Indicative Investment Plan Fluxys Belgium & Fluxys LNG 2022-2031

February 2022

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Purpose

The indicative investment plan 2022-2031 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.

It has to be noted that this indicative investment plan has been established considering both the energy and geopolitical situation known at the end of 2021. It does therefore not take into consideration the Ukraine crisis that has emerged during the finalization of this document.

All investments identified to cope with the new situation consisting on one hand of a shift of the east-west to west-east flows and the higher dependence on LNG to feed Europe on the other hand are therefore not included.

Outlook for 2022-2031

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 possible phase-out of Belgian nuclear power plants by 2025; and market demand for more regasification capacity at 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.

Fluxys is also working hard to reduce its CO_2 footprint and methane emissions from its network.

Moreover, Fluxys Belgium is fully committed to realising the energy transition; more details are provided in an annex to this document. There is a strong desire to reuse as much of the existing natural gas infrastructure as possible to transport future gases, and an extensive analysis of the technical conditions for repurposing such infrastructure is under way to this end.

Annex: Hydrogen and CO_2 networks

An annex detailing the outlook beyond the current framework of the Belgian Gas Act has been appended to the indicative investment plan 2022-2031, 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.

1. The European gas market

1.1. Consumption trends in 2020

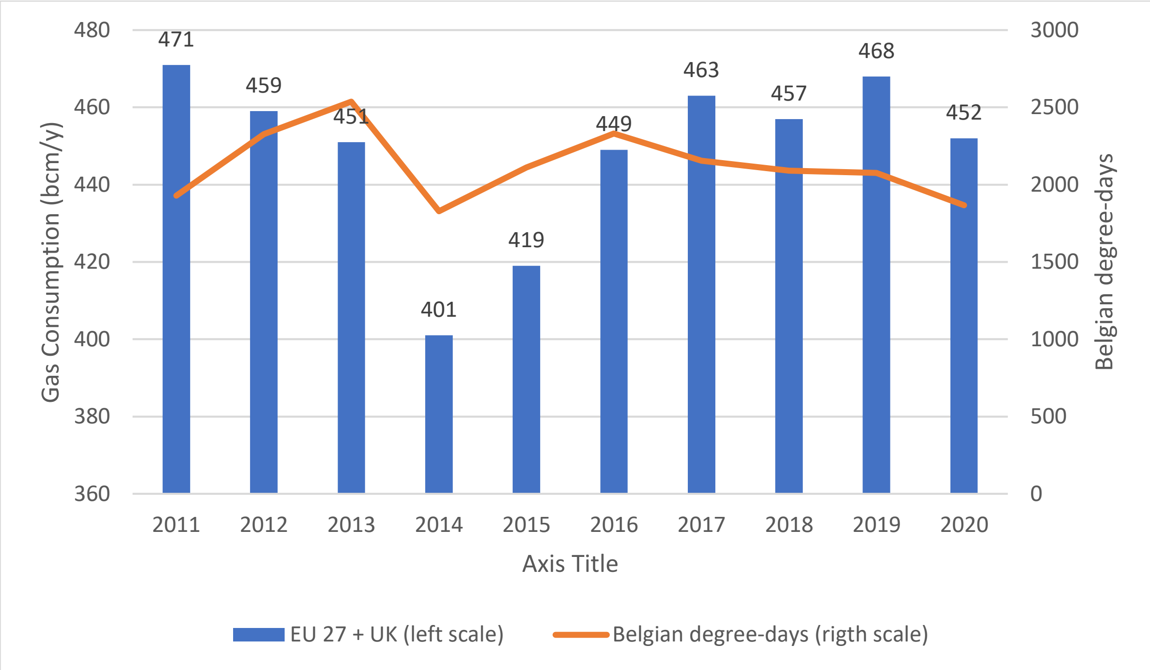
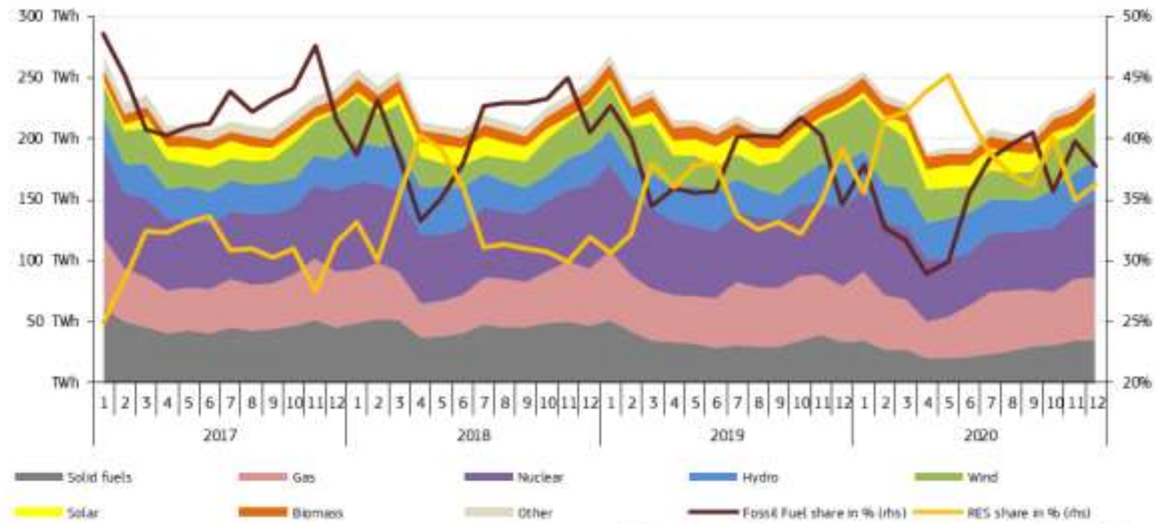


Figure 1: Gas consumption in the EU 27 and the UK, and the impact of the weather (sources: BP Statistical Review of World Energy, 2021 and Gas.be)

In 2020, European gas consumption (in the EU 27 (excluding Malta) and the UK) fell from 468.1 bcm in 2019 to 452.0 bcm, following an increase the previous year (BP Statistical Review of World Energy, 2021). 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 until the end of 2020, mitigating demand for gas to heat buildings. The COVID-19 pandemic also triggered a decline in gas demand in the industrial and power generation sectors during lockdowns, which is reflected in the 6.3% drop in European GDP in 2020.

Figure 15 – Monthly electricity generation mix in the EU



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

Figure 1: 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 2020, Europe's electricity generation mix had changed from the previous year, primarily as a result of the COVID-19 pandemic. The share of gas in this mix shrank by 3.2% (18 TWh) (slightly lower than the reduction in global electricity generation (4.1%)) as gas is the marginal source of electricity in many markets, accounting for 20.8% of total electricity generation. Renewables (mainly hydro, wind and solar power) compensated for the decline in coal and nuclear power.

The competitiveness of gas-fired power generation improved vis-à-vis coal due to lower prices for natural gas during the COVID-19 pandemic, aided by relatively high prices for carbon emission quotas (€17 to €35/tonne CO_2 equivalent). In Belgium, gas production generally offsets the deficit in nuclear capacity.

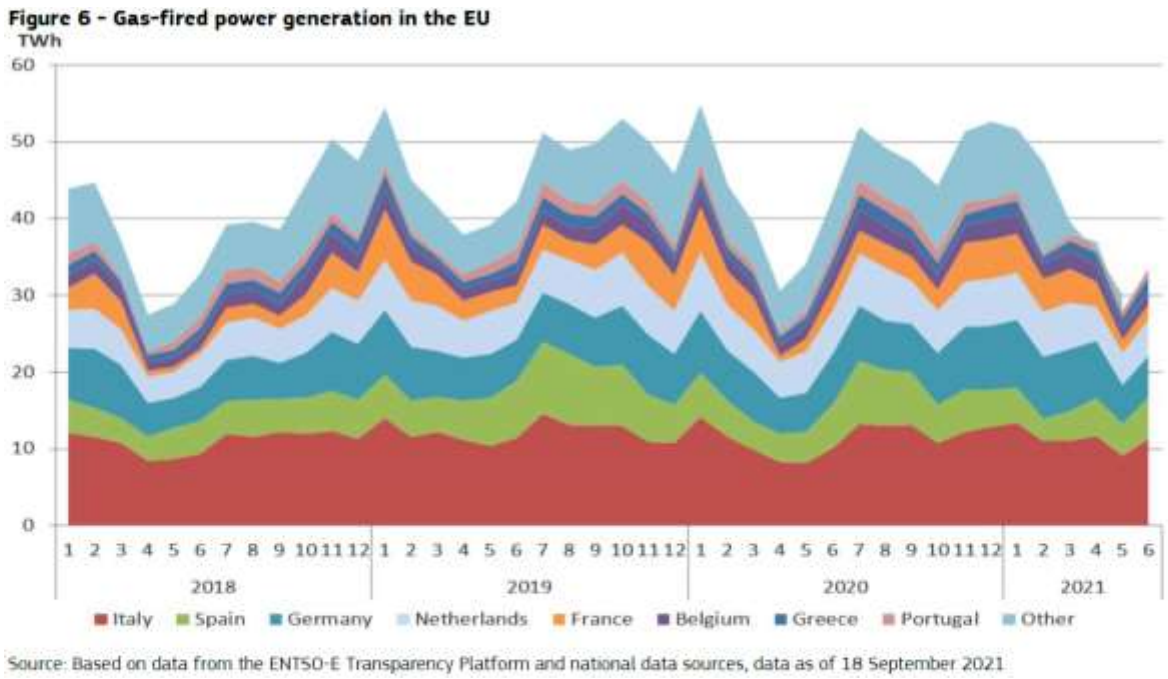


Figure 2: Gas supplies for power generation in selected EU Member States (source: European Commission, 2021)

1. Outlook for natural gas demand

An increase in gas demand is expected in 2021 as the end of winter 2020/2021 was colder and Europe's GDP is anticipated to grow by 5% as the economy recovers following the COVID-19 pandemic.

The global commitment to limiting 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) 2021, 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 above 1,500 TWh in 2050. Under the Distributed Energy scenario, demand for natural gas would fall to 1,500 TWh by 2050.

