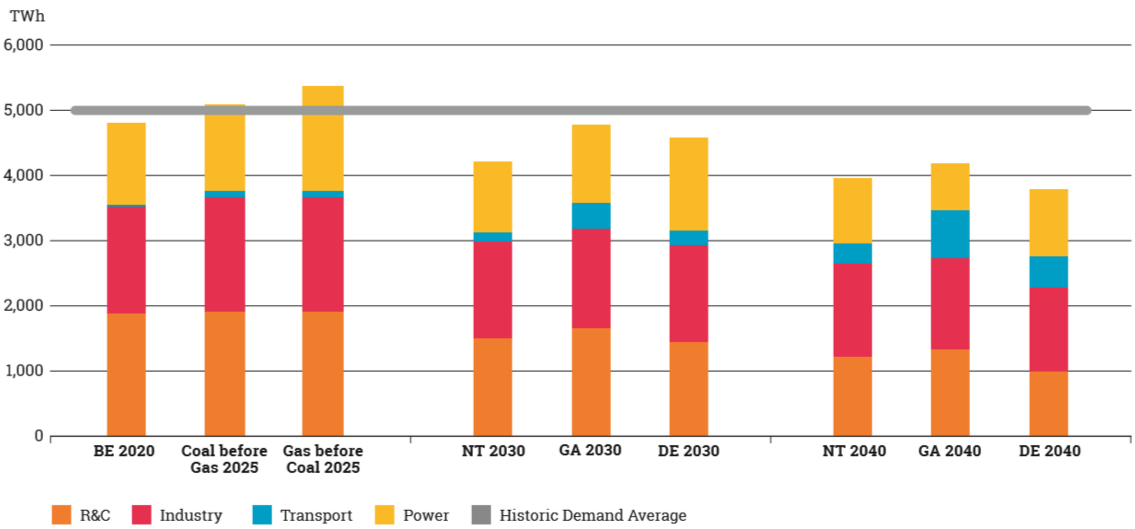

Figure 12: Total gas demand in the ENTSOG/ENTSO-E scenarios (source: 2020 Scenario Report)

ENTSOG and ENTSO-E have launched a new scenario-creation cycle with a view to submitting a draft Scenario Report for the TYNDP 2022 by the end of 2021. A series of working sessions have already led to the publication of the TYNDP 2022 Scenario Storyline

Report,[3] which appeared in early November 2020. This report outlines the scenarios that will be quantified by ENTSOG and ENTSO-E in the 2022 Scenario Report.

2.2 The ENTSOG TYNDP 2020

On 19 November 2020, ENTSOG published a draft TYNDP 2020, which mainly consisted of the Infrastructure Report and the Assessment Report.[4]

The Infrastructure Report focuses on the development of the European gas network and analyses infrastructure projects submitted by TSOs and third-party project promoters. As for previous Infrastructure Reports, Fluxys Belgium submitted the L/H conversion project.

For the first time, ENTSOG sought out a new type of project related to the energy transition, including, first and foremost, the use of hydrogen networks, power-to-gas facilities, biomethane production, and carbon capture, use and storage (CCUS). Given the decline in the number of traditional infrastructure projects, 74 of these energy transition (ETR) projects have already been submitted by promoters, accounting for 28% of all submitted projects.

The following Belgian ETR projects[5] are included in the TYNDP 2020:

- Interconnected hydrogen network
- Power to Methanol Antwerp
- Carbon Connect Delta
- H2-Import Coalition
- HyOffWind Zeebrugge
- Antwerp@C

The Assessment Report uses a range of cost-benefit analysis (CBA) indicators to analyse the performance of current and future gas infrastructure at European level in terms of security of supply, market integration, competition and sustainability. It assesses the scenarios from the Scenario Report relating to the infrastructure that is presented in the Infrastructure Report.

The main conclusion drawn at European level is that the projects classified as Final Investment Decision (FID) and Advanced cover almost all infrastructure needs and should be operational by 2025. Only a few local problems remain, for which additional infrastructure would be needed.

Like previous TYNDPs, this TYNDP once again confirms that Belgian gas infrastructure is well developed and interconnected with neighbouring countries and has access to a wide range of supply sources.

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[3] https://www.entsog.eu/sites/default/files/2020-11/entsog_TYNDP_2020_Scenario_Storyline_Report_201103.pdf

[4] https://www.entsog.eu/tyndp#entsog-ten-year-network-development-plan-2020

[5] Fluxys is not always promoter of these ETR projects.

2.3 Gas Regional Investment Plans (GRIPs)

In June 2020, the TSOs of the North-West region published the fourth edition of the GRIP for this region, coordinated by Fluxys and Gasunie Transport Services (GTS).[6]

The report provides an overview of the projects and initiatives in which the gas TSOs are involved in order to facilitate the decarbonisation of gas infrastructure throughout North-West Europe. These initiatives demonstrate the commitment of the region's TSOs to actively engaging in the decarbonisation of the gas and energy system as a whole. The technologies adopted in the various decarbonisation projects seem to vary from one EU Member State to another.

The second part of the report focuses on the L-gas markets in the North-West region. The planned shutdown of the Groningen field and declining L-gas production in Germany mean that significant investment is needed in infrastructure to convert the L-gas market to H-gas in Germany, France and Belgium. The report gives a detailed overview of the current state of the L-gas markets and the associated infrastructure adjustments needed to ensure a successful market conversion.

2.4 Projects of Common Interest (PCIs)

The European Commission has once again confirmed that Belgium's L/H conversion represents a key infrastructure need in the West European region, resulting in the renewal of the PCI label in October 2019. The fourth PCI list came into force in April 2020.[7]

[6] https://www.entsog.eu/sites/default/files/2020-06/ENTSOG_NW_GRIP_2020_web.pdf

[7] https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32020R0389

3 The Belgian natural gas market

3.1 Fluxys Belgium and Fluxys LNG natural gas infrastructure

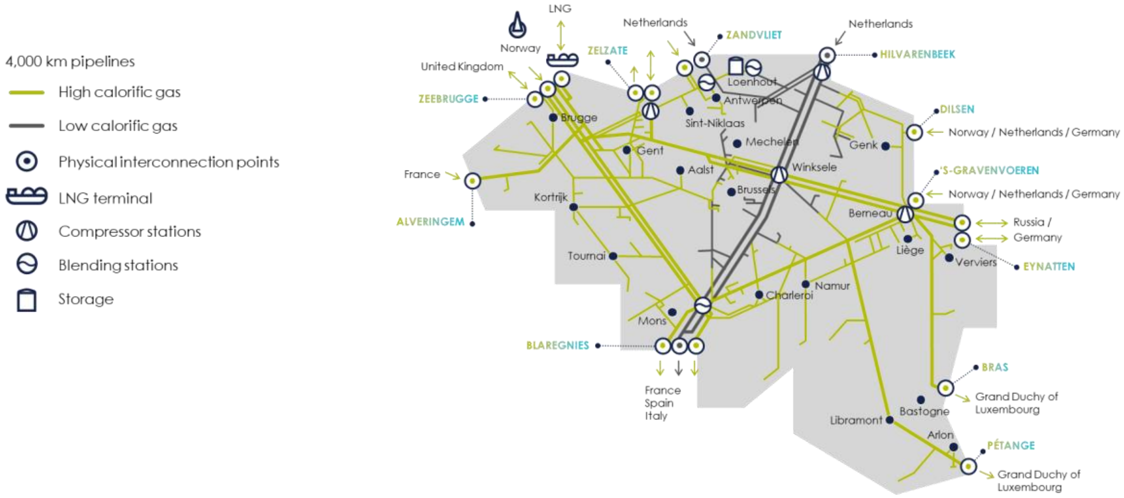

Figure 13: Fluxys Belgium and Fluxys LNG natural gas infrastructure

The natural gas transmitted and distributed in Belgium comes from a variety of sources. The chemical composition of the various natural gases is not the same; their calorific value and Wobbe index vary. Most of these are 'rich' gases. They are interchangeable and are transmitted together in the form of high-calorific natural gas (H-gas). By contrast, the low-calorific natural gas (L-gas) from the Groningen fields is quite unique in that it contains up to 14% nitrogen. It has a lower heating value and is not interchangeable with H-gas. As a result, Fluxys Belgium's Belgian transmission system is split into two networks, which are operated separately.

3.2 Market segments

The Belgian transmission system supplies gas to three market segments (or categories of end users):

- Public distribution companies, which supply gas to residential customers, SMEs and the tertiary sector
- Industrial customers, including large-scale CHP facilities
- Power stations

The natural gas offtakes by each of these market segments vary all the time and have very different profiles:

- **Public distribution** is strongly influenced by the weather conditions, and thus the temperature.
- **Industrial customers** have a fairly regular offtake pattern.

- **Power stations** make gas offtakes to meet the increasingly changeable needs for electricity generation. While electricity demand is much less heavily influenced by the temperature than natural gas demand, the availability of other energy sources (e.g. nuclear energy, solar power, wind power, import/export) and price parameters (*spark spread* of coal vs natural gas) have a significant impact too.

3.3 Consumption trends in Belgium

3.3.1 Trend in the number of degree days

The number of degree days in a year reflects the demand for heating in a given period. A normal (benchmark) year has 2,301 degree days.[8] According to the Royal Meteorological Institute of Belgium (RMI), 2014 was the warmest year since 1900, with only 1,828 degree days. 2015 saw 2,121 degree days and was also considered a warmer year. Following a normal year in 2016, which had 2,329 degree days, 2019 proved to be another fairly warm year, the third in a row.

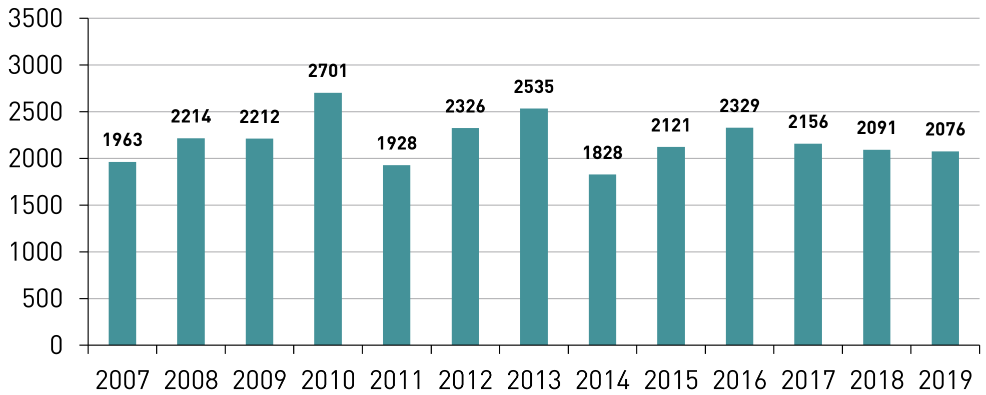

Figure 14: Degree days (calendar year)

3.3.2 Annual volumes for the Belgian market

In 2014, the warmest year since 1900, Belgium's total consumption decreased substantially (12% down on 2013), falling to 14.7 bcm. It has since picked up again, rising to 17.2 bcm in 2019. Unlike the increase in 2016, the rises in 2017, 2018 and 2019 were the result of increased offtake by power stations and industrial customers, not a colder winter period.

[8] 1986 to 2015, Synergrid benchmark (calendar year)

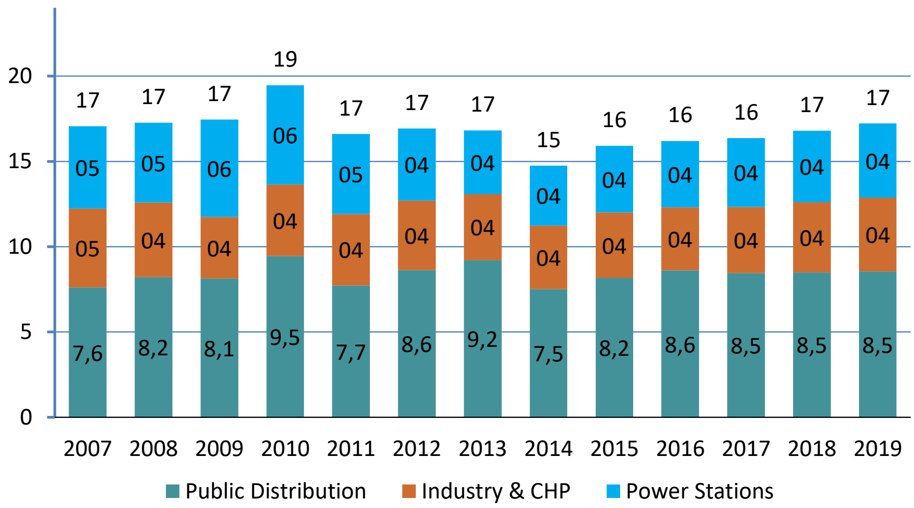

Figure 15: Changes in gas consumption in Belgium (in bcm)

3.3.2.1 Industrial customers (including combined heat and power generation)

Since the 2008-2009 economic crisis, several major industrial sites have closed, such as the steel production plant in Liège (late 2014), the Opel car plant in Antwerp (late 2010) and the Ford car plant in Genk (late 2014). Once the crisis bottomed out in 2014, industrial consumption rose by around 3% per year, hitting 4.3 bcm in 2019, mainly as a result of new connections.

3.3.2.2 Power stations

The annual consumption of power stations has also increased over the last three years. The closure of the country's older conventional generation units, including Kallo (2011), Les Awirs (2012), Langerbrugge (2012) and Ruien (2013), led to a sharp falloff in annual volumes. Natural gas offtake has once again increased since 2014, with H-gas offtake reaching 4.4 bcm in 2019.[9] That said, the offtake pattern of power stations has become more volatile, as highly flexible open-cycle gas turbines and efficient, combined-cycle gas turbine (CCGT) units are frequently being used to back up variable power generation from solar and wind sources at any time. Recently, the *spark spread* for natural gas has also evolved in a positive direction, meaning that units that were temporarily shut down and put on the (strategic) reserve list for several years will once again come back into daily use during the winter period. The reduced availability of various units at the Doel and Tihange nuclear power stations also plays a role here.

[9] The last L-gas-fired power stations were decommissioned in 2008. All units still operating are powered by H-gas.

3.4 Network simulation model

Transmission systems are systematically analysed to ascertain whether they are fit for purpose. Analysing the network's behaviour in a peak offtake situation makes it possible to determine whether infrastructure needs to be adapted to cope with demand fluctuations. Given the variety of offtake profiles that exist, special statistical methods are used to calculate the peak values for the different market segments.

3.4.1 Public distribution

3.4.1.1 Method

Consumption peaks are partly linked to the severity of winter weather conditions and must therefore be analysed in light of the temperatures recorded.[10] The standard winter period used for such analyses runs from the start of November to the end of February.

3.4.1.2 Assessment of winter 2019/2020

The last winter period (from November 2019 up to and including February 2020) was relatively mild, with 1,230 degree days (a benchmark winter[11] has 1,428 degree days). The two short colder periods in the first half of December 2019 and the second half of January 2020 can hardly be described as a cold snap. The coldest day of the winter (measured in Uccle) was recorded on Thursday, 5 December 2019, with an equivalent temperature of +1.2 °C. No frost days were recorded last winter (2019/2020), meaning that the linear regression reflecting the relationship between consumption and ambient temperature is insufficiently representative this year.

[10] The concept of 'equivalent temperature' was introduced to take account of the thermal inertia of buildings. This temperature is determined as follows: $T_{eq\ D} = 0.6 \times T_{av\ D} + 0.3 \times T_{av\ D-1} + 0.1 \times T_{av\ D-2}$

[11] 1986 to 2015 (winter months). Source: Synergrid

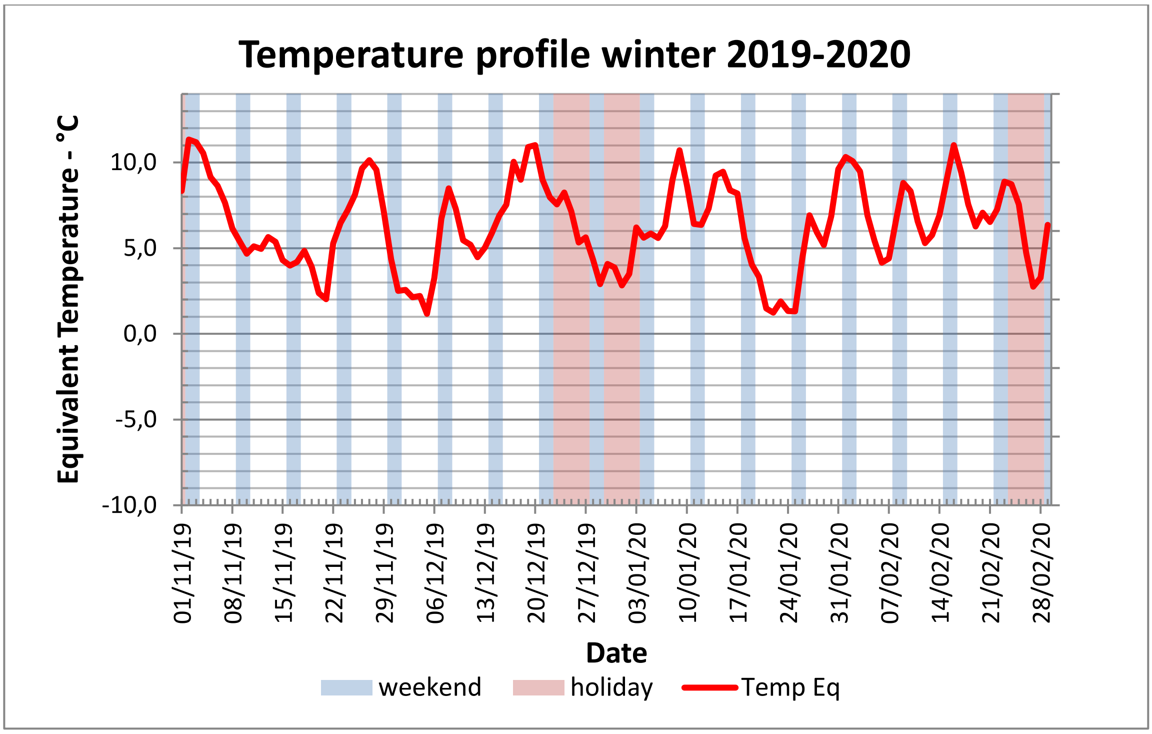

Figure 16: Assessment of winter 2019/2020

3.4.2 Power stations, CHP units and industrial customers

3.4.2.1 Method

The temperature has very little impact on gas offtakes for industrial processes and power generation. Consequently, analysis of these market segments is based on a statistical analysis of past offtakes combined with a commercial analysis of the market segments' development prospects, rather than on a linear regression linked to the ambient temperature. Since industrial customers' consumption profiles do not really depend on the temperature, their consumption peak will not occur at the same time (smoothing effect), and therefore peak offtakes for this segment are corrected using a regional-level multiplication factor. The approach for power stations is based on the theoretical simultaneous use of all generation facilities, and so not solely on the ambient temperature.

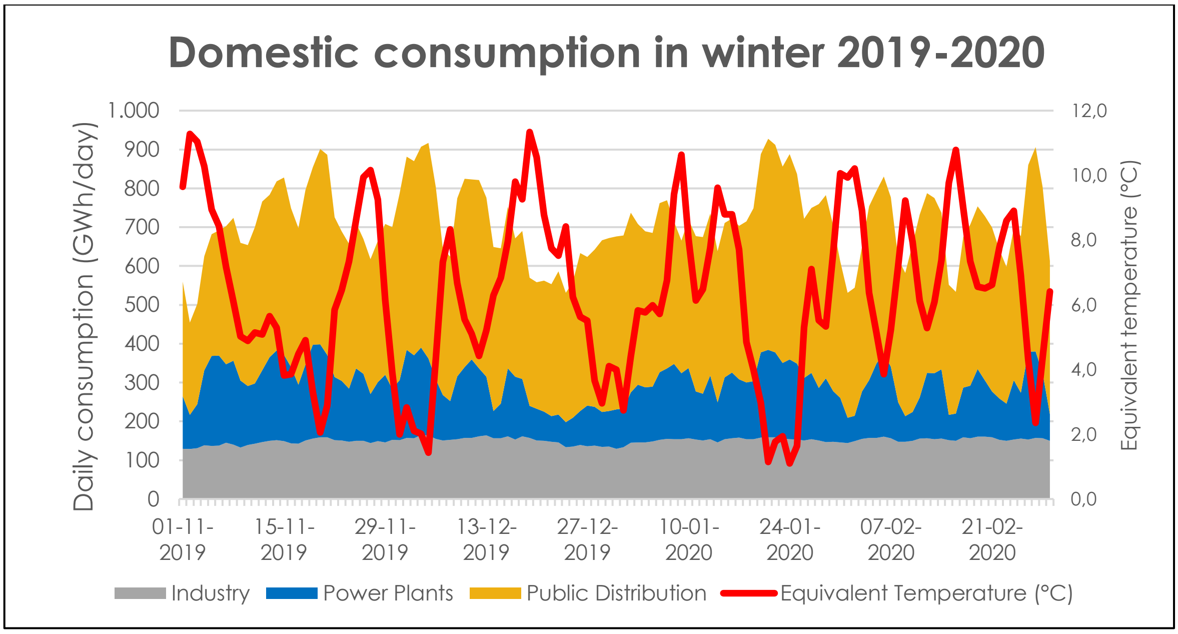

Figure 17: Domestic consumption in winter 2019/2020

3.5 Investments required in the domestic market

3.5.1 Public distribution

Despite the steady increase in the number of active connections, several factors have caused a slight decline in gas consumption. The thermal insulation of houses and buildings and the efficiency of heating systems are constantly improving thanks to the introduction by public authorities of strict regulations concerning renovations and new constructions.

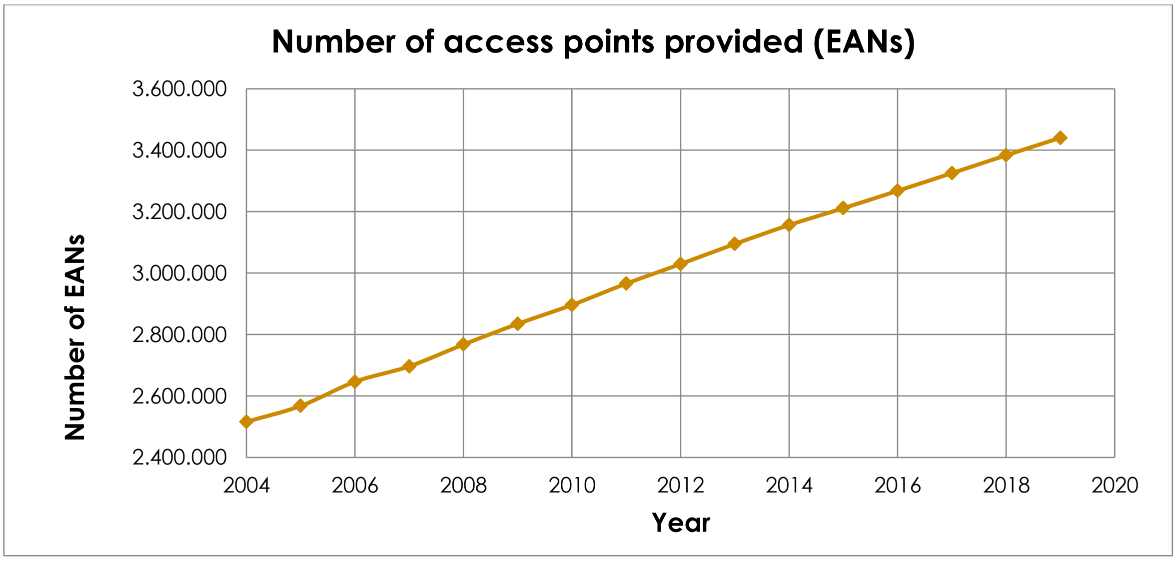

Figure 18: Increase in the number of EAN access points[12] (source: Synergrid)

[12] *EAN* (European Article Numbering) codes are unique codes used to identify gas meters.

The combination of these erosion factors and the change in the potential number of new connections to the public distribution network in some regions means that the increase in peak consumption will not grow at the same rate in every region.

Use of the available capacity on the networks is constantly analysed by the relevant distribution system operators (DSOs) based on detailed analyses and simulations. The investments identified as necessary to support more local/regional growth in the coming years remain limited.

3.5.2 Industrial customers

The outlook for industrial consumption still has two facets. While it is true that each year sees several industrial customers wind down their production operations in Belgium, new industrial projects are also launched. Generally speaking, only limited investment is required to create local connections. On the whole, the existing networks hosting the connections have enough capacity to supply the new end customers. However, large-scale projects combined with the construction of new power stations may require local investments.

3.5.3 Power generation

Natural-gas-fired power generation in Belgium, as elsewhere in Europe, has been under considerable pressure for some time. Gas-fired power stations are used to maintain a balance on the electricity grid during short periods of high demand or when *renewable* sources prove insufficient. Thanks to a favourable *spark spread*, a higher baseload has gradually been observed again in recent years.

Gas-fired power stations have the advantage of being able to start up quickly while producing far less CO_2 than coal-fired power stations. Thanks to their flexibility, they provide the ideal back-up needed for intermittent power generation from wind and solar facilities.

The complete shutdown of Belgium's nuclear generation facilities by the end of 2025 is enshrined in law. As a result, almost 6,000 MW of nuclear generation capacity is set to be phased out in the very near future. Alongside increased import facilities and the steady growth of wind and solar energy, natural-gas-fired generation facilities will also have to be further expanded, in part to replace existing gas-fired units that will reach the end of their technical and economic life in the next few years. State-of-the-art CCGT units with capacities of 450 to 850 MW are now available. These efficient generation units are expected to be developed at a number of sites, preferably close to the backbone of the high-pressure transmission system.

More specifically, the Capacity Remuneration Mechanism (CRM) launched by the government would result in the construction of additional generation facilities with a capacity of around 3.9 GW[13] to compensate for the total phase-out of nuclear power.

The older, less efficient units would have to be used as peak units for a number of years before being shut down. However, the resulting increase in the need for synchronous peak capacity will not necessarily translate into a significant change in annual volumes.

3.5.4 Other sectors

3.5.4.1 The transport sector

CNG and LNG are two gas products that are very well suited to use in the transport sector. Methane combustion produces less CO_2 than the combustion of conventional fuels like diesel, petrol and liquefied petroleum gas. Natural gas is also a clean fuel in terms of particle emissions.[14]

Since LNG takes up 600 times less space than the same amount of energy in gaseous form under atmospheric conditions, it is especially suitable for use in road transport (as an alternative to diesel) and shipping (as a substitute for heavy fuel oil). CNG, on the other hand, is an attractive solution for fuelling private cars and vans.

The CNG network, which is supplied from the public distribution networks, is expected to continue growing in the short term. The capacity of the transmission system is sufficient to support such growth.