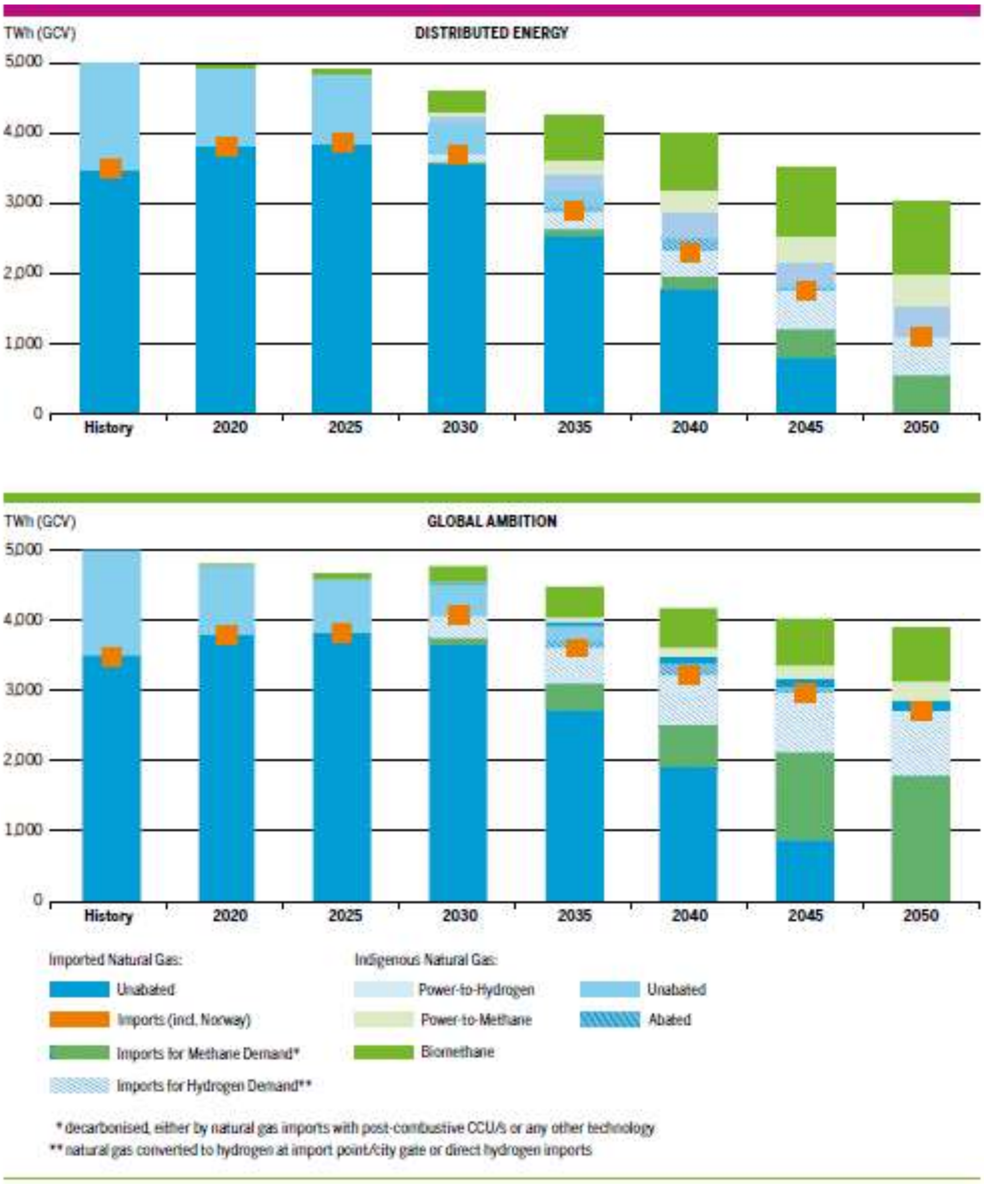


Figure 3.4 Gas source composition in COP 21 scenarios

Figure 3: Projections for total gas demand (methane and hydrogen) (source: ENTSOG TYNDP 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 security of the gas supply. In the long term, the gradual replacement of natural gas by biomethane or synthetic gas will allow the decarbonisation of gas consumption in this segment.

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

Supply trends in 2020

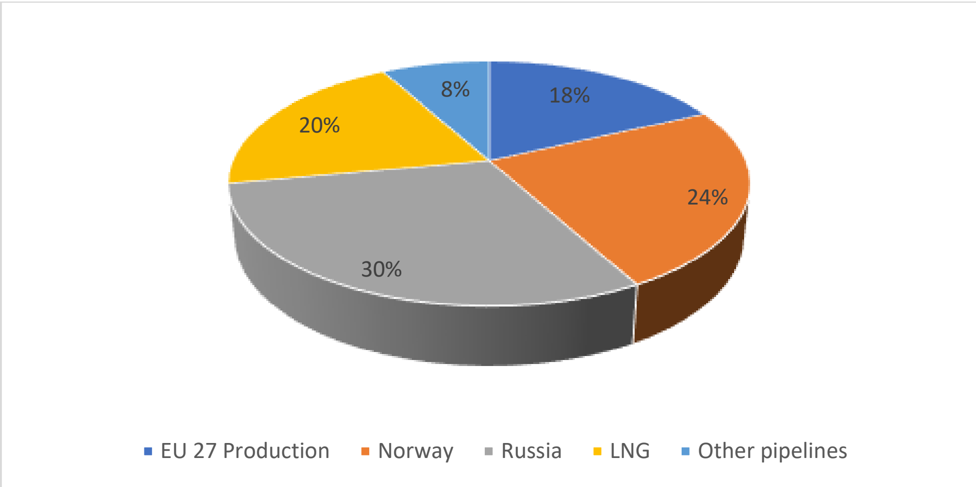


Figure 4: Gas supply mix in 2020 (EU 27 and Russia) (source: BP Statistical Review, 2020)

In 2020, Russia was Europe's biggest supplier of natural gas (market share of 30%), followed by Norway and LNG imports (24% and 20% respectively), and European production (18%). Imports via pipeline from outside Europe (Algeria, Libya and Azerbaijan) accounted for 9% of supplies.

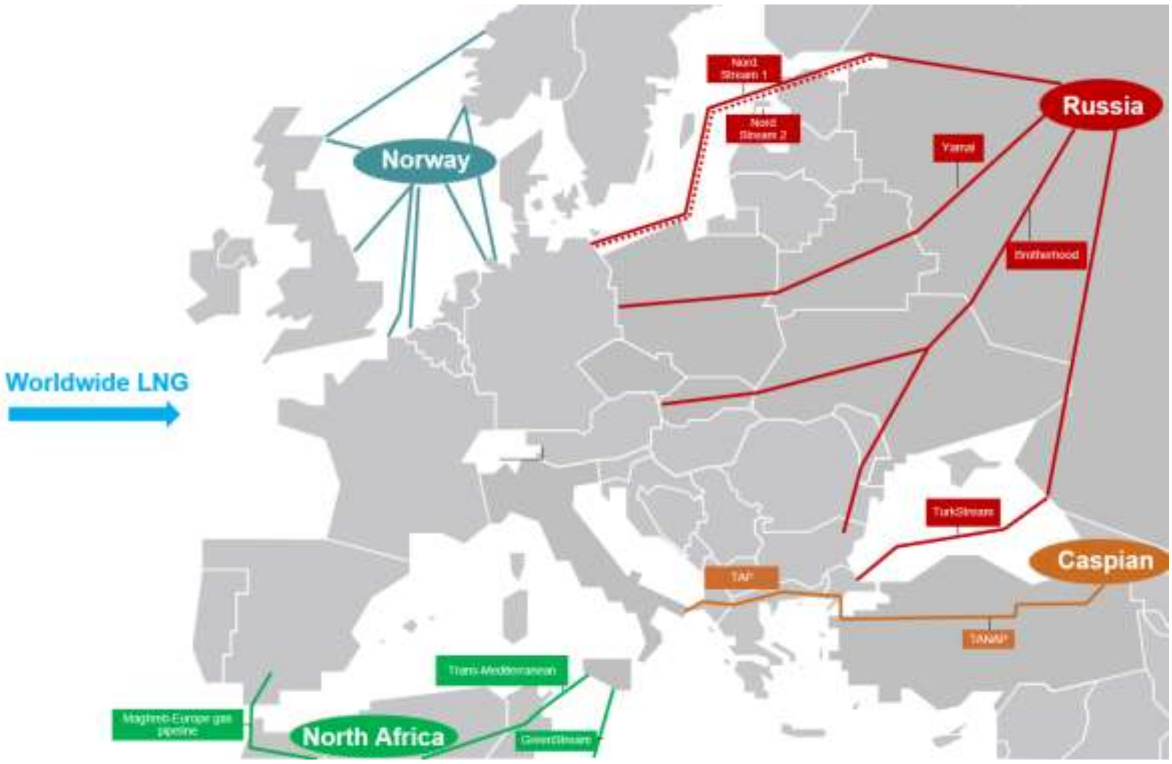


Figure 5: Europe's current and future supply routes

Russian pipeline gas supplies to Europe in 2020 came via Ukraine (31% in 2020 vs 45% in 2019), the Nord Stream pipeline (40% in 2020 vs 33% in 2019), Belarus (23% in 2020 vs 22% in 2019), the Baltics (2% in 2020) and the TurkStream pipeline (4% in 2020), which was commissioned on 8 January 2020.

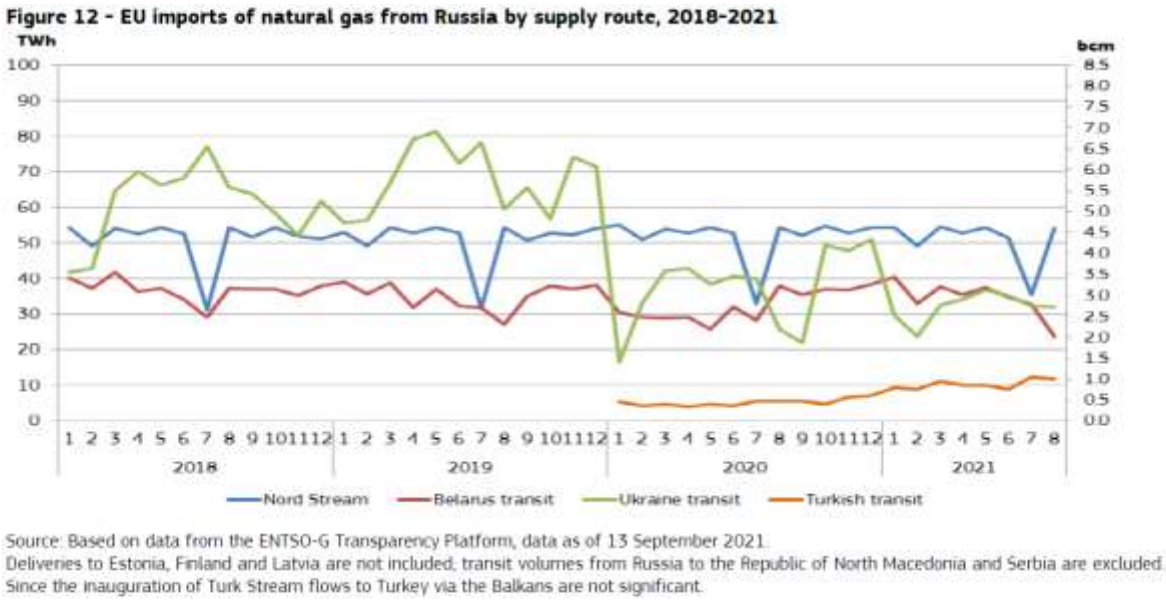


Figure 6: EU imports of gas through Russian supply routes (source: European Commission, 2021)

Supplies from LNG imports to Europe have experienced 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 triggered by excess levels of LNG production. Owing to the economic recovery and the transition from coal to natural gas (especially in Asia), the cold winter of 2020/2021 and maintenance work in some production units, the global LNG supply has become insufficient and wholesale prices have increased significantly. European LNG imports experienced an upturn from Q4 2021 onwards.