[13] Adequacy and flexibility study for Belgium 2020-2030 - Elia

[14] CREG 2018, Study on the cost-effectiveness of natural gas (CNG or compressed natural gas) used as fuel in cars

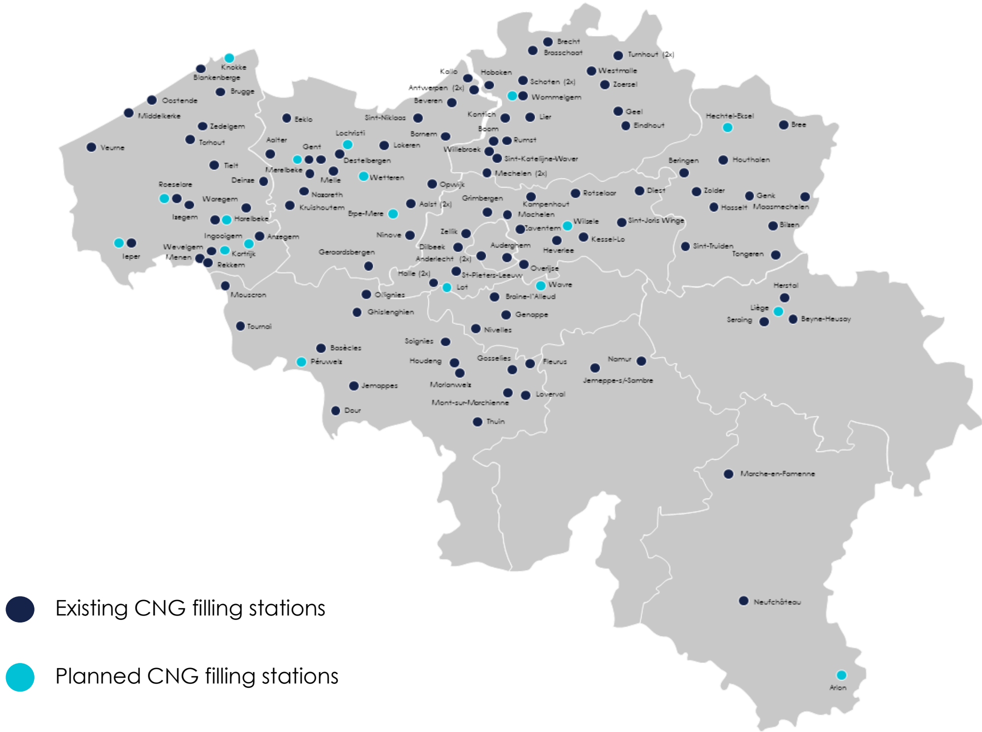

Figure 19: Existing/planned CNG filling stations

3.5.4.2 Development of off-network natural gas distribution

It is usually not economically viable to develop both the transmission network and the distribution network to connect remote population centres. CNG and LNG satellite installations supplied by land or water can serve as a starting point for the development of new natural gas distribution networks. At a later stage, once these markets are sufficiently developed, consideration can be given to connecting the natural gas network to the transmission network.

These networks can be developed in tandem with CNG and LNG for the transport sector.

4 Transit at Belgium's borders

4.1 General description

With all its interconnection points, the Belgian network is connected to most of the natural gas production sources supplying the European market, namely:

- natural gas supplied by pipeline from Norway, the UK, the Netherlands, Germany and France;
- LNG supplied from producer countries through the LNG terminals at Zeebrugge and Dunkirk.

The Fluxys Belgium network is connected to the following gas markets/production zones:

- Netherlands: TTF
- UK: NBP
- Germany: NCG and Gaspool
- France: TRF
- Norway
- LNG: via Zeebrugge and Dunkirk

LNG and pipeline gas brought into Belgium can be traded via the Fluxys Belgium network at the Belgian gas trading point, which is divided into two services:

- ZTP-P (Zeebrugge Trading Point – Physical Trading Services)
- ZTP-N (Zeebrugge Trading Point – Notional Trading Services), which encompasses ZTP (for the H-gas network) and ZTPL (for the L-gas network)

Physically, the natural gas supplied is consumed on the Belgian market or transmitted across the country's borders for sale at other gas trading points or consumption on end-user markets in Europe. As such, various capacity products are traded:

- **Entry/Exit**: A capacity product for access to the Belgian market area, trading on the ZTP, supply to the domestic market or transmission of gas to neighbouring markets.
- **Shorthaul**: An Operational Capacity Usage Commitment (OCUC) is a Shorthaul that combines the use of Entry/Exit services at predefined interconnection points. A Wheeling is a specific OCUC with entry and exit at the same location. Lastly, Zee Platform is a Shorthaul service for transporting unlimited quantities of natural gas between two or more interconnection points in the Zeebrugge area.

The figure below provides a general overview of interconnection points, capacity products (Entry/Exit, OCUC, Wheeling and Zee Platform) and links to neighbouring markets.

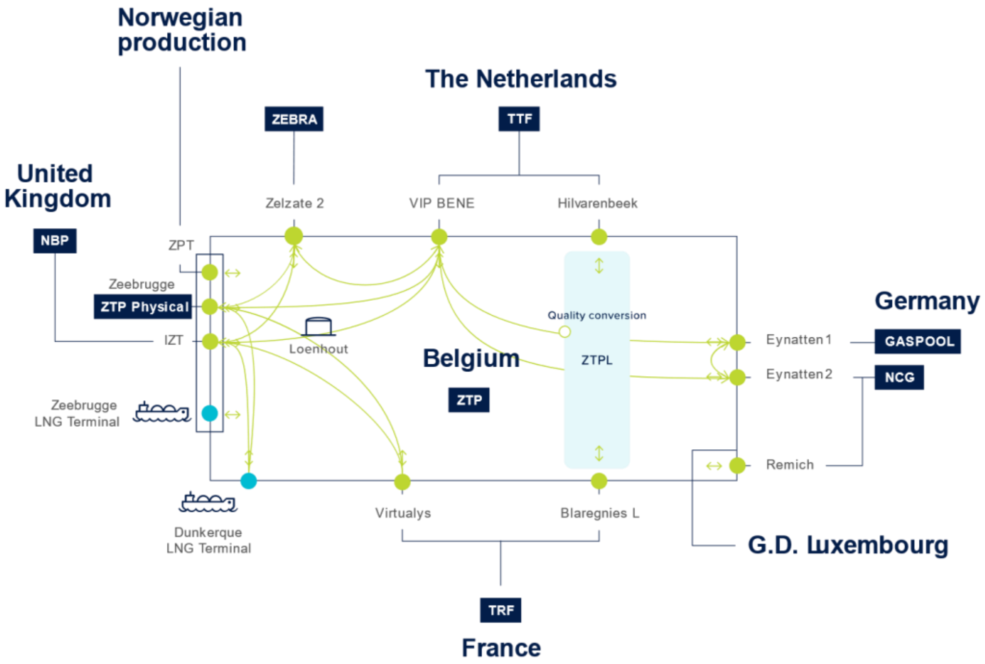

Figure 20: Fluxys Belgium interconnection points

4.2 Overview of allocations at border points

The figure below provides an overview of the volumes (allocations) imported and exported at border points in 2019.

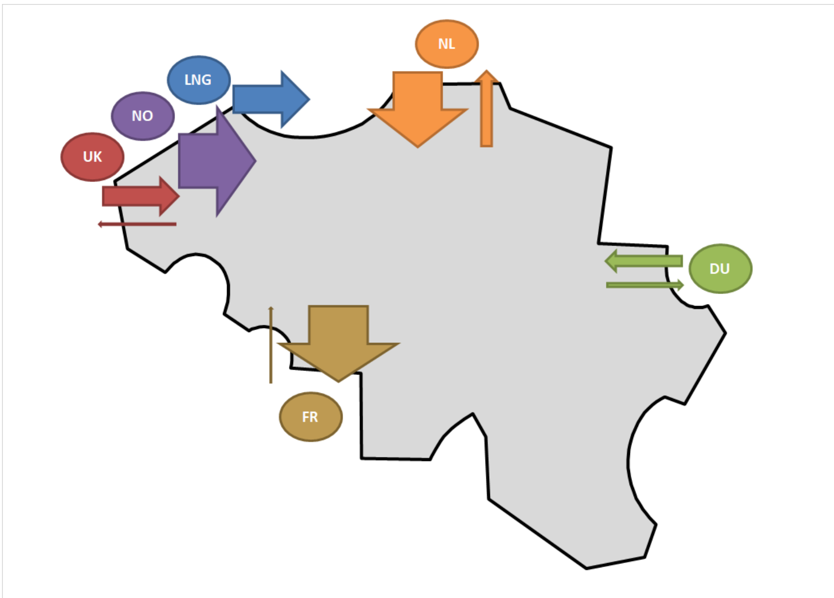

Figure 21: Allocations at border points in 2019

4.2.1 Natural gas imports

The total annual average volume entering the Fluxys Belgium network was 430 TWh in 2015-2019, peaking at over 460 TWh in 2017.

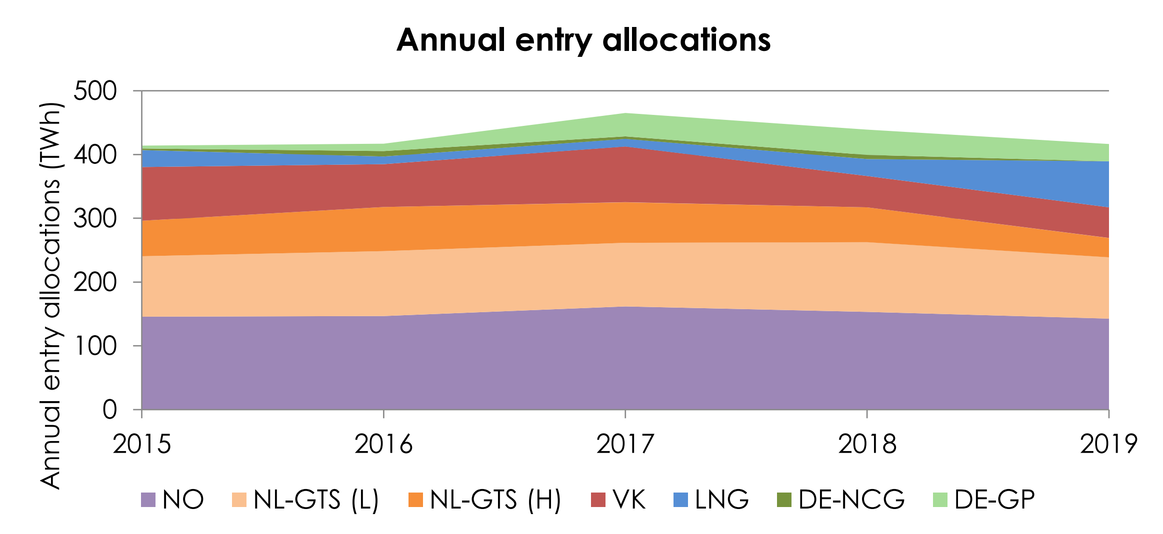

Figure 22: Annual entry allocations

Two main entry routes carry approximately 60% of incoming flows: Norwegian gas comes into Belgium through the Zeepipe (around 150 TWh), while L-gas from the Netherlands enters the country via the Hilvarenbeek entry point (around 100 TWh). H-gas supplies from the Netherlands have been falling since 2017, with significantly lower volumes being supplied in 2019 in particular.

Volumes from the UK fluctuate, totalling between 50 and 90 TWh per year.

The volume of LNG injected into the Belgian transmission system at Zeebrugge rose in 2015 (over 25 TWh). However, this trend did not continue in 2016 and 2017. Following a trend observed at European level, the volume of LNG injected into the transmission system rose considerably in 2018 and 2019.

Imports from Germany remained relatively low. 2017 and 2018 saw an increase, perhaps due to the larger quantities transmitted to the UK. It is worth noting that virtually all imports come from the Gaspool market area.

4.2.2 Natural gas exports

The total annual average volume of gas (H-gas and L-gas) transmitted to neighbouring markets at the border points was 240 TWh in 2015-2019, with a significant peak of 275 TWh in 2017.

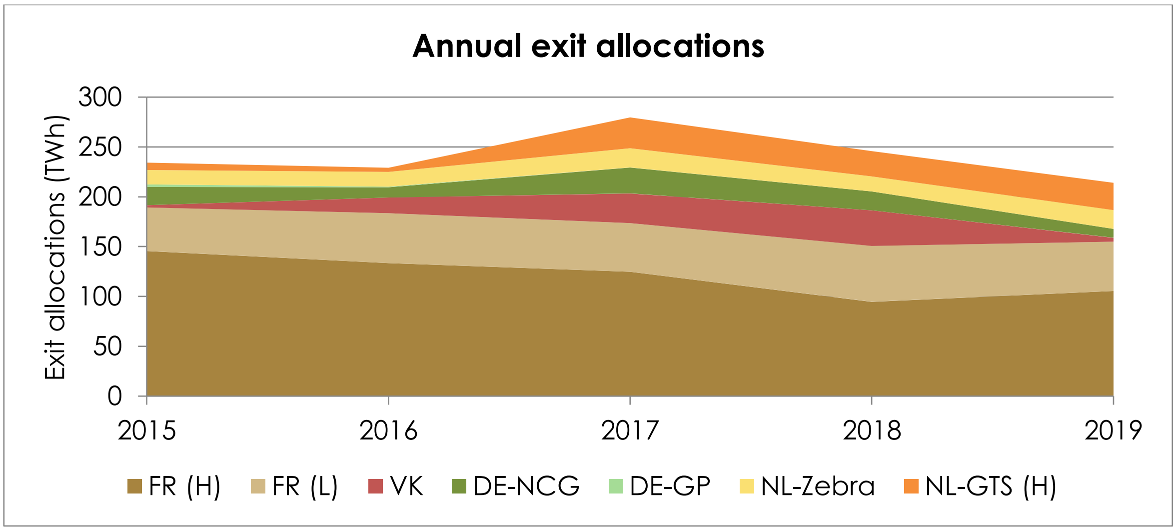

Figure 23: Annual exit allocations

Between 65% and 85% of this volume (between 150 and 200 TWh, of which around 50 TWh is L-gas) is intended for the French market.

The volume of gas exported to the UK (through the IZT pipeline) fluctuates considerably from one year to the next. Between 2016 and 2018, the volume of gas exported to the UK climbed sharply due to, for example, the closure of the Rough underground storage facility and the reduced availability of LNG in the UK compared with 2015. The relatively high level of exports in 2018 was fully recorded in the first quarter. The impact of the expiry of long-term contracts can clearly be seen in the low volumes recorded in 2019.

The volume of gas transmitted to Germany totals between 10 and 30 TWh per year, with almost all exports being transmitted to the NCG market area.

The volume transmitted to the Netherlands mainly goes to the Zebra network and the annual supply is relatively consistent (15 TWh per year). Transmission via the GTS network has also increased since 2017, most likely as a result of the growing need for H-gas in the Netherlands following the restriction of production at the Groningen gas field.

Gas transmitted to Luxembourg is not included on the above graph because Belgium and Luxembourg form a single market.

4.3 Fluctuations in daily allocations at border points

Fluxys Belgium analyses network load and use of capacity supplied to neighbouring networks based on simultaneous daily and hourly flows.

4.3.1 Natural gas imports

The following graph shows the change in daily flows simultaneously injected at various border points on the Fluxys Belgium network (2015-2019). On average, around 50 GW of gas is injected into the Fluxys Belgium network, with peaks of between 70 and over 80 GW.

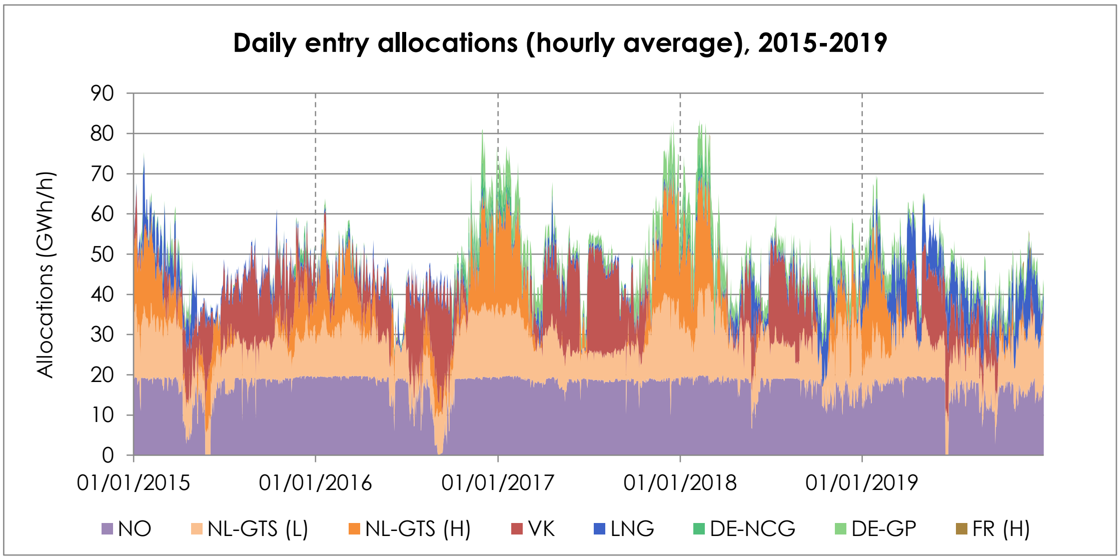

Figure 24: Daily entry allocations, 2015-2019

The graph[15] below shows the use of entry capacity in 2017-2019.

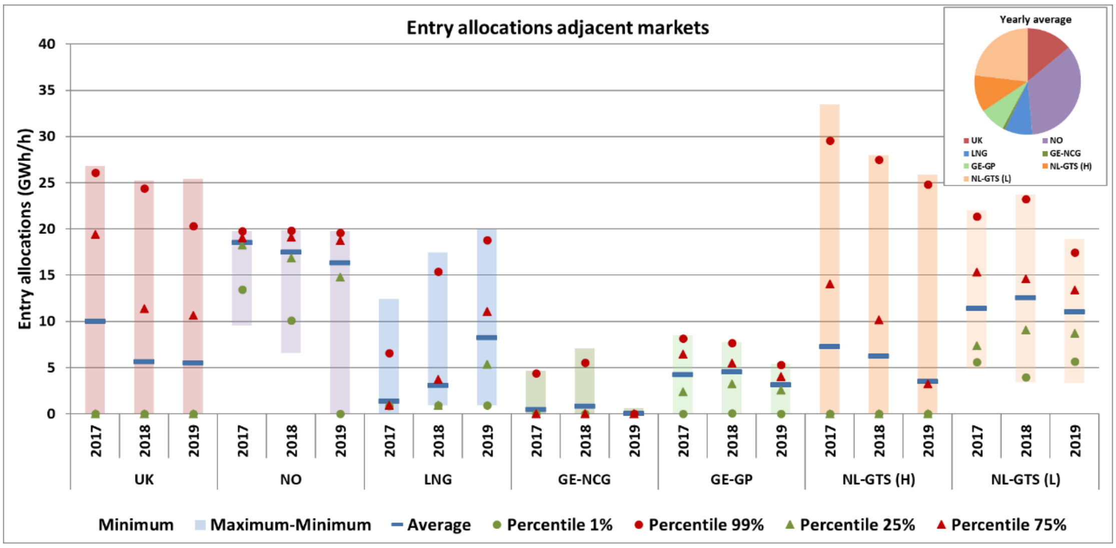

Figure 25: Entry allocations, neighbouring markets

Flows entering the Fluxys Belgium network from entry points directly linked to gas production zones (Norway, Netherlands L) account for the highest average volumes. Average incoming flow volumes at entry points connected to a neighbouring TSO's transmission system (Netherlands H, UK, Germany) are lower and/or more variable. The total import capacity of the H-gas network is sufficient to compensate for an increase in

[15] This graph is based on a calculation of the daily net value of the allocations.

the domestic market (e.g. as a result of the L/H conversion). Market signals will gradually pinpoint which sources will actually be used to supply the new H market.

4.3.2 Natural gas exports

The following graph shows the change in daily flows exported simultaneously at various border points on the Fluxys Belgium network (2015-2019).

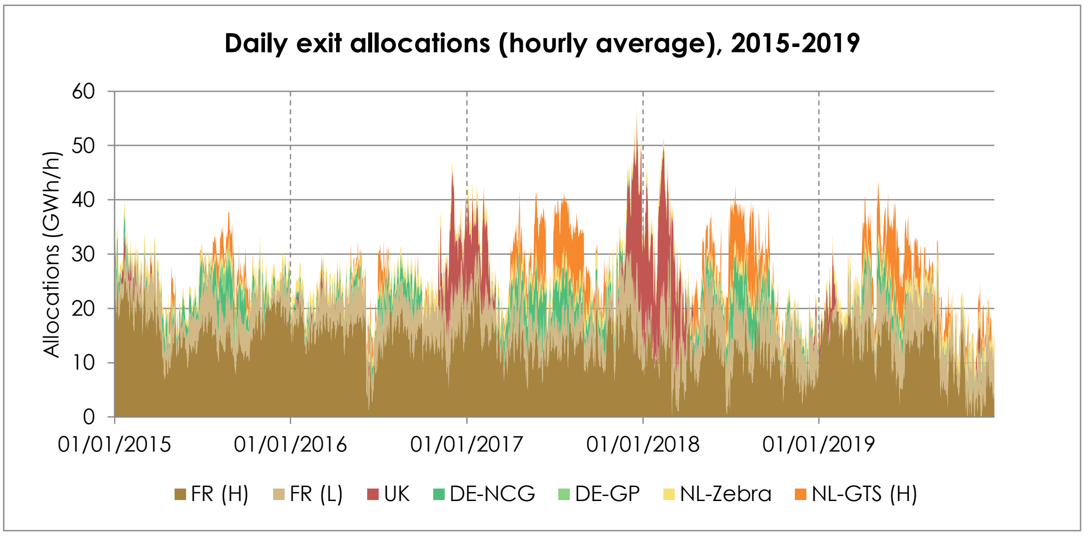

Figure 26: Daily exit allocations

The average daily flows simultaneously exiting the Fluxys Belgium network amount to 27 GW. There were substantial transit flows towards the UK in winter 2016-2017 and 2017-2018 and an increase towards the Netherlands during the summer months. Transit during winter 2017-2018 peaked in December, with large volumes bound for the UK and France. The Fluxys network had no problems handling this peak transmission.

The graph[16] below shows the use of the capacity supplied to each market area in 2017-2019.

[16] This graph is based on a calculation of the daily net value of the allocations.

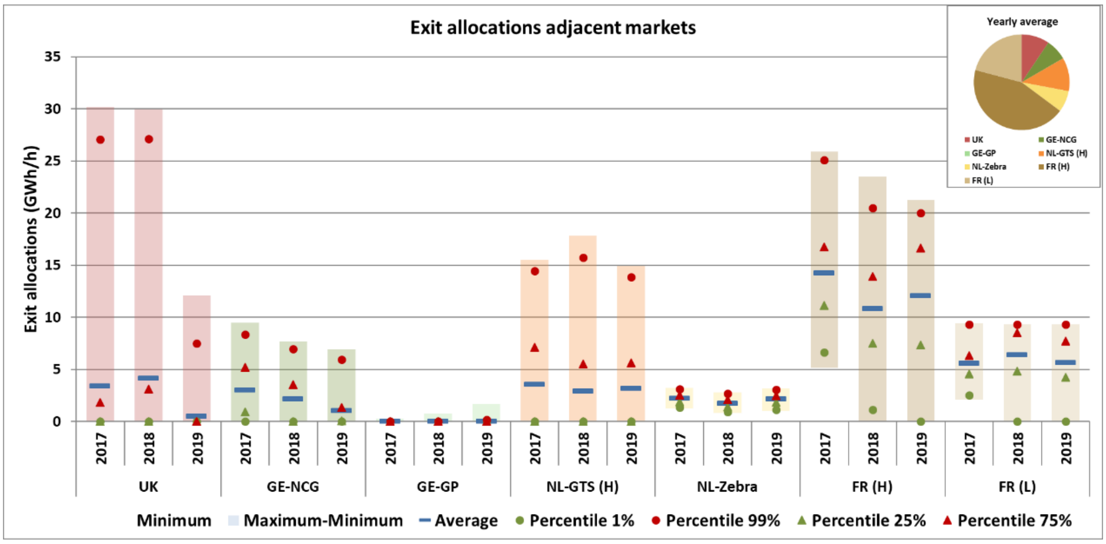

Figure 27: Exit allocations, neighbouring markets

The graph shows that the highest average daily flow is to the French market (H-gas and L-gas). The French market also had the average closest to peak consumption (higher load factor). By contrast, the average daily flows to the UK, Germany and the Netherlands were lower.

5 Change in domestic and transit demand

5.1 Domestic demand

Fluxys Belgium maintains a projection of future natural gas consumption, in terms of annual volume and peak consumption, for public distribution, industry and power stations. These projections are based on the latest prospective studies of the gas sector (coordinated by Gas.be), projections by the Federal Planning Bureau and Elia's latest adequacy studies for power stations. ENTSOG requires these projections when drafting the TYNDP, which is compiled every two years at European level.

Taking into account the conclusions of Elia's *Adequacy and flexibility study for Belgium 2020–2030* (published in June 2019), which shows that an additional 3.9 GWe of power-station capacity would be needed by 2025 in the event of a nuclear phase-out, Fluxys Belgium's projections indicate an increase in peak daily supply demand from 61 GW in 2020 to between 65 and 67 GW in 2025 (H- and L-gas, daily average) depending on the scenario.[17]

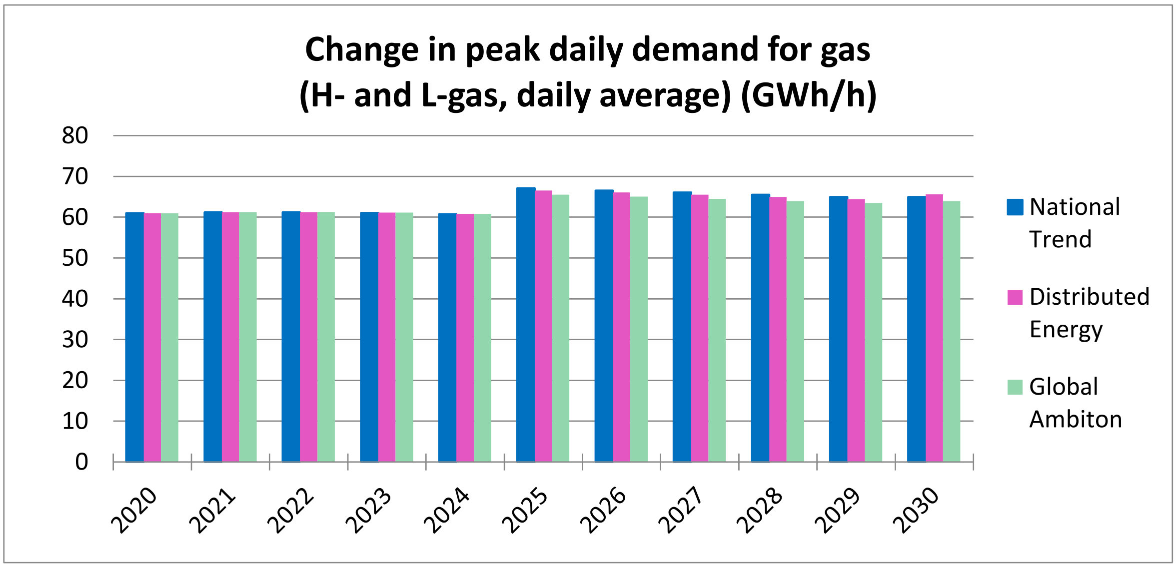

Figure 28: Projection of peak daily demand for gas on the Belgian gas market

The adequacy of the Fluxys Belgium network in view of gas demand is assessed both overall and at local level.

[17] The Fluxys Belgium demand scenarios are aligned with those of ENTSOG (see Section 2.1). The National Trends scenario is compatible with the NECP. The Global Ambition scenario covers the period up to 2050, is compatible with the 1.5 °C limit on global warming set by the 2015 Paris Agreement, and is built on the centralised development of renewable energy generation resources. The Distributed Energy scenario is also aligned with the 1.5 °C target but takes a decentralised approach to the energy transition up to 2050.