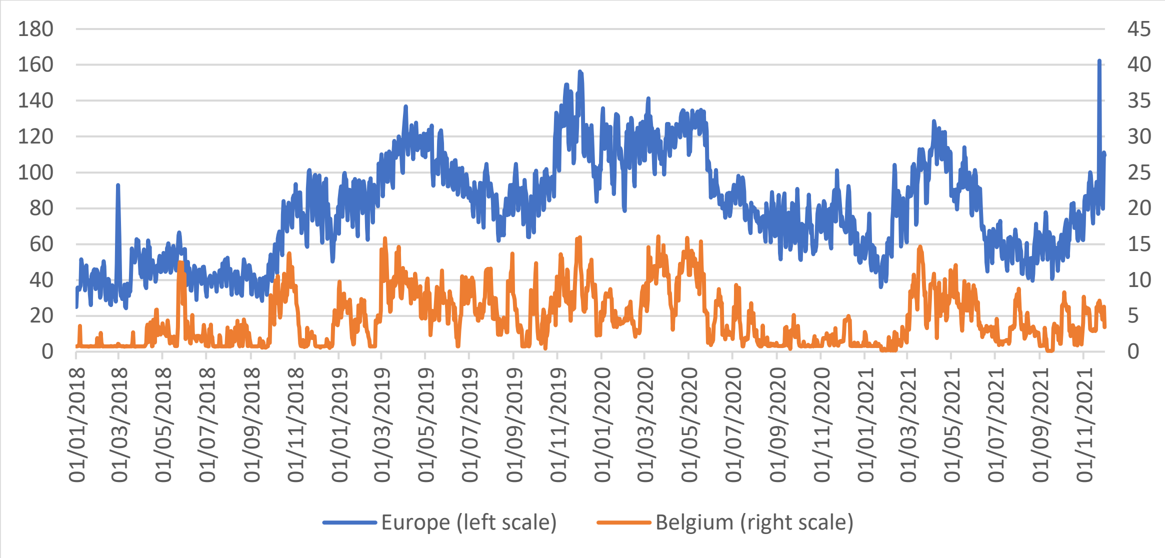


Figure 7: Send-out from LNG terminals in the European Union (source: GLE transparency platform)

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.

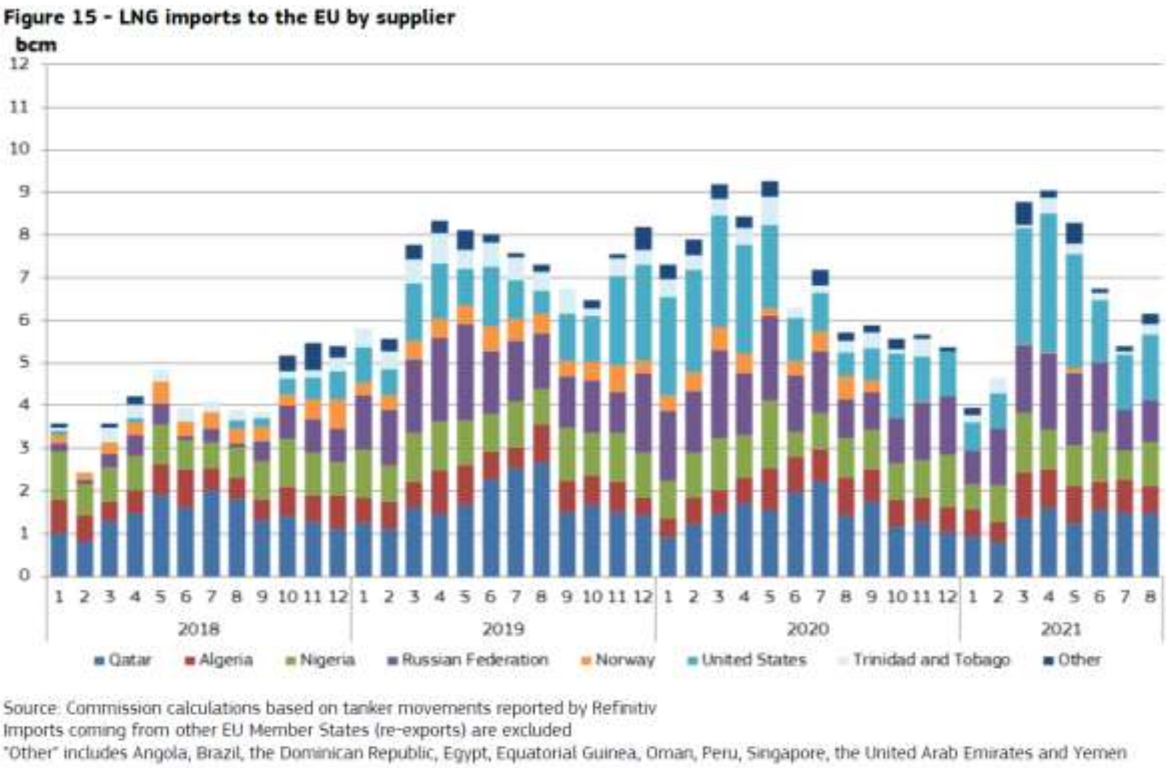


Figure 8: Cumulative LNG imports to the EU by source (source: European Commission, 2021)

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 could be offset by the development of green gas production (biomethane, hydrogen, synthetic methane) up to 2040. No major development of shale gas is currently anticipated.

Regarding the Groningen gas field, the supply of L-gas to Germany, Belgium and France will gradually decline, ending completely by 2030 at the latest. Owing to an increase in the number of earthquakes in the surrounding area, caps on gas production in Groningen have been systematically lowered, with closure scheduled for mid-2022, though some facilities will continue operating to supply additional gas in emergencies, more specifically in the event of a cold snap. 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.

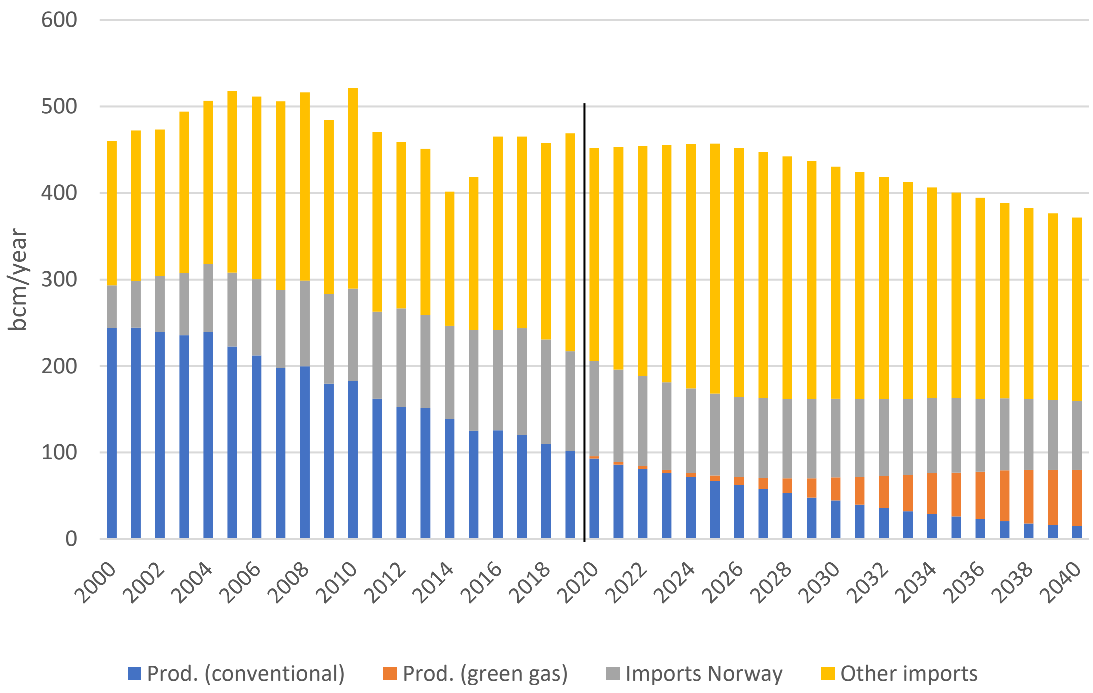


Figure 9: Evolution of indigenous European gas production and imports (source: BP Statistical Review, 2020 and the ENTSOG TYNDP)

Outlook for supply

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

The Nord Stream 2 pipeline, which is currently being commissioned, 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 and the introduction of regulatory measures are currently affecting the completion of this project. The TurkStream pipeline, which has been operational since 8 January 2020, allows Russia to supply Central and South-East Europe via Turkey.

Furthermore, the South European Gas Corridor currently links the EU and Azerbaijan to the TANAP and TAP pipelines, which have been 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 establish connections to new resources in the Eastern Mediterranean (Cyprus, Israel, Lebanon, 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 any additional imports required. 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 LNG terminal projects in Germany are 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 has commissioned a floating storage and regasification unit (FSRU) in Krk. In Greece, the FSRU project at Alexandroúpoli is advancing, bolstered by progress on the IGB interconnection between Greece and Bulgaria and a potential link with the TAP.

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 110 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

ENTSOG & ENTSO-E Draft Scenario Report for the TYNDP 2022

In connection with Regulation (EU) no 347/2013, the ENTSOs for gas and electricity have published their third joint Scenario Report.[1] The common scenarios described in the Scenario Report serve as a basis for spotlighting future gas and electricity infrastructure needs in the upcoming TYNDP 2022.

Three differing future energy scenarios have been developed, allowing the TYNDP to thoroughly and comprehensively assess European energy infrastructure requirements taking into account the entire energy system.

National Trends

The bottom-up central policy-based scenario, reflecting Member States' energy and climate policies, is based on supply and demand data collected from both gas and electricity TSOs.

Distributed Energy & Global Ambition

Two contrasting top-down scenarios with an all-energy perspective (not limited to gas and electricity) were devised in line with the goals of the Paris Agreement and the efforts of the EU 27 to reduce GHG emissions to 55% by 2030 and to net zero by 2050. While Distributed Energy can be considered a decentralised scenario with high energy autonomy, Global Ambition considers more larger scale solutions, with the EU as an actor of the global energy transition.

For the first time, the scenarios utilise new sector-coupling methodologies and dedicated modelling tools, including hydrogen and electrolysis on a pan-European scale. This will make it possible to better capture interactions between the gas and electricity systems and assess infrastructure from an integrated system perspective.

In both COP 21 scenarios, the EU's overall energy demand falls significantly owing to a combination of energy efficiency measures and the impact of further system integration.

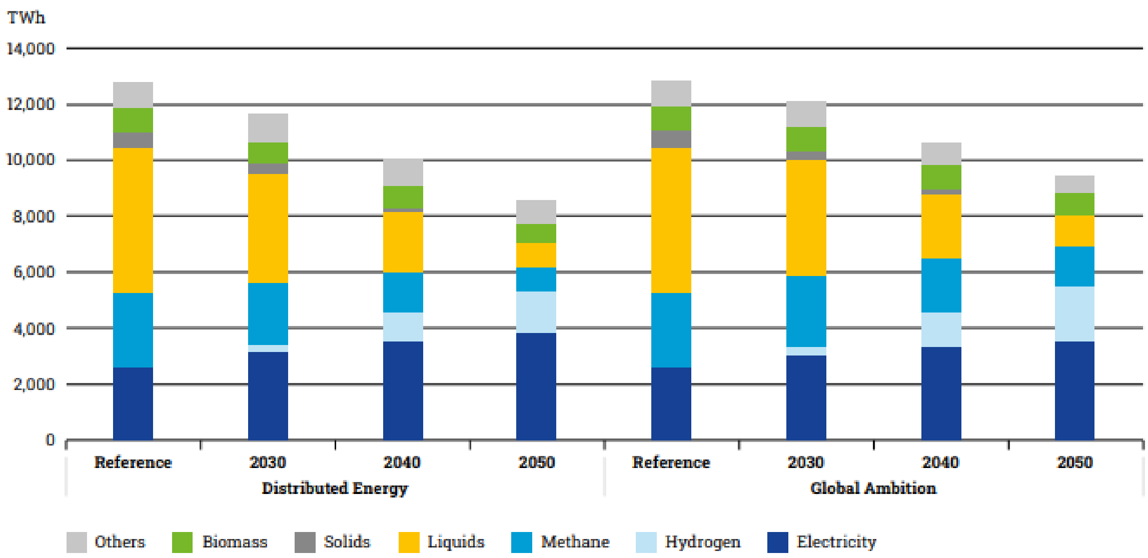


Figure 11 : Final energy demand per carrier (energy and non-energy use for feedstock) for the EU 27 (source: TYNDP 2022 Draft Scenario Report)

[1] https://2022.entsos-tyndp-scenarios.eu/

In terms of gas demand, a clear reduction in methane demand can be observed over time. However, methane remains key to covering demand for energy in the EU until 2050. Demand for methane is generally sustained by the final demand of different biomethane end users and the indirect demand of abated natural gas for hydrogen production.

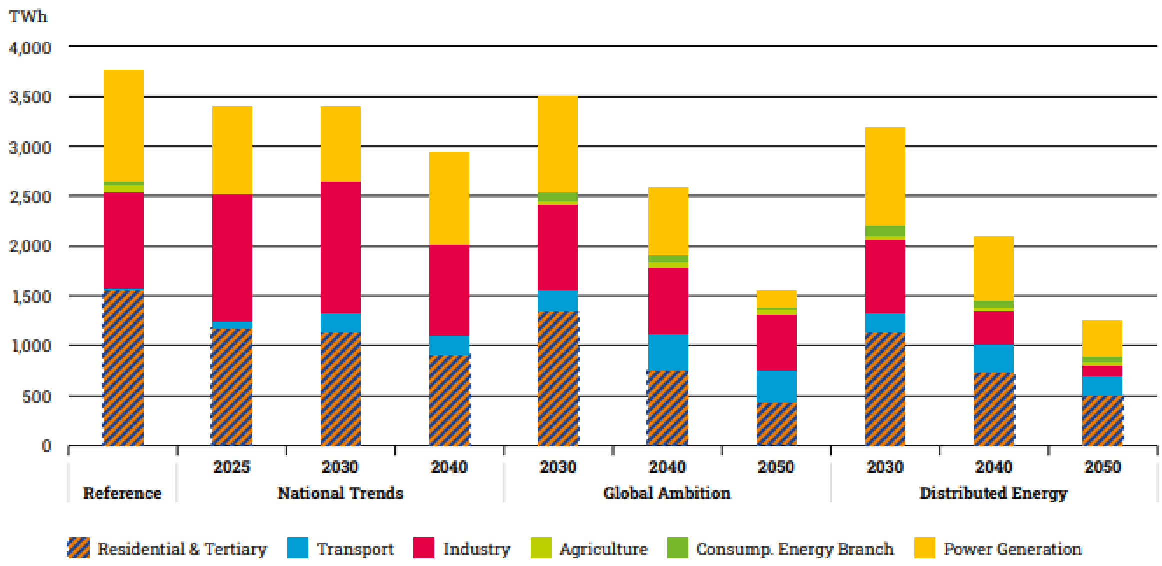


Figure 12 : Methane demand per sector for the EU 27 (source: TYNDP 2022 Draft Scenario Report)

At the same time, demand for hydrogen grows from 2030 onwards and in both COP 21 scenarios hydrogen becomes the main gas energy carrier by 2050. National Trends considers the different national policies released over the previous years by EU Member States with a shorter-term view, which translates into a slower development of hydrogen demand.

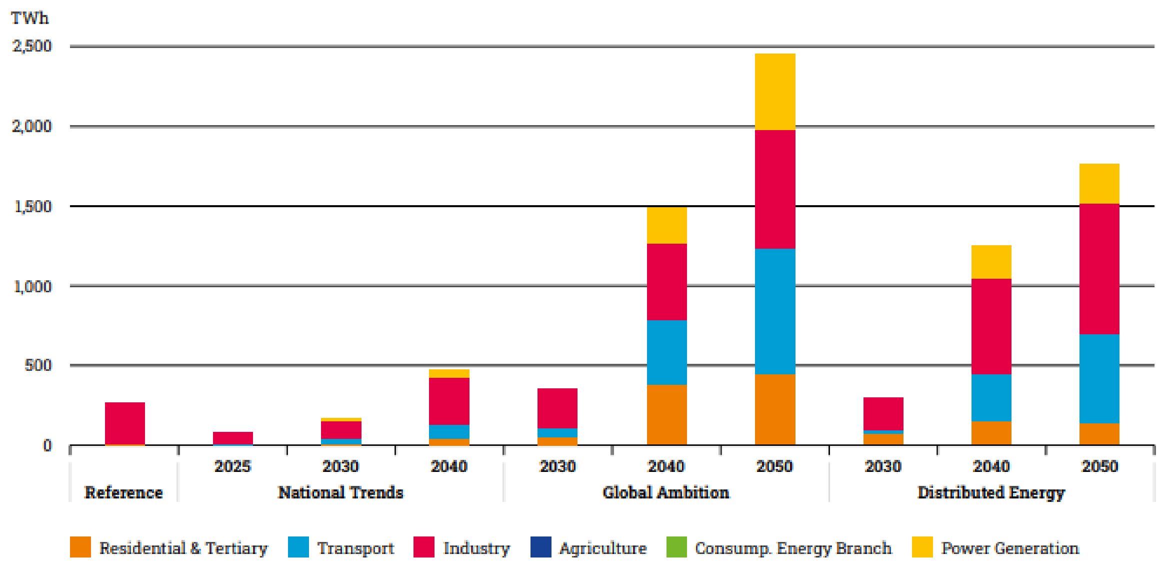


Figure 13 : Hydrogen demand per sector for the EU 27 (excluding hydrogen from by-products) (source: TYNDP 2022 Draft Scenario Report)

The development of renewable capacities and energy efficiency measures results in the decarbonisation of Europe's energy supply, leading to a sharp decline in natural gas supplies after 2030.

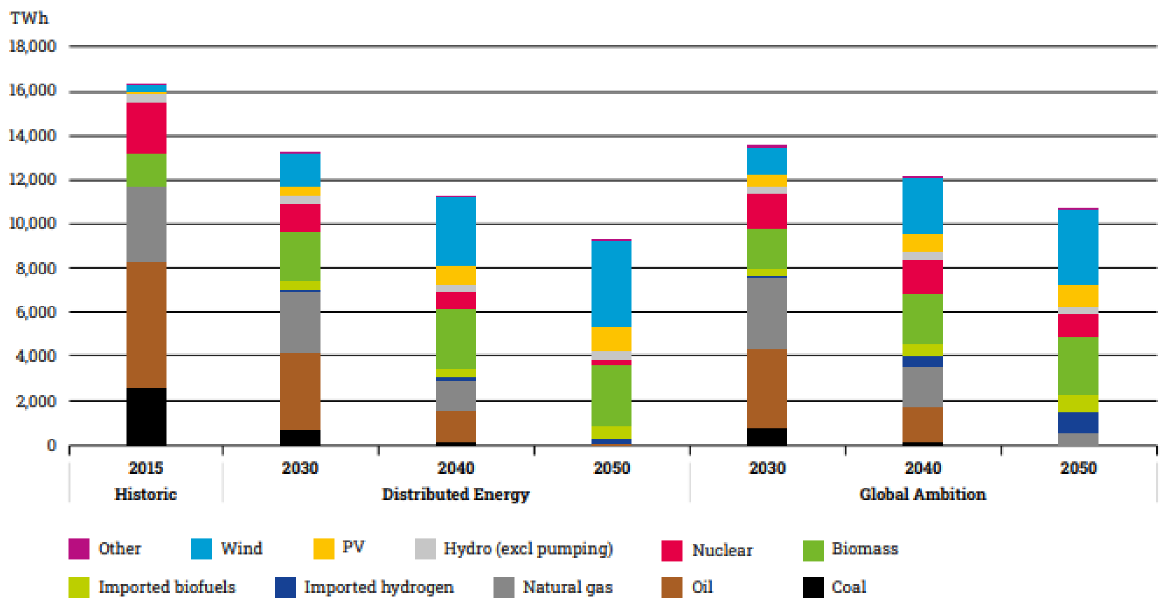


Figure 14 : Primary energy supply in the two COP 21 scenarios (for energy and non-energy use) for the EU 27 (source: TYNDP 2022 Draft Scenario Report)

All scenarios integrate a consistent decline in conventional indigenous natural gas production as well as natural gas imports. Biomethane plays a major role in the decarbonisation of the methane supply, while the production of synthetic methane through electrolysis remains rather limited.

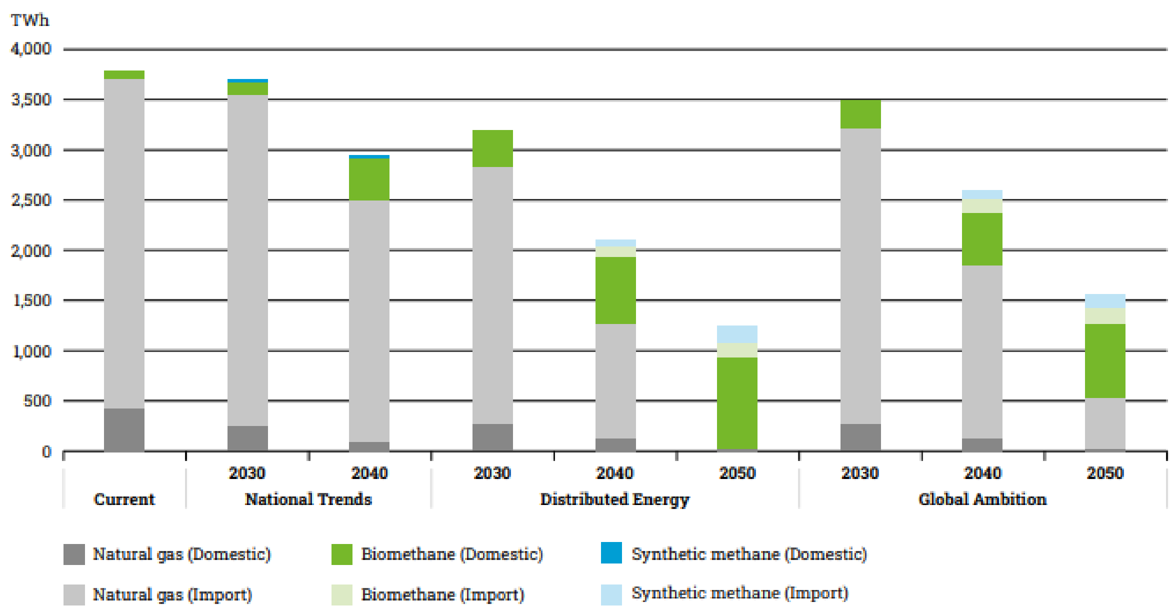


Figure 15 : Methane supplies for the EU 27 (source: TYNDP 2022 Draft Scenario Report)

While today's hydrogen supplies are mainly used for feedstock, hydrogen is expected to become the main gas energy carrier by 2050, with only limited demand for its use as feedstock. The significant potential at EU and global level for producing hydrogen from variable renewable electricity is the main driving force behind this transformation of the hydrogen market.