Overall, Fluxys Belgium determines the entry and exit capacities of its network, taking into account peak hourly demand from public distribution, industry and power stations, divided into consumption clusters. This calculation is based on hydraulic simulations carried out for the various potential flow scenarios.

Overall capacity calculations (network entry and exit) show that, should new gas-fired power stations be built by 2025 (integrated into the peak gas demand scenarios), the total entry capacity of the H network would remain higher than the peak demand, even after full integration of the current L network into the H network. Under this scenario, total peak day demand would be just under 6 million m³/h (daily average), while the entry capacity into the H network would total 10 million m³/h, without taking into account the injection capacity into the network from the underground storage facility at Loenhout.

5.2 Outlook for imports

The physical gas entry capacity on the Fluxys Belgium network comes mainly from Zeebrugge (imports via pipeline from Norway and the UK and via LNG) and Alveringem (imports from France) in the west, Zelzate, Zandvliet and Hilvarenbeek in the north (imports from the Netherlands), and 's Gravenvoeren (imports from the Netherlands) and Eynatten (imports from Germany) in the east.

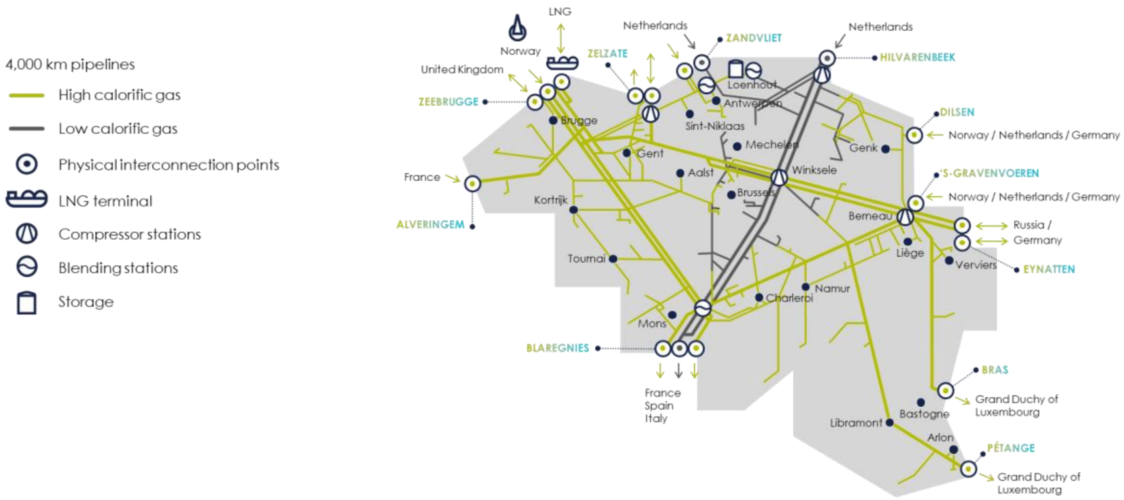

Figure 29: Fluxys Belgium network and interconnections

5.2.1 Imports from Norway

ENTSOG's TYNDP predicts a reasonably stable supply from Norway to the European market over the coming years. Imports to Belgium are also expected to experience little change.

5.2.2 LNG imports

It is commonly accepted that the decline of European domestic production will be predominantly offset by competition between LNG and Russian gas. The volume of LNG coming to Europe will also depend, among other factors, on the availability of LNG for Europe (in light of demand in Asia as well as South and Central America) and the available capacity for transmission of Russian gas to Europe. Fluxys Belgium's Zeebrugge entry zone directly connects LNG sources to neighbouring market areas where more H-gas will be needed to offset the decline in L-gas supplies.

5.2.3 Imports from France

Imports from France have been possible since late 2015 thanks to the new Alveringem interconnection point. The gas may come from the Dunkirk terminal or from TRF, the French gas trading point. LNG's role in supplying Europe will be a decisive factor for this new entry point too.

5.2.4 Imports from the UK

Imports from the UK (via Interconnector) vary greatly depending on the overall supply/demand balance in the UK and are substantially influenced by general market forces in Europe. The future usage rate is hard to predict, given the expiry of long-term contracts from October 2018 onwards, but the inter-market balancing function is expected to retain its importance and peak use is expected to continue.

5.2.5 Imports from Germany

Since the planned Zeelink investment project is to be bidirectional, increased imports from Germany cannot be ruled out. Imports from Germany will mainly serve as transit flows to the UK and as such will be substantially influenced by supply and demand in the UK and by market forces.

5.2.6 Imports from the Netherlands

L-gas imports will gradually decline as a result of the L/H conversion. H-gas imports from the Netherlands will be highly dependent on gas demand on the Belgian and British markets.

5.3 Outlook for exports

5.3.1 Transmission to France

In its Ten-Year Development Plan 2018-2027,[18] GRTgaz sets out four scenarios based on different levels of natural gas demand. Three of these scenarios show a decline in annual consumption. The capacity required (peak consumption) would be lower in each scenario. Due to the degree of uncertainty in the consumption scenarios and the evolution of contracts and nominations at border points, Fluxys will not, for the time being, change the rate of use of capacity supplied to France in the coming years. However, because of the L/H conversion, the volume of L-gas transmitted to the French market by Fluxys Belgium will gradually decrease, ceasing completely in 2030.

[18] http://www.grtgaz.com/fileadmin/plaquettes/fr/2019/Plan_decennal_2018-2027.pdf (in French)

5.3.2 Transmission to the UK

National Grid's Gas Ten Year Statement 2019[19] describes four possible scenarios, ranging from a slight dip in the UK's gas needs to a significant decline. Peak demand falls less significantly, remaining stable in two scenarios. The country's own gas production levels continue to fall. Any additional imports will mainly come from LNG, continental Europe (through the Interconnector and BBL pipelines) or the development of shale gas (depending on the scenario) and/or green gas production.

At present, the available transmission capacity towards the UK (via Interconnector) is deemed sufficient to respond to market signals (arbitrage flows) while also contributing to that country's security of supply. Any analysis of the future role of this infrastructure must be conducted with security of supply in mind.

5.3.3 Transmission to Germany

Germany is also set to replace L-gas with H-gas (around 30 bcm/year). The (draft) German Network Development Plan 2020[20] envisages a new pipeline from the Eynatten border point to the German regions requiring conversion (with commissioning expected in 2021). This new pipeline (Zeelink) will strengthen the link with the Zeebrugge zone, which is itself directly connected to the new Dunkirk LNG terminal by the Alveringem-Maldegem pipeline and to the Dutch network via the Zelzate border station. Zeelink will give the German market the capacity and flexibility it needs as well as access to diversified supply sources.

5.3.4 Transmission to the Netherlands

The most recent GTS Investment Plan (2020)[21] describes three scenarios. The capacity of the Groningen field and other small fields is set to fall substantially in the next few years. This decrease will be partly offset by increased transit flows on the H-gas network. Additional imports will also be needed to meet domestic gas demand, although this is decreasing. The upward trend of volumes flowing from Belgium to the Netherlands may therefore continue in the years to come.

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[19] https://www.nationalgrid.com/uk/gas-transmission/document/128886/download

[20] https://www.fnb-gas.de/en/network-development-plan/network-development-plan/network-development-plan-2020/

[21] https://www.gasunietransportservices.nl/en/gasmarket/investment-plan/investment-plan-2020

6 L/H conversion

6.1 Introduction

Exports of L-gas to Belgium, France and Germany will cease by 2030. To guarantee security of supply, Belgium, France and Germany decided to begin converting the L-gas market to H-gas; this is because there is plenty of H-gas available and existing L-gas transmission infrastructure can be used for H-gas, resulting in an economically optimal solution for all users.

It should be noted that the Dutch government has decided to close production at the Groningen site as soon as possible in order to alleviate the earthquakes experienced in the region. Therefore, production has been capped at 8.1 bcm for the gas year 2020-2021 (compared with 10.7 bcm for 2019-2020[22] and 19.4 bcm for 2018-2019) and the authorities have announced their intention to shut down production at Groningen in mid-2022, based on estimated domestic and export needs, as well as the pseudo L-gas production and storage capacities established by GTS.[23]

At the request of the Belgian authorities, Synergrid has devised an indicative conversion schedule.[24] The indicative schedule is based on repurposing as much of the existing Belgian infrastructure as possible with a view to avoiding investments that are only necessary for the transition period. For the conversion to be a success, Fluxys Belgium will gradually have to adapt its network to ensure the continuity of transmission services for both converted and non-converted markets.

6.2 Optimising the conversion programme

In 2020, TSOs and DSOs identified opportunities to optimise the L/H conversion schedule. As a result, according to the new indicative schedule drawn up by Synergrid, the entire Belgian natural gas market should be converted to H-gas by the end of 2024. However, the transit of L-gas from the Netherlands to France will continue for several years. The indicative conversion schedule is provided in Figure 30.

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[22] Groningen's authorised production level for the gas year 2019-2020 was 11.8 bcm in September 2019 but this was revised downwards after the winter because of the small number of degree days that year.

[23] From mid-2022 onwards, the Groningen field will still be needed to cover exceptional circumstances, such as a technical incident on the network combined with a very low temperature.

[24] The Federation of Electricity and Gas System Operators in Belgium (http://www.synergrid.be/ (in French or Dutch))

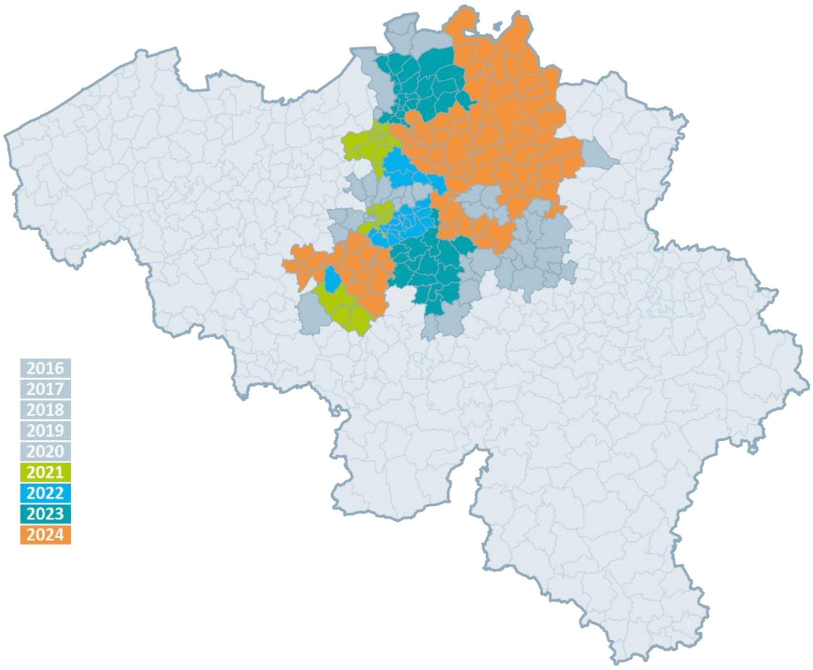

Figure 30: Indicative schedule for the L/H conversion by municipality (source: Synergrid)

The sections below outline the broad thrust of this conversion in terms of infrastructure and transmission capacity.

6.3 Principles governing the conversion of transmission systems

The main changes to be made to the transmission system involve connecting and gradually integrating L-gas infrastructure into the H-gas transmission system. Under the conversion schedule, existing connections between the L and H systems will be adapted, if necessary, in order to selectively supply H-gas to DSOs and industrial customers.

However, in some parts of the network, the capacity of the existing connections will not be high enough and some upgrades will have to be made, especially at connections between the major L-gas and H-gas transmission routes (such as the connection between the RTR[25] and the Dorsales[26]).

Maintaining transmission capacity to the non-converted L-gas market is a significant constraint, especially as regards export capacity to the French market. Since there is a single entry point for L-gas at Hilvarenbeek/Poppel and a single exit point at Blaregnies (for transmission to France), one of the two Dorsales will need to continue transmitting L-gas until the conversion of the French market is complete.

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[25] Renforcement Réseau de Transport/Transit ('transmission/transit network upgrade' in English). Major H-gas transmission pipeline between Zeebrugge and the German border.

[26] The pipelines transmitting L-gas from Hilvarenbeek to the south are known as the 'Dorsales'.

The Belgian market can only be converted by gradually supplying H-gas into the second Dorsale, primarily from a yet-to-be-built interconnection linking the major H-gas transmission pipeline between Zeebrugge and Eynatten to the Dorsales at the Winksele compressor station, at the heart of the L-gas market awaiting conversion. With that in mind, the conversion process will run from south to north, gradually pushing back L-gas to the entry point at Hilvarenbeek/Poppel.

6.4 Adjustments to the Fluxys Belgium network

6.4.1 Progress of conversion since 2016

Between 2016 and 2019, the L/H conversion was rolled out at existing interconnections requiring only minor changes to the network, namely the Warnant Dreye (1), Beuzet (2) and Antwerp CGA (3) interconnection hubs. Only the conversion of the Brasschaat-Wuustwezel area required a new pressure-reducing station at Kalmthout (4).

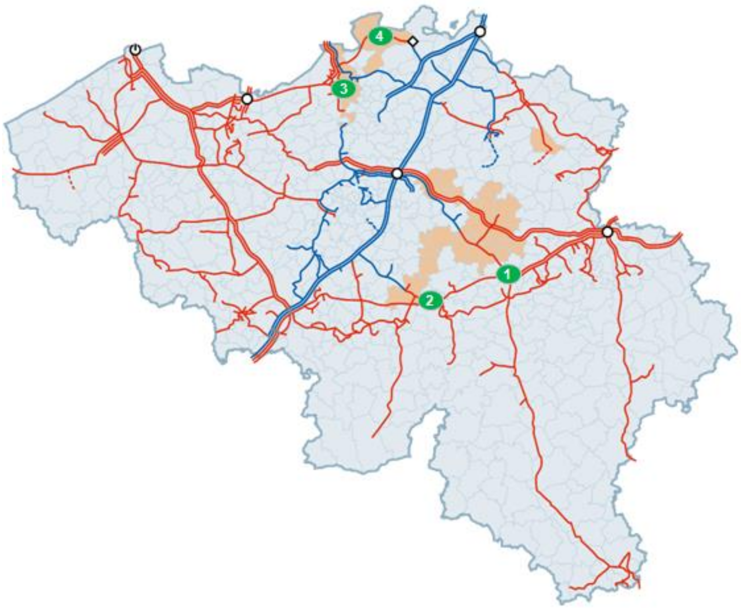


Figure 31: Adjustments to the Fluxys Belgium network in 2016-2019 (source: Synergrid & Fluxys Belgium)

The 2020 conversion phase began in early September and involved the injection of H-gas from the RTR to Ring 1 starting from the Winksele station (5). Major adjustments had to be made to this station to make this injection possible.

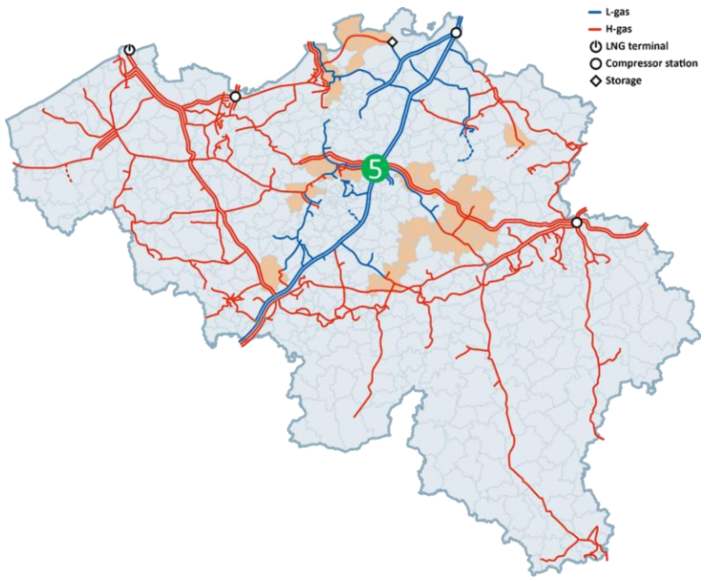


Figure 32: Adjustments to the Fluxys Belgium network completed in 2020 (source: Synergrid & Fluxys Belgium)

6.4.2 Next steps

6.4.2.1 South of the Zeebrugge-Eynatten pipeline

Additional adjustments need to be made to the Winksele station (5) to connect the RTR to the transmission systems supplying the Brussels-Capital Region and the Dorsales. As such, the conversion of the Brussels-Capital Region will continue in 2021, with completion scheduled for 2022. All the other regions south of the Zeebrugge-Eynatten pipeline and supplied by the Dorsales will be converted by 2024.

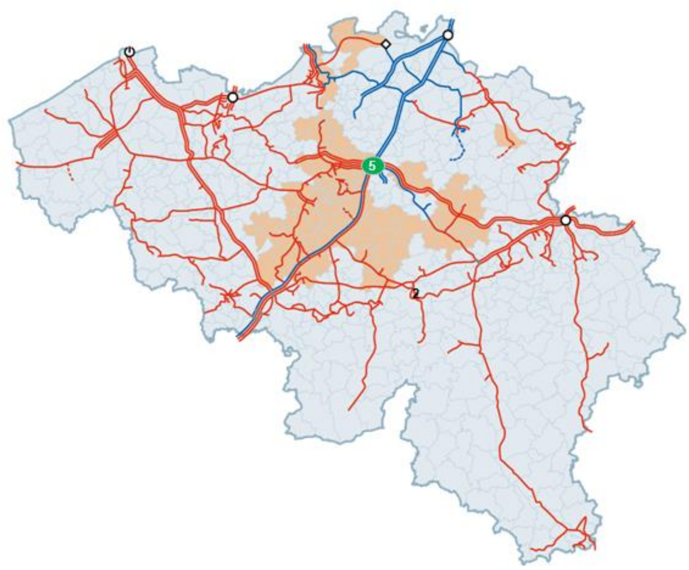


Figure 33: Adjustments to the Fluxys Belgium network south of the Zeebrugge-Eynatten pipeline (source: Synergrid & Fluxys Belgium)

6.4.2.2 North of the Zeebrugge-Eynatten pipeline

TSOs and DSOs have identified ways to optimise the conversion programme, meaning that the Belgian market north of the Zeebrugge-Eynatten pipeline up to the Hilvarenbeek L-gas entry point will be converted by late 2024.

As a result, the Antwerp and Kempen regions will be converted in 2023 and 2024 respectively by means of the gradual introduction of H-gas in one of the two Dorsales (north section) from Winksele (6).

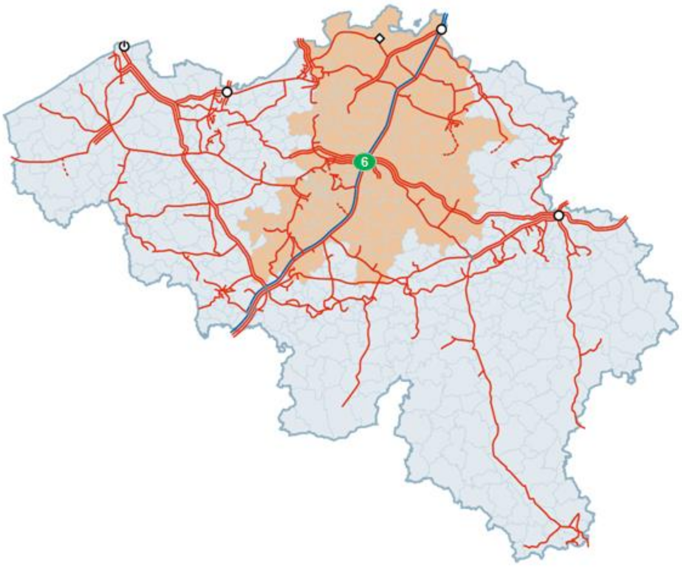


Figure 34: All adjustments to the Fluxys Belgium network (source: Synergrid & Fluxys Belgium)

6.5 Entry capacity for the new H market

6.5.1 Conversion period

L-gas customers affected by the conversion need to be supplied with H-gas at each stage of the process. Given that the Hilvarenbeek/Poppel entry point is only supplied with L-gas, the companies shipping gas to these new customers need to have entry capacity at another (H-gas) entry point on the Fluxys Belgium network.

Fluxys Belgium's assessments show that there is enough H-gas entry capacity to absorb the needs of the Belgian domestic market for H-gas capacity. This indicative investment plan therefore does not include new investments aimed at boosting H-gas entry capacity. These assessments will be reviewed based on signals and indications from the market, particularly in connection with needs relating to the replacement of L-gas in France and Germany or the Netherlands.

6.5.2 Post-conversion period

Following the conversion period, the main west-east and north-south transmission routes on the Fluxys Belgium network will be able to play a major role in replacing L-gas on the French and German markets in terms of both diversity and security of supply and access to LNG sources.

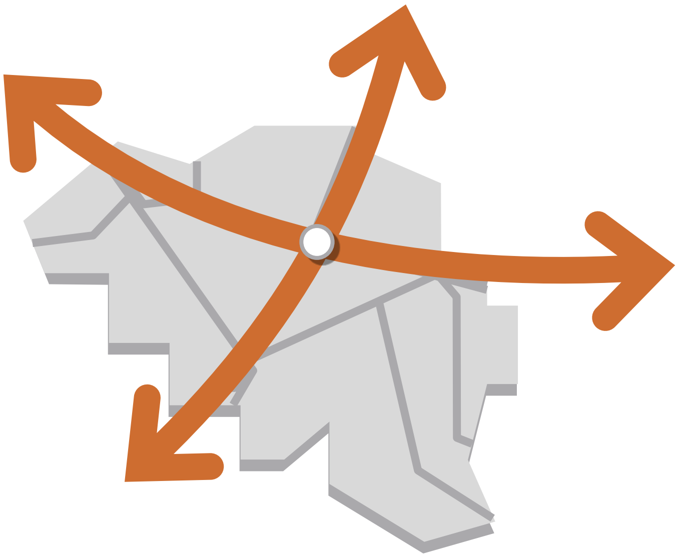


Figure 35: Potential contribution of the Fluxys Belgium network to the H-gas supply in Europe (source: Fluxys Belgium)

6.5.3 Investments required for the L/H conversion

The following investments covering adjustments associated with the L/H conversion are expected:

- interconnections between the RTR pipelines and the Dorsales (at Winksele) so that work can begin on converting the area south of Winksele in 2020;
- the adjustment of certain pressure-reducing stations to ensure optimal operation of the H-gas market after the conversion;
- additional temporary separators between the parts of the network with different gas qualities during the various phases of the conversion, or different pressures during or after conversion.

The indicative investment plan does not include inspections of gas facilities on industrial or residential customers' premises, nor does it include adjustments to DSO infrastructure.

7 Developments concerning LNG

In light of the market interest in LNG supply at Zeebrugge, Fluxys LNG is considering increasing its regasification capacity at the terminal.

In July and August 2020, Fluxys LNG organised the non-binding open season phase for an increase in regasification capacity, with an additional 8.2 GWh/h available from 2024 onwards, reaching 10.2 GWh/h as of 2026. The result of this open season shows the strong demand on the market for additional send-out capacity at Zeebrugge.

The binding phase of the open season process, organised in November 2020, was also a success. Fluxys LNG is now taking further steps in the regulatory approval process with a view to making a final investment decision.

The appropriate investments in the LNG terminal's regasification capacity are included in the indicative investment plan.

Figure 36: Zeebrugge LNG Terminal

8 Developments concerning biomethane

8.1 Status of biomethane today

Biogas is produced from organic matter and is neutral in terms of its contribution to the greenhouse effect. At present, there are almost 200 active biogas production units in Belgium, mainly used to power local heat or electricity generation processes. Biogas can also be purified and transformed into biomethane, which can be injected into the natural gas distribution or transmission system.

Biomethane has the potential to make a significant contribution to Belgium's energy and climate goals, making it possible to influence the share of renewables in the country's energy mix and therefore to reduce greenhouse gas emissions.

A study conducted by Valbiom has shown that realistically, biomethane could generate 15.6 TWh[27] by 2030, equivalent to around 8% of Belgium's natural gas consumption in 2019.

Figure 37: Biomethane production

[27] 'Quelle place pour le biométhane injectable en Belgique' study conducted by the non-profit Valbiom at the request of Gas.be into the potential of injectable biomethane in Belgium: https://www.gas.be/sites/default/files/pdf/laybrochPotentielBiomethaneFRv10BAT.pdf (in French)

8.2 Injecting biomethane into natural gas networks

Existing natural gas networks are an important means of enhancing the use of this zero-carbon gas, whether this is biomethane or gas from renewables, meaning that its environmental benefits can be enjoyed by society: the agricultural sector, citizens, businesses and public authorities.

At present, units that convert biogas to biomethane inject it into the public distribution network. The first facility for injecting biomethane into the distribution system in Belgium was inaugurated in late 2018. In 2020, a second such facility was commissioned, with the possibility of injecting biomethane into the Fluxys Belgium network during the summer.

Over the next few years, the expectation is that new facilities will be built to inject biomethane into the distribution system, as well as directly into the natural gas transmission system.

9 Summary

Developments on the Belgian gas market and neighbouring markets require adjustments to the natural gas and biomethane transmission system. This is especially the case for:

- **the L/H conversion**, which will make the Belgian natural gas market independent of L-gas supplies from winter 2024/2025 onwards;
- **the possible construction of several new gas-fired power generation units** in connection with the nuclear phase-out scheduled for 2025;
- **the increase in LNG regasification capacity** at the terminal in Zeebrugge;
- **the connection of biomethane production units** directly to the Fluxys Belgium network.

Furthermore, Fluxys Belgium must adapt its network to the demand from public distribution (which sees between 55,000 and 60,000 new customers each year) and new industrial customers, and keep its network in good condition to ensure that it fulfils safety requirements.

Capacity calculations show that, should new gas-fired power stations be built by 2025, the total entry capacity of the H network would remain higher than the peak demand, even after full integration of the current L network into the H network. Under this scenario, the total average peak day demand for gas would be just under 6 million m^3/h in 2025 (daily average), while the entry capacity into the H network would total 10 million m^3/h, without taking into account the injection capacity into the network from the underground storage facility at Loenhout.

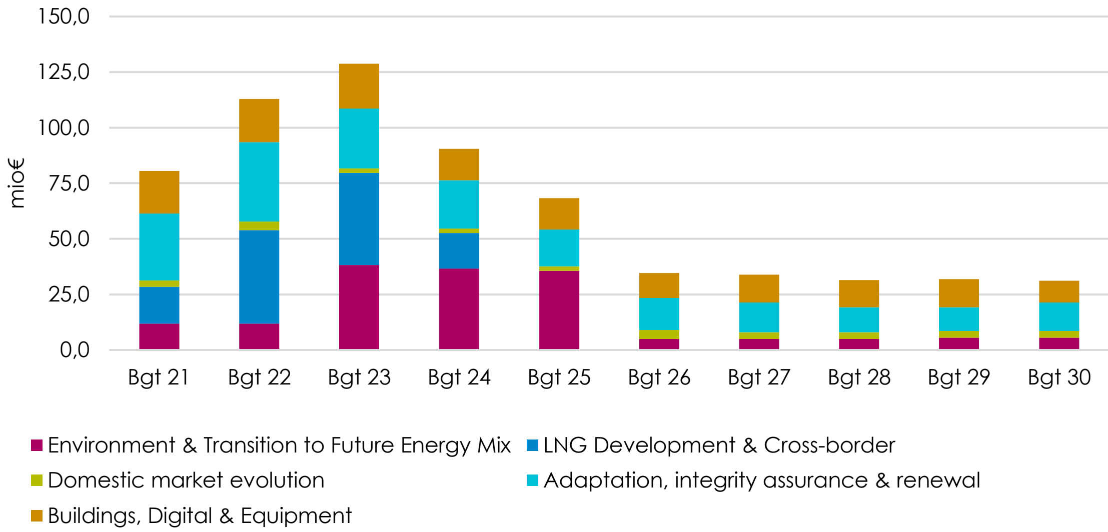
At local level, Fluxys Belgium has analysed various distribution configurations for these power stations on its network. This analysis identified a potential need for localised network upgrades at two points:

- Antwerp area: the capacity of an existing pipeline between the Zelzate and Kallo stations may need to be doubled, depending on the changing natural gas supply needs of industry in the port of Antwerp.
- Limbourg area: an upgrade of the network by completing the local network in Diest with the west-east RTR pipeline[28] may be necessary depending on the number and location of any power generation units in the region.