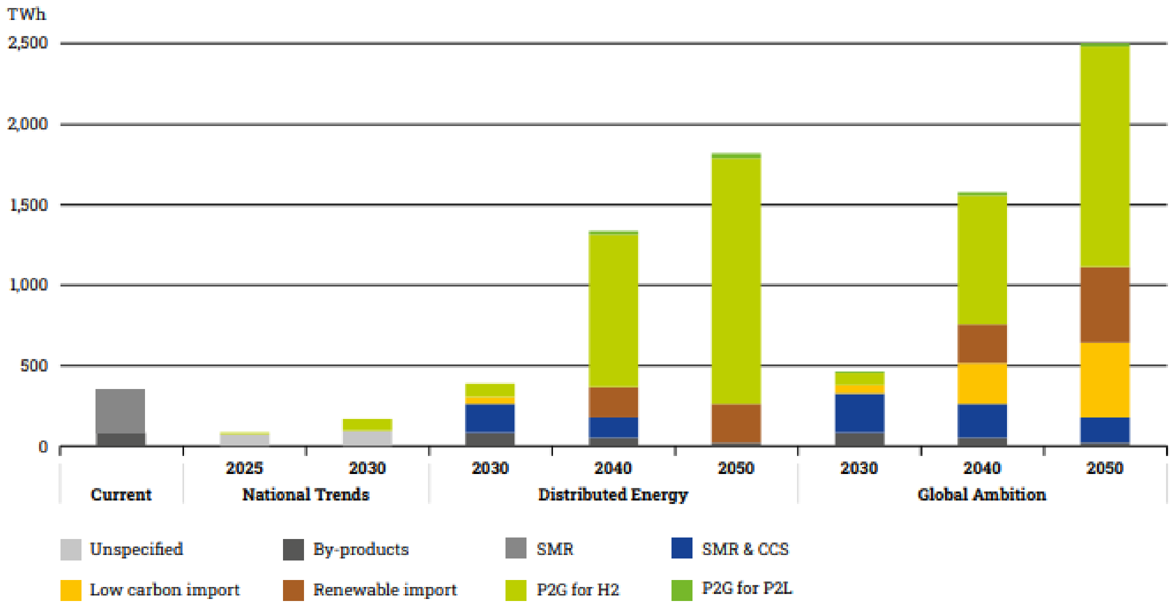


Figure 16: Hydrogen supplies for the EU 27 (source: TYNDP 2022 Draft Scenario Report)

Indigenous production of clean hydrogen within the EU, as included in the scenarios, will require a sharp increase of installed electrolyser capacity up to around 300 GW in 2050, combined with significant growth in renewable electricity generation to satisfy P2G demand.

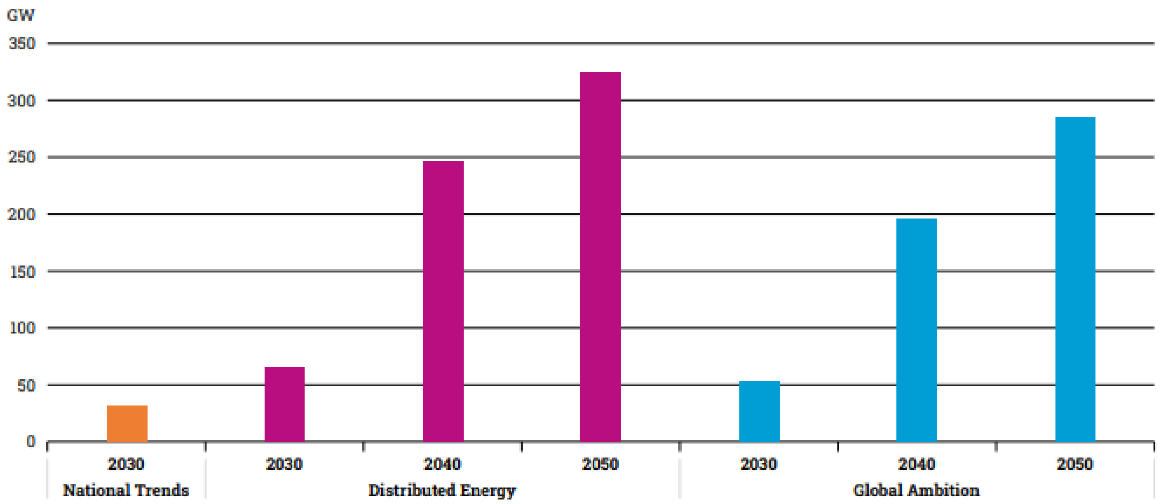


Figure 17: Electrolyser capacity for the EU 27 (source: TYNDP 2022 Draft Scenario Report)

The Belgian natural gas market

Fluxys Belgium and Fluxys LNG natural gas infrastructure

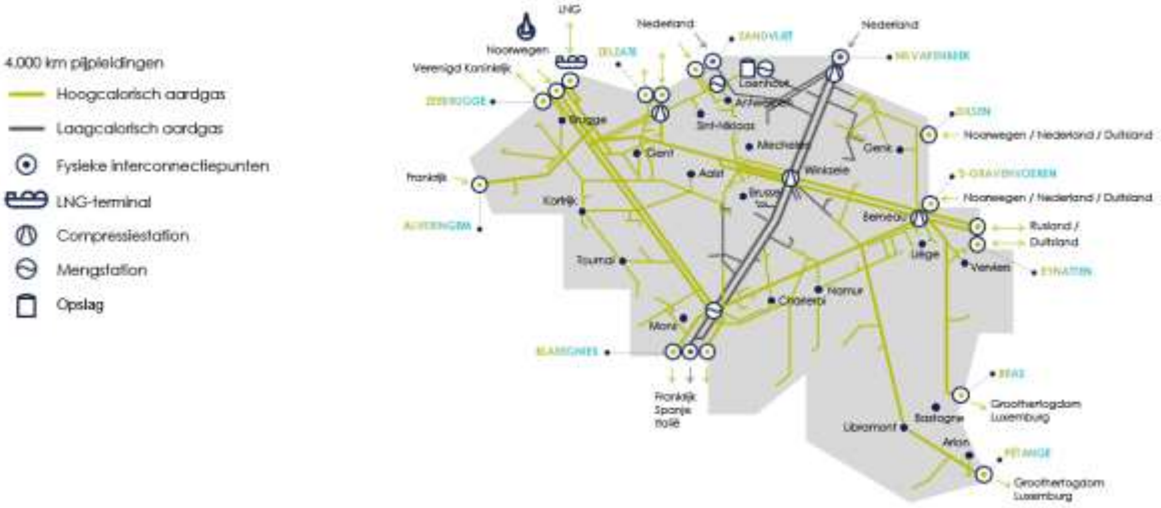


Figure 18: Fluxys Belgium and Fluxys LNG natural gas infrastructure

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). In contrast, the low-calorific natural gas (L-gas) from the Groningen gas field 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.

Market segments

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

- Distribution companies, which supply gas to residential customers, SMEs and the tertiary sector
- Industrial customers, including large-scale combined heat and power (CHP) generation facilities
- Power stations

The amount of natural gas taken off by each of these market segments varies constantly, according to very different offtake profiles:

- **Public distribution** is strongly influenced by the weather conditions and therefore temperature.
- **Industrial customers** have a fairly regular offtake pattern.
- **Power stations** take off gas 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, imports/exports) and price parameters (*spark spread* of coal vs natural gas) have a significant impact too.

Consumption trends in Belgium

Change in the number of degree days

The number of degree days in a year reflects the severity of that year's temperatures. A normal (benchmark) year has 2,301 degree days.[2] 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 warm year. Following a normal year in 2016, which had 2,329 degree days, 2020 proved to be a warmer year than average, the fourth in a row, with 1,867 degree days.

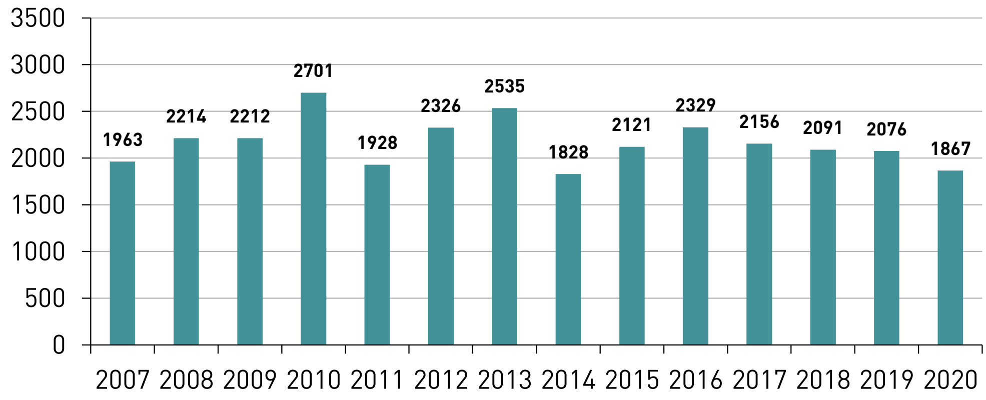


Figure 19: Degree days (calendar year)

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. This trend continued in 2020.