[28] Renforcement Réseau de Transport/Transit: 'transmission/transit network upgrade' in English

10 Indicative investments up to 2030

Fluxys Belgium and Fluxys LNG plan to make investments totalling **€644 million[29] over the period 2021-2030.**



Investments will be made in the following five areas:

- **Environment and transition to the future energy mix**: €160 million
- Adaptation, integrity assurance and **renewal** of infrastructure: €194 million
- Network modifications to meet the changing needs of **end consumers**: €29 million
- **LNG initiatives and cross-border projects**: €116 million
- **Miscellaneous** investments (buildings, ICT, etc.): €145 million

10.1 Environment and the transition of the network to the future energy mix

Earmarked amount: €160 million

This investment category encompasses all planned investments intended to reduce the environmental impact of Fluxys Belgium and Fluxys LNG operations (their carbon footprint in particular), as well as network developments to connect new power stations in particular and facilities for injecting biomethane and hydrogen (mixed with natural gas) into the Fluxys Belgium network.

[29] In constant euros. These investments relate to the current regulated activities of Fluxys Belgium and Fluxys LNG and do not include the development of future hydrogen and CO_2 transmission systems. See Part II for more information.

10.2 Adaptation, integrity assurance and renewal of infrastructure:

Earmarked amount: €194 million

This category of investments encompasses the renewal and adjustments of the existing infrastructure to ensure its safe operation, as well as the changes required especially in connection with the L/H conversion project.

10.3 Development of end-user needs

Earmarked amount: €29 million

This investment primarily encompasses the adaptation and adjustment of capacities offered to end users, especially changes to the geographical distribution of peak demand for public distribution, and industrial connections.

10.4 LNG initiatives and cross-border projects

Earmarked amount: €116 million

This investment segment encompasses the increase in regasification capacity at the Zeebrugge terminal, as well as new LNG truck loading bays to satisfy a growing demand.

10.5 Miscellaneous

Earmarked amount: €145 million

This amount encompasses the investments required in particular to develop new applications for managing and marketing gas flows, boost the digitalisation of activities and reinvest appropriately in various buildings and equipment.

Annex

Hydrogen and CO_2 transmission systems

1 Context

1.1 European energy and climate policy

The European Union aims to achieve **carbon neutrality by 2050** by means of the **Green Deal**[30] adopted by the European Parliament in January 2020. The European Commission also announced in September 2020 the objective of reducing greenhouse gas emissions by 55% compared with 1990 levels. These aims are reflected in actions to be taken in many sectors, of which energy is a central pillar.

An EU **Strategy for Energy System Integration**[31] was published in July 2020. This strategy promotes the coordinated planning of the energy system, across multiple energy carriers, infrastructure and consumption sectors, paving the way for an effective, affordable and deep decarbonisation of the energy system. Energy system integration strives for energy efficiency, particularly by exploiting synergies between different sectors. It also incorporates the use of low-carbon fuels, more specifically hydrogen, when direct electrification is not feasible, efficient or cost-effective. The energy system must become 'multi-directional' and integrate decentralised production units to supply energy, as well as providing for horizontal exchanges of energy between consumption sectors. Lastly, energy system integration must open up the additional flexibility needed to increase the share of variable renewable sources, more specifically through storage technologies.

At the same time, the European Commission also published a **hydrogen strategy for a climate-neutral Europe**[32] (the EU Hydrogen Strategy). This document highlights the role hydrogen needs to play in an integrated energy system to decarbonise industry and the transport, power and building sectors in Europe. Hydrogen can serve as the energy carrier for uses not suitable for electrification and provide a storage solution to balance flows from variable renewable energies. The strategy's priority is to develop the direct production of hydrogen from renewable energies such as wind and solar energy. However, in the short and medium term other forms of low-carbon hydrogen will be needed to rapidly reduce greenhouse gas emissions and support the development of a viable market.

The European Commission's Hydrogen Strategy sets out a phased approach:

- From 2020 to 2024: installation of 6 GW of renewable hydrogen electrolysers and production of up to 1 million tonnes of renewable hydrogen
- From 2025 to 2030: installation of at least 40 GW of renewable hydrogen electrolysers and production of up to 10 million tonnes of renewable hydrogen

[30] European Commission, The European Green Deal, COM(2019) 640, December 2019

[31] European Commission, Powering a climate-neutral economy: An EU Strategy for Energy System Integration, COM(2020) 299, July 2020

[32] European Commission, A hydrogen strategy for a climate-neutral Europe, COM(2020) 301, July 2020

- From 2030 to 2050: renewable hydrogen production technologies reach maturity and renewable hydrogen will be deployed on a large scale across all hard-to-decarbonise sectors

As part of the post-COVID-19 **recovery plan for Europe,**[33] the Commission focused on investments to accelerate the energy transition, such as technologies for producing renewable energy and green hydrogen, and sustainable energy infrastructure.

1.2 Role of gas and gas infrastructure

The transition to a zero-carbon energy system requires major investments and a paradigm shift. A concerted, cross-sectoral approach will be needed to achieve the targets set at European level.

The existing gas infrastructure must be used to accomplish these aims:

- **High-volume, low-cost energy transmission**: Historically, gas infrastructure has been designed to transmit large volumes of energy over long distances, with minimal losses and costs. The gas transmission system can be repurposed to transmit decarbonised gases like biomethane or green hydrogen.
- **Energy storage and flexibility:** Europe is currently home to considerable gas storage capacity, which can be used in the future to store gases produced using renewable energies.
- **Transmission of CO_2:** Some sectors will be unable to switch to green energy sources in the short term. This is particularly true of certain industrial processes. In such cases, carbon capture solutions will be needed, alongside the necessary CO_2 transmission infrastructure, to take the captured CO_2 to sites for reuse (CCU) or storage (CCS).

[33] NextGenerationEU, European Commission, May 2020

2 Hydrogen transmission in Belgium

At present, production of and demand for hydrogen in Belgium are mainly linked to industry (especially in oil refining or ammonia production processes). Hydrogen production is currently based on the reforming of methane (natural gas).

It is widely accepted that demand for hydrogen is set to increase. In a recent study into the role of gases and electricity in a carbon-neutral system in 2050, the Federal Planning Bureau suggested that annual demand for hydrogen as an energy carrier in Belgium will total between 80 TWh and 99 TWh, depending on the scenario.[34] Such volumes could be produced in Belgium through the electrolysis of water, which would produce green hydrogen, provided that the electricity used comes from renewable sources.

Existing gas transmission infrastructure could be used to facilitate the development of hydrogen as an energy transmission carrier. In fact, where several gas pipelines are present, synergies could be unlocked to repurpose one of these pipelines to transmit the hydrogen needed, for example, in industrial processes or for transport.

[34] Federal Planning Bureau, 'Fuel for the Future – More molecules or deep electrification of Belgium's energy system by 2050', October 2020

3 CO_2 transmission in Belgium

In addition to green gases, CCS/CCU will have to be developed for sectors where it is difficult to cut emissions to meet Europe's CO_2 emission reduction targets (a 55% decrease by 2030 and net zero by 2050).

In 2018, Belgium's total CO_2 emissions amounted to 100.3 million tonnes of carbon dioxide (Mt CO_2 excluding LULUCF).[35] Figure 38 illustrates the CO_2 emissions related to the use of energy and feedstock (industrial processes and products) by sector. Industry accounts for the bulk of emissions (39.1 Mt, 16 Mt of which are linked to feedstock),[36] followed by transport (26.0 Mt) and residential heating (22.1 Mt).

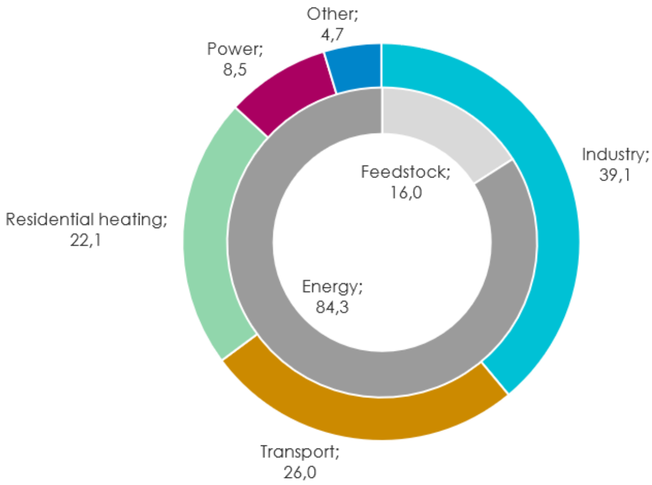


Figure 38: CO_2 emissions in Belgium linked to the use of energy and feedstock per sector in Mt (2018)

CO_2 networks linking emitters and wells (CO_2 storage and use) would allow the development of competitive carbon-reduction technologies. CO_2 liquefaction terminals could be required to ship CO_2 to sequestration sites.

Fluxys Belgium's network can play a vital role here by reusing part of the natural gas transmission infrastructure to transport/export CO_2 from industrial sites in Belgium to CO_2 use/storage facilities.

[35] Federal Public Service Health, Food Chain Safety and Environment, the Belgian federal website for reliable information on climate change www.climat.be (in French or Dutch), 2020 – emissions in this report exclude emissions of greenhouse gases other than CO_2 (e.g. N_2O) and exclude land use, land-use change and forestry (LULUCF).

[36] Emissions from refineries are reallocated from electricity to industry, and this is applied consistently throughout the report.

4 Development of future hydrogen and CO_2 transmission systems

4.1 Europe's backbone for hydrogen transmission

The figure below is the result of an exercise to define a European hydrogen transmission infrastructure, which was published in July 2020 by a group of 11 TSOs. This exercise, which Fluxys participated in, was based on the reuse of some existing natural gas transmission facilities. The authors of the study envisage the development of a hydrogen network linking consumption and production centres with 6,800 km of pipelines by 2030. The infrastructure will develop further in the 2030s, and will comprise 23,000 km of pipelines by 2040.

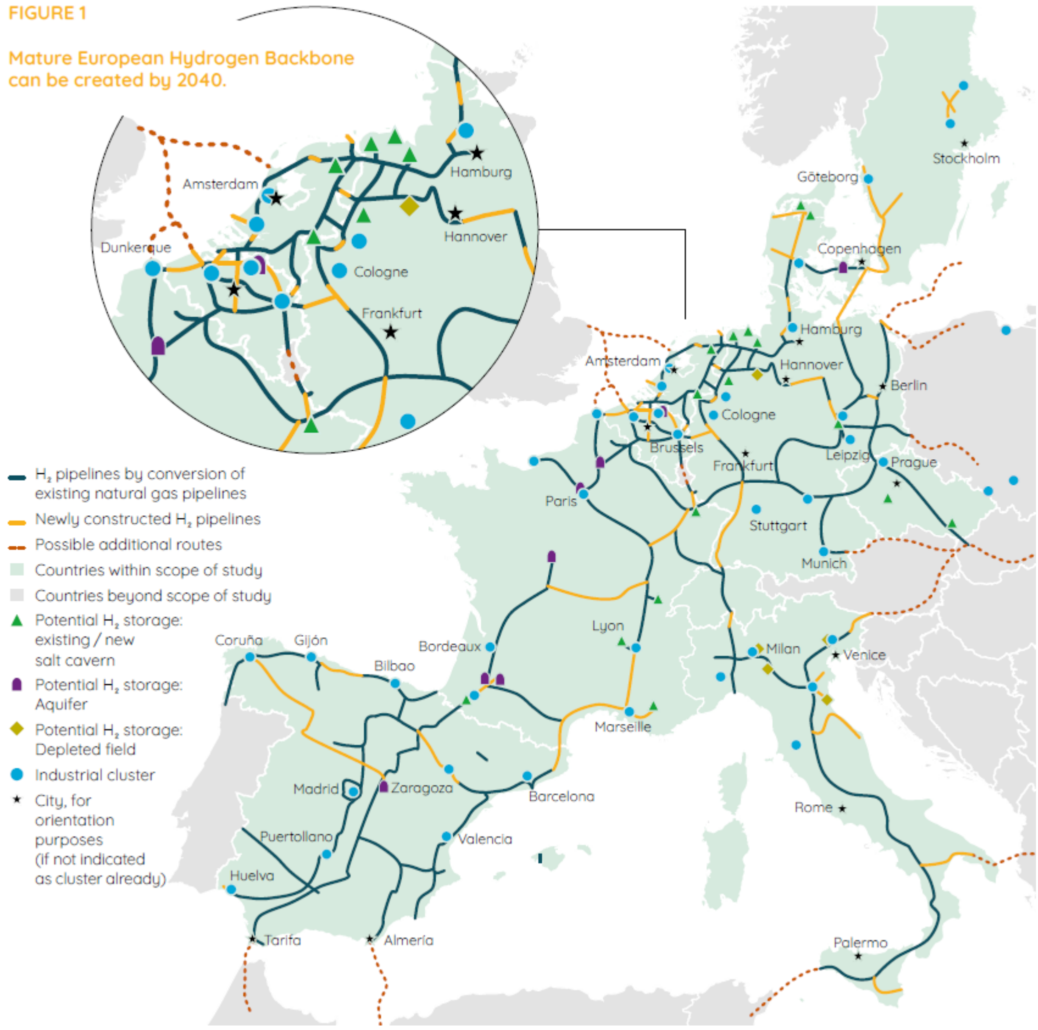


Figure 39: European hydrogen backbone[37] (source: Guidehouse, July 2020)

[37] https://gasforclimate2050.eu/sdm_downloads/european-hydrogen-backbone/

4.2 Long-term vision of a Belgian H_2/CO_2 backbone

The figure below sets out a long-term vision for the development of future H_2 and CO_2 transmission systems in Belgium. These networks connect the main regions identified for hydrogen demand and production and CO_2 emissions, and are connected to the various neighbouring markets.