[2] 1986 to 2015, Synergrid benchmark (calendar year)

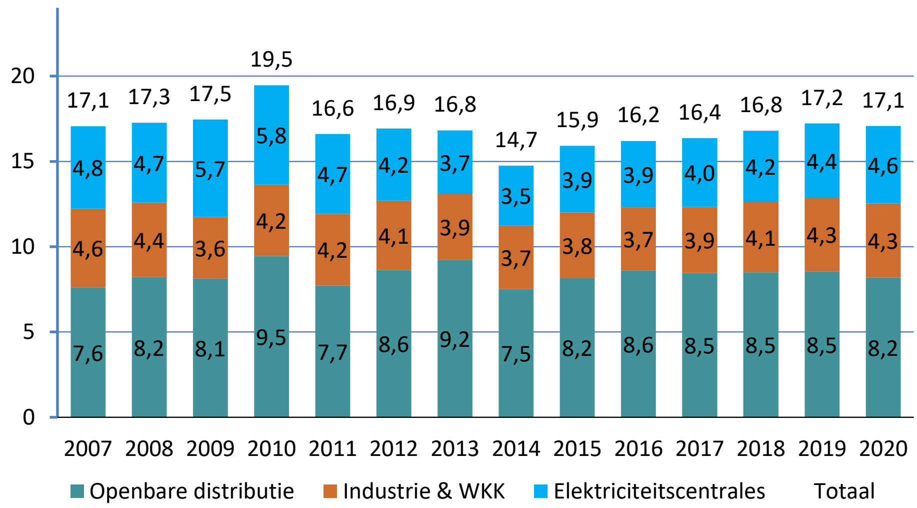


Figure 20: Changes in gas consumption in Belgium (in bcm/year)

Industrial customers (including combined heat and power generation)

Since the 2008-2009 economic crisis, several major consumers have closed, such as the Opel car plant in Antwerp (late 2010), the steel project plant in Liège (late 2014) and the Ford car plant in Genk (late 2014). Once the crisis bottomed out in 2014, industrial consumption rose by around 2.5% per year, hitting 4.3 bcm in 2020, mainly as a result of new connections.

Power stations

The annual consumption of power stations has also increased steadily 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 4.6 bcm/year.[3] 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 and uncertain power generation from solar and wind sources at any time. Recently, the *spark spread* for natural gas has also evolved positively, 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 played a role here in 2018 in particular. In 2020, natural gas offtake by power stations remained high, in a year marked by COVID-19, with renewables accounting for a remarkable share of the generation mix.

Network simulation model

Transmission systems are systematically analysed to check that they are *fit for purpose*. Analysing the network's behaviour during periods of peak demand for capacity 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] The last L-gas-fired power stations were decommissioned in 2008. All units still operating are powered by H-gas.

Public distribution

Method

Consumption peaks are partly linked to the severity of winter weather and must therefore be analysed in light of the temperatures recorded.[4] The standard winter period used for such analyses runs from the start of November to the end of February.

Assessment of winter 2020/2021

The winter period from November 2020 up to and including February 2021 was fairly mild, with 1,283 degree days (a benchmark winter[5] has 1,428 degree days). During winter 2020/2021, nine ice days were recorded, two at the beginning of January 2021 and seven at the beginning of February 2021. Saturday, 9 February 2021 was the coldest day of the winter peak in February 2021, with an equivalent temperature of -5.8 °C recorded in Uccle.

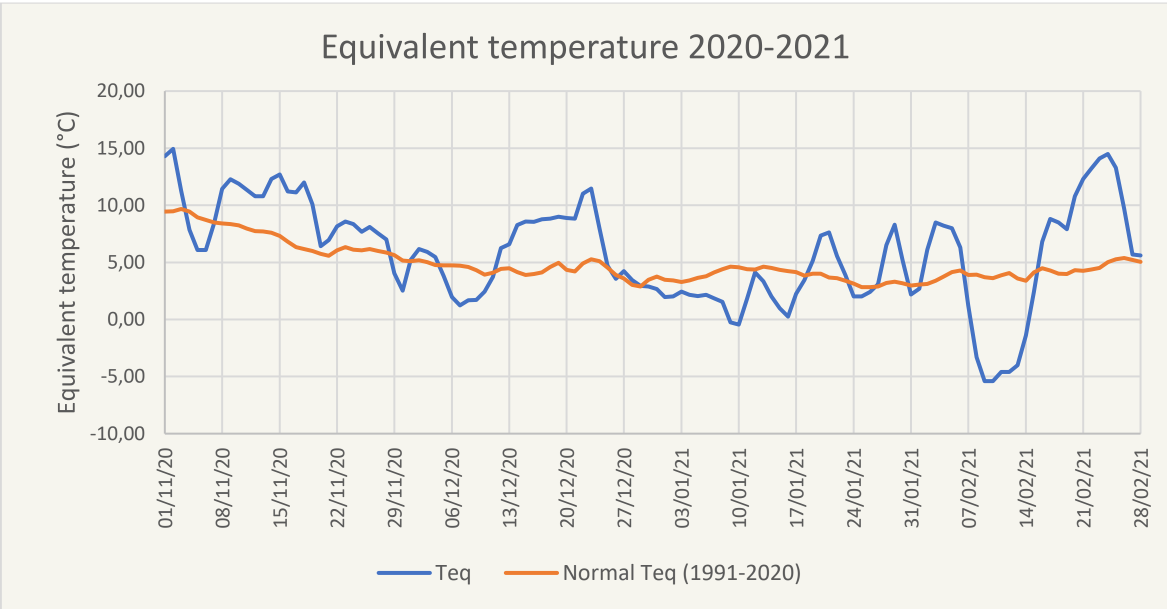


Figure 21: Temperature profile for winter 2020/2021

Power stations, CHP units and industrial customers

Method

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

[5] 1986 to 2015 (winter months), source: Synergrid

[6] The impact of temperature on electricity consumption is reflected in the number of power stations generating power at the same time. The offtake of one individual generation unit only slightly correlates to the ambient temperature.

As temperature has very little impact on electricity generation[6] and industrial processes, the analysis for this market segment is based on past offtake coupled with a commercial analysis of development prospects rather than on a linear regression as a function of the ambient temperature. Since industrial customers' peak offtake does not really depend on the ambient temperature, their peak will not occur at the same time (smoothing effect), so absolute peak offtake is adjusted using a regional-level synchronisation factor. The approach for power stations focuses on the possible simultaneous use of all generation facilities, which is not purely based on the ambient temperature but rather depends on various external factors such as the availability of renewable sources (sun, wind, water), imports/exports, and the technical availability of the remaining generation facilities.

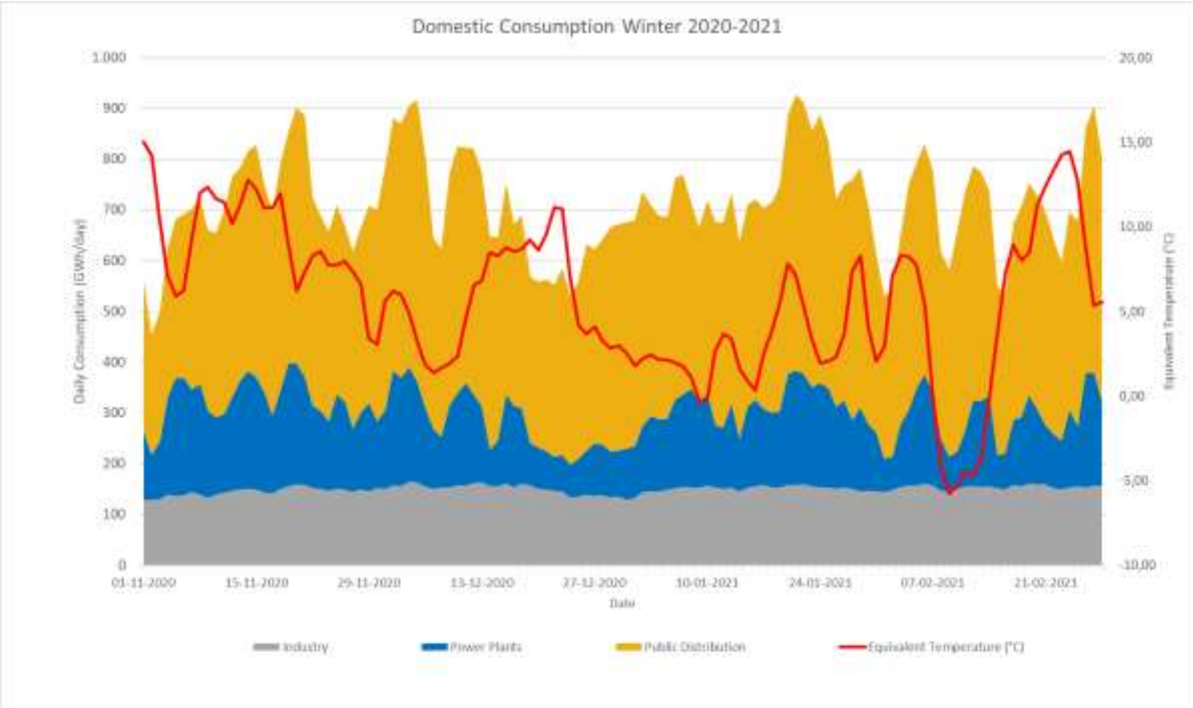


Figure 22: Domestic consumption in winter 2020/2021

Required investments (domestic market)

Public distribution

The steady rise in the number of active connections has been somewhat offset by several demand erosion factors. Now that public authorities have adopted strict regulations on renovation and new-build projects, houses and buildings are being insulated better and the efficiency of heating systems is constantly improving.

[6] The impact of temperature on electricity consumption is reflected in the number of power stations generating power at the same time. The offtake of one individual generation unit only slightly correlates to the ambient temperature.

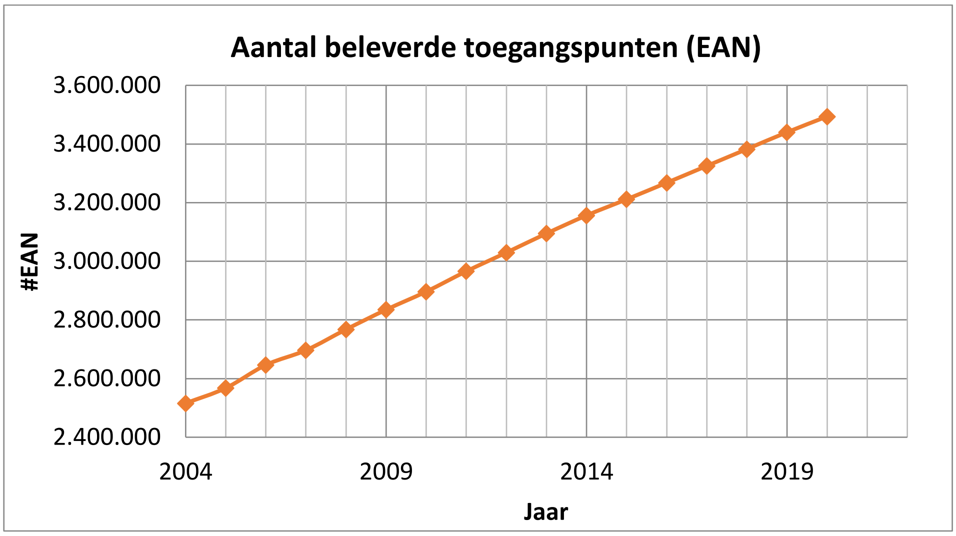


Figure 23: Increase in the number of EAN[7] access points (source: Synergrid)

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

Use of the capacity available on the networks is continuously analysed with the relevant distribution system operators (DSOs) based on detailed analyses and simulations. Investments identified as necessary to support more local/regional growth remain limited.

Industrial customers

The outlook for industrial consumption is still a mixed picture. While it is true that each year sees a number of 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 new connections have enough capacity to supply the new end users. However, large-scale projects combined with the construction of new power stations may also require local investments.

Power generation

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

Gas-fired power stations have the advantage of being able to start up quickly while emitting considerably 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 turbines and solar panels.

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

[7] The *EAN* (European Article Numbering) code is unique to each gas meter.

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 800 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 Renumeration Mechanism (CRM) launched by the government would result in the construction of additional generation facilities. In addition to the confirmed maintenance of existing units with capacity of 1.9 GW, approximately 1.7 GW of generation capacity will be allocated to two additional CCGT units, which should allow for a complete phase-out of nuclear power.

While these new efficient units are likely to ensure the basic load, the older, less efficient units can be expected 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.

Other sectors

The transport sector

Compressed natural gas (CNG) and liquefied natural gas (LNG) are two natural gas products that are very well suited to use in the transport sector. Methane combustion releases less CO_2 than that of conventional fuels such as diesel, petrol and liquefied petroleum gas (LPG). Natural gas is also a *clean fuel in terms of particle emissions.*[8]

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 cars and vans.

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

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

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

Figure 24: Existing/planned CNG filling stations

Development of off-network natural gas distribution

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

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

Transit at Belgium's borders

General description

With all its interconnection points, the Belgian network is connected to most of the natural gas generation 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 via the LNG terminals at Zeebrugge and Dunkirk.

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

- Netherlands: TTF
- UK: NBP
- Germany: THE
- 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 transported across the country's borders for sale at other gas trading points or consumption on end-user markets in Europe. Various capacity products are traded here:

- **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.

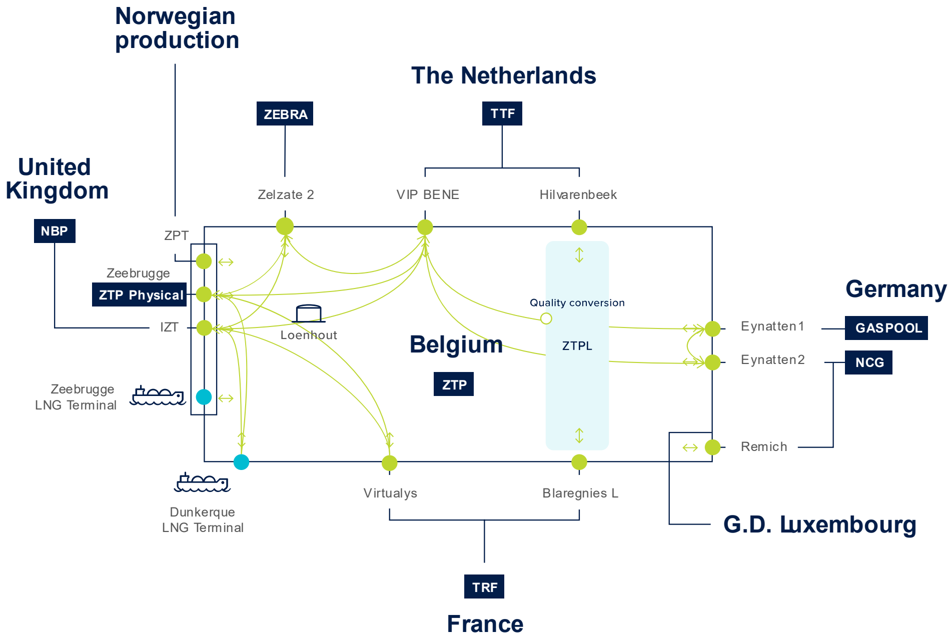


Figure 25: Fluxys Belgium interconnection points

Overview of annual allocations at border points

The overview in this section covers the period up to and including 2020. Zebra (currently part of the GTS network) and Gaspool & NCG (both currently part of a unique market zone, THE) are still included separately.

The figure below provides an overview of the average volumes (allocations) imported and exported at the border points in 2016-2020.

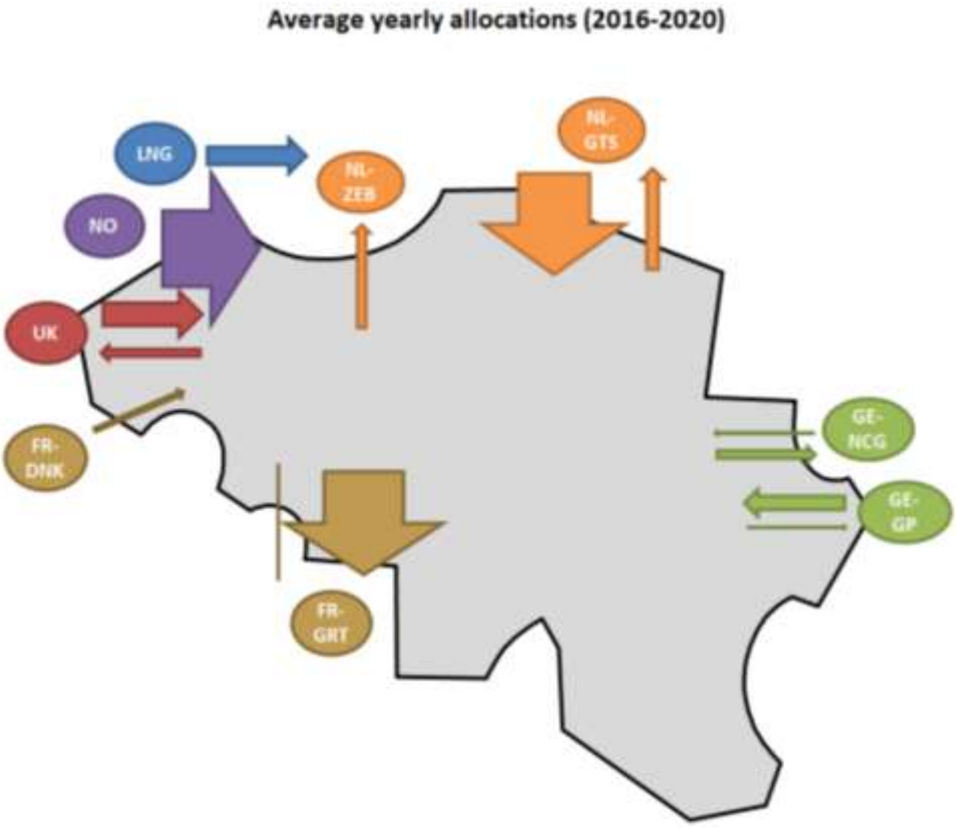


Figure 26: Allocations at border points, 2016-2020

Natural gas imports

The total annual average volume of gas entering the Fluxys Belgium network amounts to approximately 425 TWh per year (2016-2020), peaking at over 460 TWh in 2017.

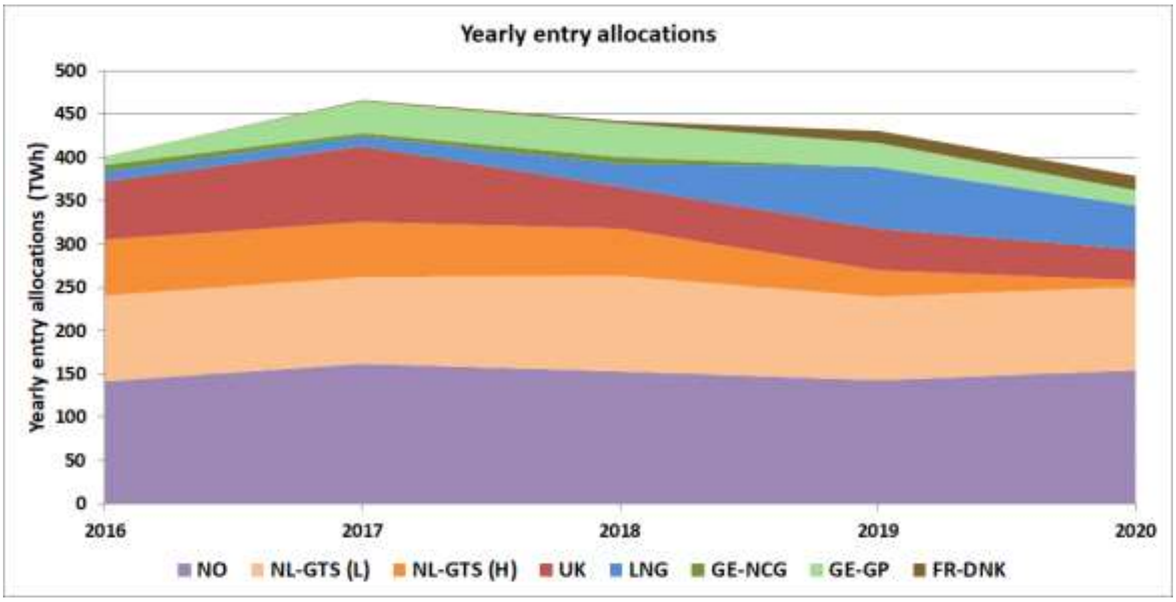


Figure 27: Annual entry allocations

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 since 2019 in particular.

Volumes from the UK fluctuate between approx. 35 and 90 TWh per year, although this has also been falling since 2018.

The volume of LNG injected into the Belgian transmission system at Zeebrugge is experiencing an upturn after two difficult years in 2016 and 2017. Substantial volumes were recorded in 2019 (approx. 70 TWh) and 2020 (approx. 50 TWh) in particular.

The volumes imported from Germany remain relatively low at between approximately 15 and 40 TWh/year. It is worth noting that virtually all imports come from the (former) Gaspool market area.

Gas is also imported from France via Virtualys (as this rarely results in a net entry allocation, it is not included in this figure) and Dunkirk.

Natural gas exports

The total annual average volume of gas (L- and H-gas) transported to neighbouring markets at the border points was approximately 230 TWh in 2016-2020, with a significant peak of over 275 TWh in 2017. There has been a downward trend since 2018.