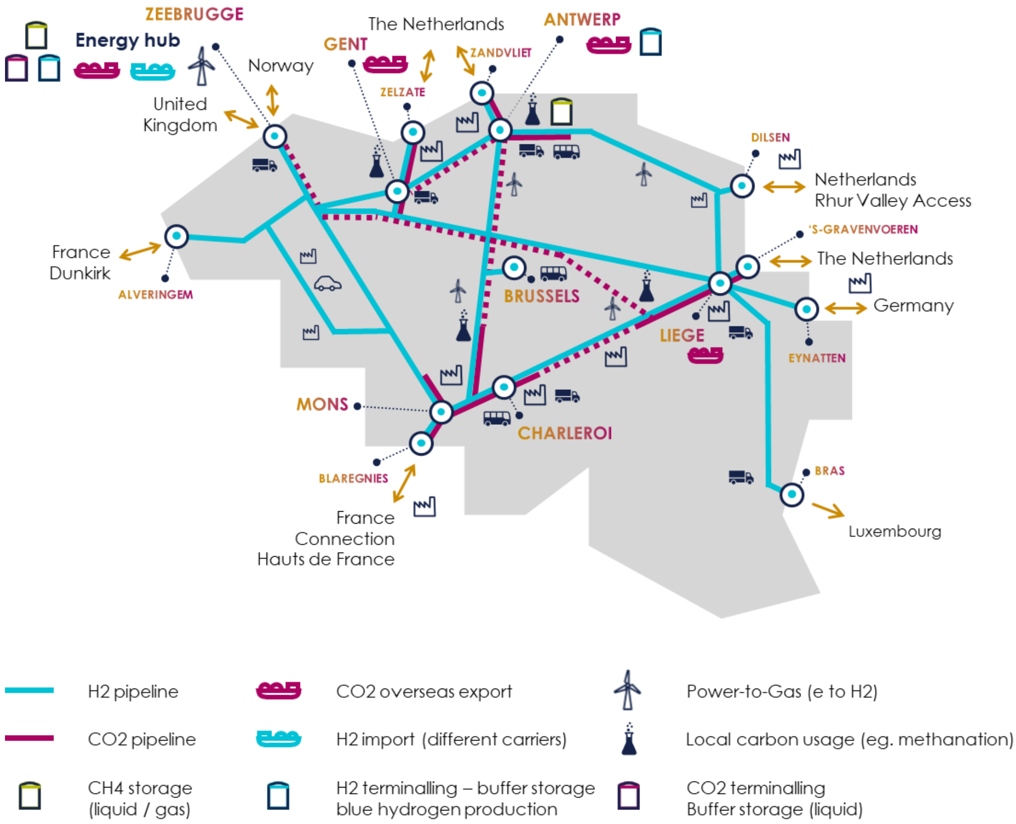


Figure 40: Long-term vision of the H_2/CO_2 backbone

This H_2 and CO_2 transmission backbone partly follows the route of the existing natural gas transmission system, and combines repurposed and new natural gas pipelines. It is connected to the ports of Antwerp and Ghent, the Zeebrugge terminal and the industrial zones of Hainaut, Liège and Limburg, as well as to Brussels. The networks are also connected to neighbouring countries: the Netherlands, Germany, France and Luxembourg. A connection with the UK is also possible via Zeebrugge. Furthermore, the Zeebrugge terminal provides for the import and export of H_2 and CO_2 in liquid form, for example.

The H_2 backbone will enable the transfer of hydrogen between industrial clusters in Belgium as well as the import and export of hydrogen. Through multiple interconnection points, producers, transporters and end customers should be able to trade on a growing hydrogen market in Europe, supported by a liquid trading market.

The CO_2 backbone complements the hydrogen backbone. It enables the transmission of CO_2 captured for example in current hydrogen production processes. More broadly, industrial processes that are difficult to decarbonise will benefit from a transmission infrastructure that makes it possible to collect CO_2 emissions. The captured CO_2 can be exported to a storage site or reused more locally in another industrial process.

The H_2/CO_2 backbone will be key to the decarbonisation of the Belgian energy system. It will allow both the supply of hydrogen, which will gradually become green (i.e. be produced from renewable energy), and the transmission of captured CO_2 to industrial processes that are harder to decarbonise.

4.3 Short-term options

The figure below shows the initial steps planned in the development of an H_2/CO_2 backbone.

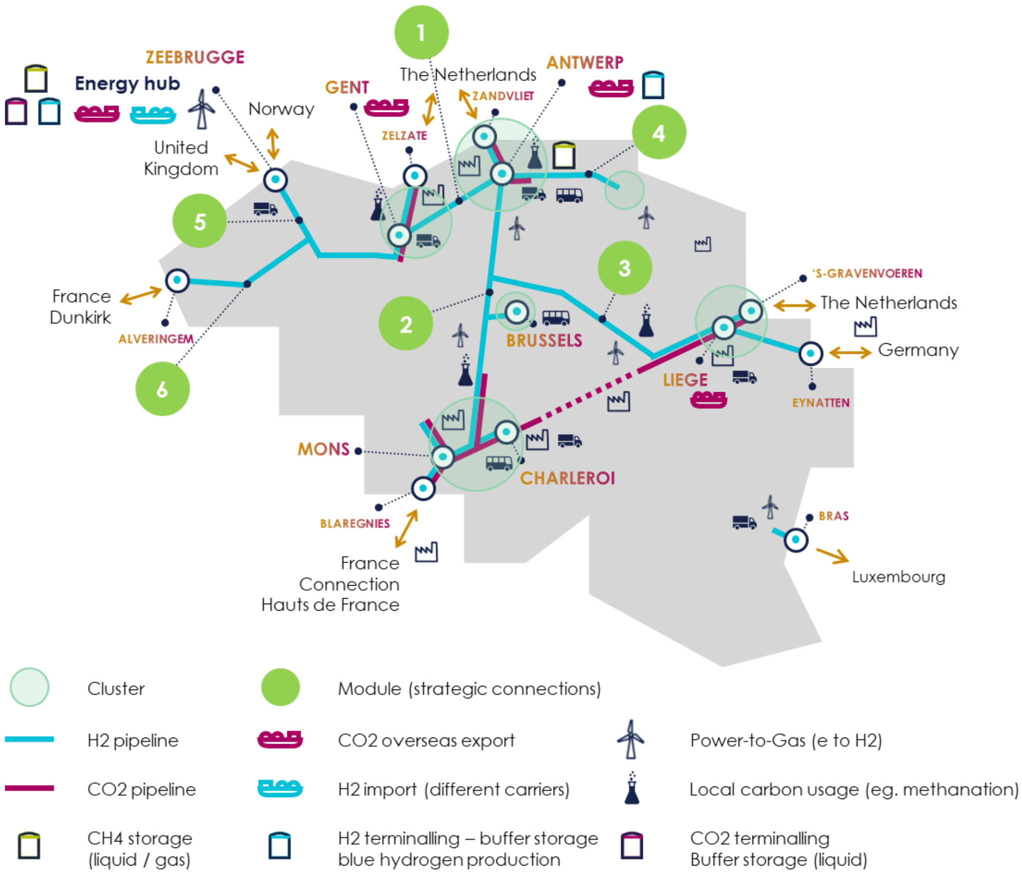


Figure 41: Short-term options for the deployment of the H_2/CO_2 backbone

Six H_2 production/consumption and CO_2 emission clusters, six H_2 connection modules between clusters, and six interconnections with neighbouring countries have been identified as potential first steps in the development of the H_2 network.

4.3.1 Clusters

The clusters are regions where current and future hydrogen consumers could be connected to facilitate the supply of hydrogen, either as a raw material or as part of a transition to hydrogen as a decarbonised energy carrier. The 'grey' hydrogen produced at methane reforming sites could gradually be replaced by 'blue' hydrogen (produced using captured CO_2) and 'green' hydrogen (produced from renewable energy).

A local CO_2 network would be a useful complement to the H_2 backbone in this region, either for export for storage or for reuse in chemical processes, and help to reduce industrial greenhouse gas emissions.

The following clusters have been identified:

- Antwerp
- Brussels
- The Albert Canal
- Ghent
- Hainaut
- Liège

4.3.2 Modules for connecting clusters for H_2

4.3.2.1 Module 1: 'Antwerp-Ghent'

The creation of the Antwerp-Ghent pipeline supports the development of this area by interconnecting more production and consumption facilities. In conjunction with the Zandvliet and Zelzate (Netherlands (see below)) interconnections, this pipeline will foster a liquid hydrogen market connecting multiple producers and consumers.

4.3.2.2 Module 2(a): 'Antwerp-Brussels'

This module allows the supply of hydrogen in and around Brussels. Hydrogen can be used for transport (e.g. public transport and fleets), small-scale industry or buildings in the tertiary sector.

4.3.2.3 Module 2(b): 'Brussels-Hainaut'

This module connects Brussels and Belgian industrial clusters to Hainaut, facilitating this region's access to hydrogen at conditions similar to other regions in Belgium.

4.3.2.4 Module 3: 'Brussels-Liège'

Once Module 2(a) is operational, it can be extended and linked to industry in the Meuse Valley. This will enhance the liquidity of the hydrogen market, with more producers and consumers being linked together.

4.3.2.5 Module 4: 'Antwerp-Albert Canal'

This module connects industry on the Albert Canal to other industrial regions in Belgium. Depending on demand, this module could even be extended eastwards to the Ruhr area in Germany (via the Netherlands), ultimately linking it to the port of Antwerp.

4.3.2.6 Module 5: 'Ghent-Zeebrugge'

Belgium will most likely continue to import a significant proportion of the energy it needs in the future. The LNG terminal in Zeebrugge is a substantial asset in this regard. It could be used to import green hydrogen in liquid form, for example.

However, the wind farms in the North Sea could provide the energy needed to produce hydrogen in the Zeebrugge area.

In this context, connecting Zeebrugge (and potential future production sites nearby) to the various clusters specified above will be important.

4.3.2.7 Module 6: 'Dunkirk-Zeebrugge'

This last module is intended to finalise the connection of the major North Sea port areas along a pipeline linking the ports of Amsterdam, Rotterdam, Antwerp, Ghent, Zeebrugge and Dunkirk.

4.3.3 Interconnections with neighbouring countries

4.3.3.1 'Zandvliet (Netherlands)' interconnection

This interconnection enables the joint development of the hydrogen market with the Netherlands (in particular with the Rotterdam region). Hydrogen produced from wind energy in the Netherlands could be imported to the Antwerp cluster via this interconnection point in particular.

CO_2 could also be exported from the emitters in the port of Antwerp to storage sites via this route.

4.3.3.2 'Zelzate (Netherlands)' interconnection

This additional interconnection with the Netherlands enhances the coordination of the H_2 and CO_2 networks, which are attracting interest from industrial players on both sides of the Belgian-Dutch border in the North Sea Port zone.

4.3.3.3 'Blaregnies (France)' interconnection

Once Module 2 (with its 'Antwerp-Brussels' and 'Brussels-Hainaut' links) has been established, this interconnection with the Hainaut cluster will link the players (producers and consumers) in the Hauts-de-France region to the future North-West European hydrogen market.

4.3.3.4 ''s-Gravenvoeren (Netherlands)' interconnection

This additional connection to the Netherlands provides access to the industrial area of Dutch Limburg. This increased capacity would boost the competitiveness of Belgium's hydrogen supply as well as security of supply, and provide further export routes.

4.3.3.5 'Eynatten (Germany)' interconnection

The Liège cluster can be linked to Germany via Eynatten and provide access to the Ruhr and the Rhine industrial areas, thereby promoting the cross-border trading of hydrogen. Germany is likely to become a major consumer of hydrogen.

4.3.3.6 'Alveringem (France)' interconnection

As described above, the connection between the Belgian hydrogen transmission system and France (the Dunkirk terminal in particular via Alveringem) provides opportunities to optimise hydrogen supply/consumption for the Antwerp, Ghent and Zeebrugge areas.

5 Indicative investments up to 2030

Indicative estimates have been made for an infrastructure meeting demand for hydrogen and CO_2 transmission by 2030. It goes without saying that these amounts will evolve as the scope and technical specification of these networks become clearer in the future.

The future hydrogen and CO_2 transmission systems will combine repurposed and new natural gas pipelines.

5.1 Hydrogen transmission system

An indicative estimate has been devised for a **hydrogen network by 2030, linking the industrial sectors of Antwerp, Ghent, Hainaut and Liège/Meuse Valley as well as Brussels and the Zeebrugge terminal and connected to the Netherlands, France and Germany**.

Such a network represents an indicative investment of **€1,181 million (in constant euros) by 2030**.

5.2 CO_2 transmission system

By 2030, Fluxys plans to develop a **CO_2 transmission system to collect emissions from industry in the port of Antwerp, the Ghent industrial zone and the industrial areas of Hainaut and the Meuse Valley** for reuse or export (by pipeline or via a liquefaction terminal).

The investment associated with these development plans comes to **€310 million (in constant euros) by 2030**.

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