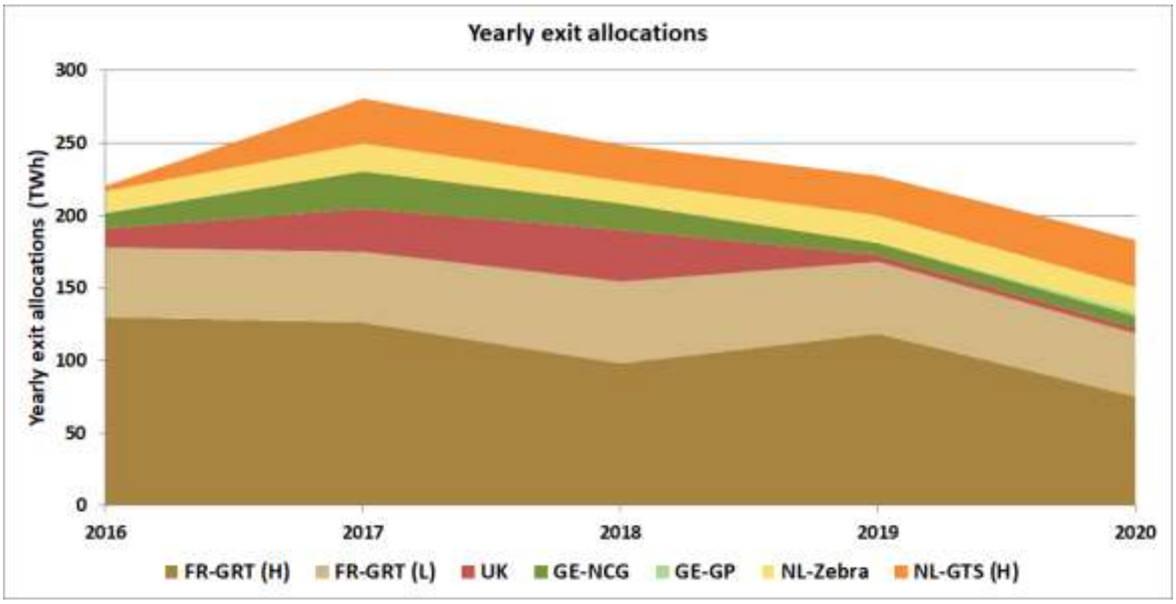


Figure 28: Annual exit allocations

Between 65% and 85% of this volume is intended for the French market. The share of L-gas is fairly stable (approx. 50 TWh), whereas the transmission of H-gas is declining.

The volume of gas transported to the UK has experienced a marked decline since 2019 due to the expiry of long-term contracts.

Volumes transported to Germany total between around 10 and 30 TWh per year, though this is also declining. Almost all exports are transmitted to the (former) NCG market area.

Supplies to the Netherlands have remained fairly consistent since 2017, with annual supplies of 15 to 20 TWh to the Zebra network (now part of the GTS network) and 25 to 30 TWh to the GTS network.

Gas transmitted to Luxembourg is not included in the above graph, as Belgium and Luxembourg form a single market.

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.

Natural gas imports

The graph below shows the change in daily flows simultaneously injected at various border points on the Fluxys Belgium network (2016-2020). On average, just under 50 GWh/h of gas is injected into the Fluxys Belgium network, with peaks of over 80 GWh/h.

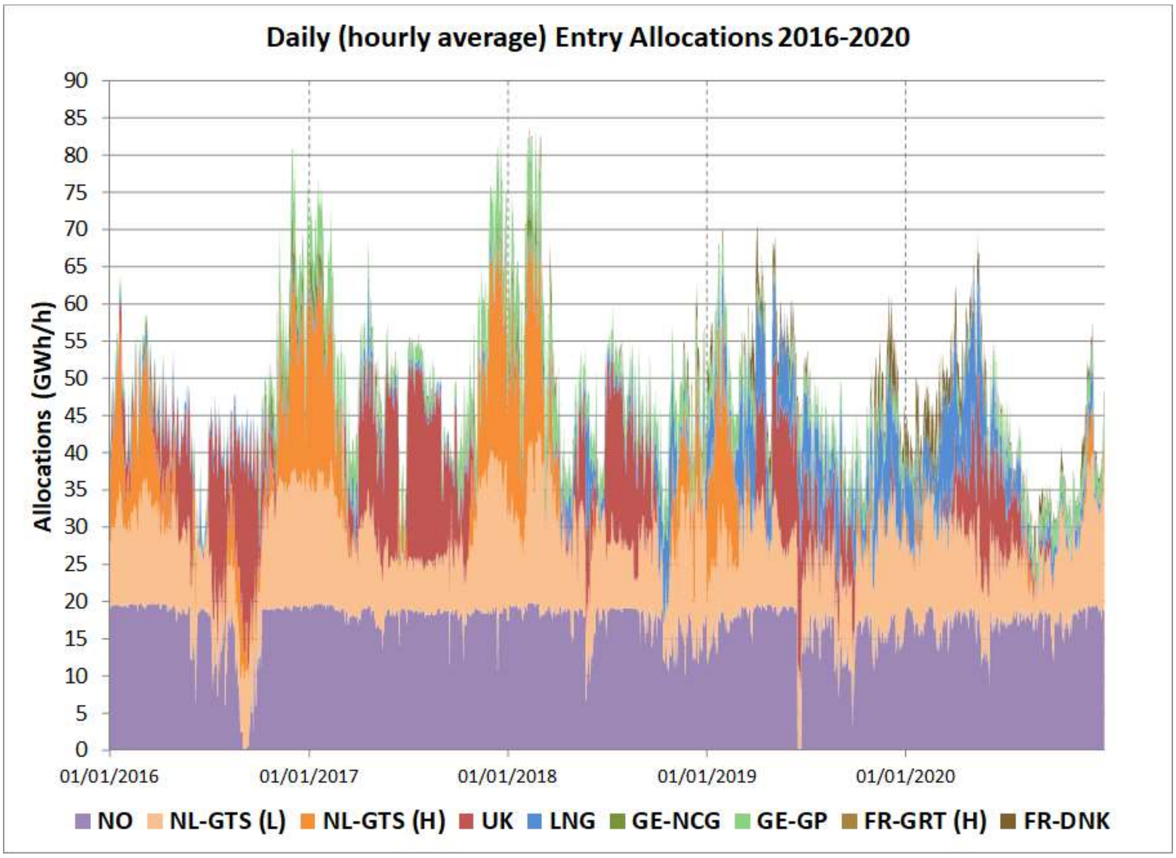


Figure 29: Daily entry allocations, 2016-2020

The graph[9] below provides details of the use of injected capacity in 2016-2020.

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

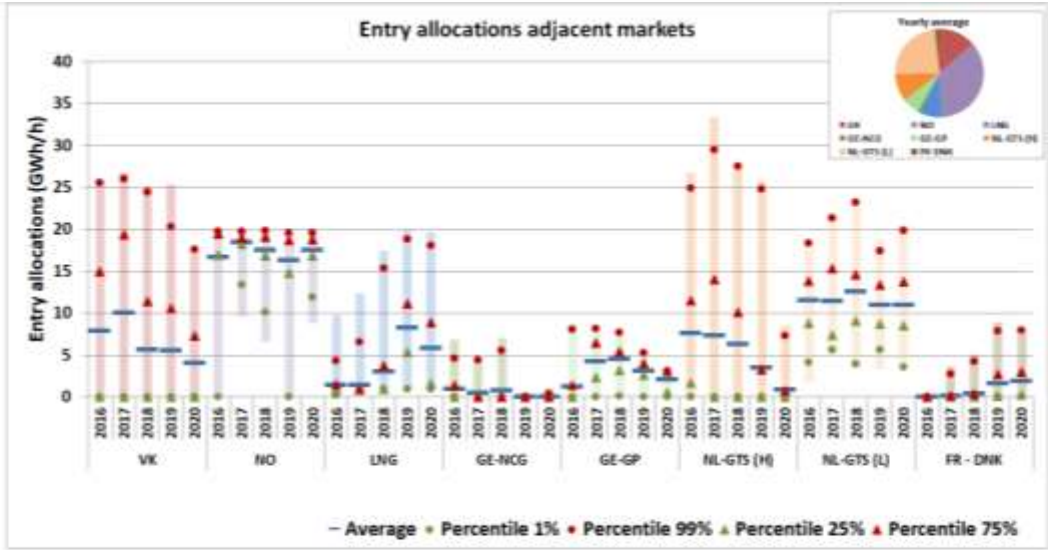


Figure 30: Entry allocations, neighbouring markets

Gas flows entering the Fluxys Belgium network from entry points directly linked to production zones (Norway, Netherlands L) account for the highest average volumes. Average incoming flow volumes at entry points connected to a neighbouring operator'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 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.

Natural gas exports

The following graph shows the change in daily flows simultaneously exiting various border points on the Fluxys Belgium network (2016-2020).

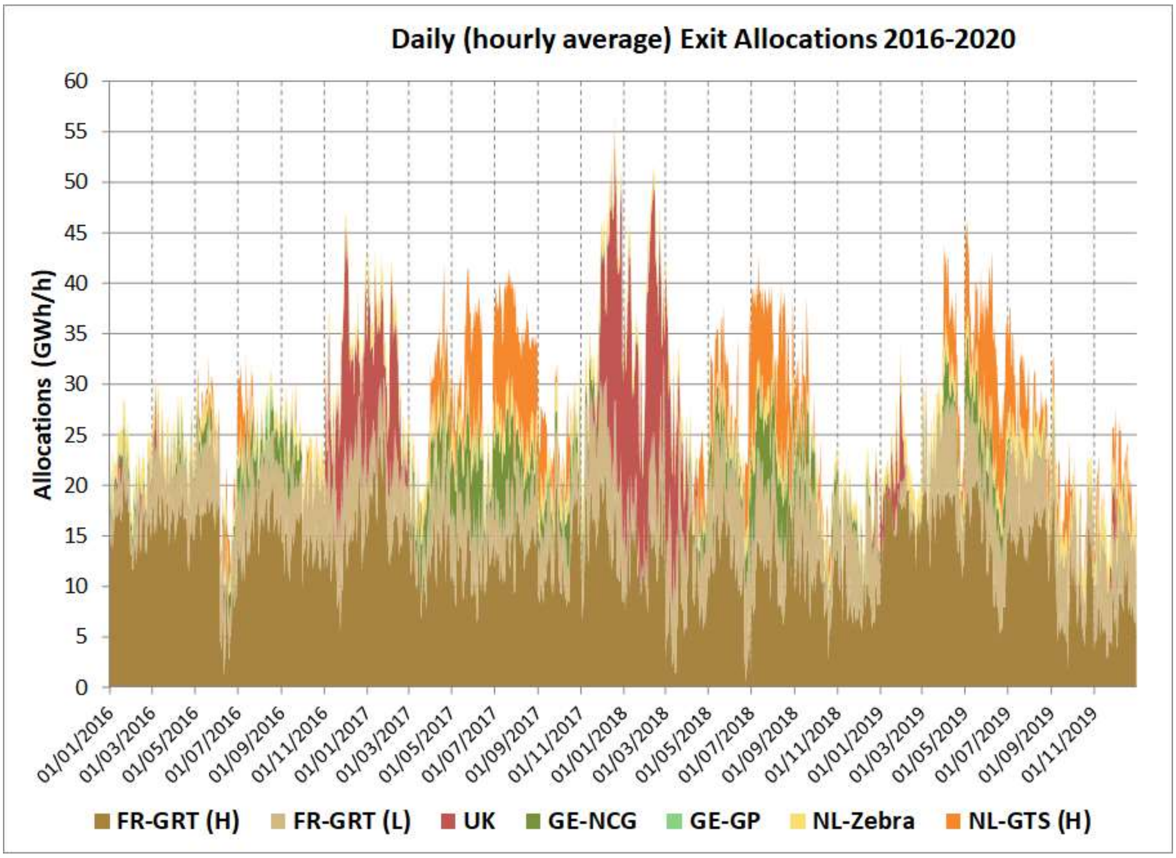


Figure 31: Daily exit allocations

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 significant volumes bound for the UK and France. The Fluxys network had no problems handling this peak transmission.

The graph[10] below provides an overview of the use of capacity supplied to each market area in 2016-2020.

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

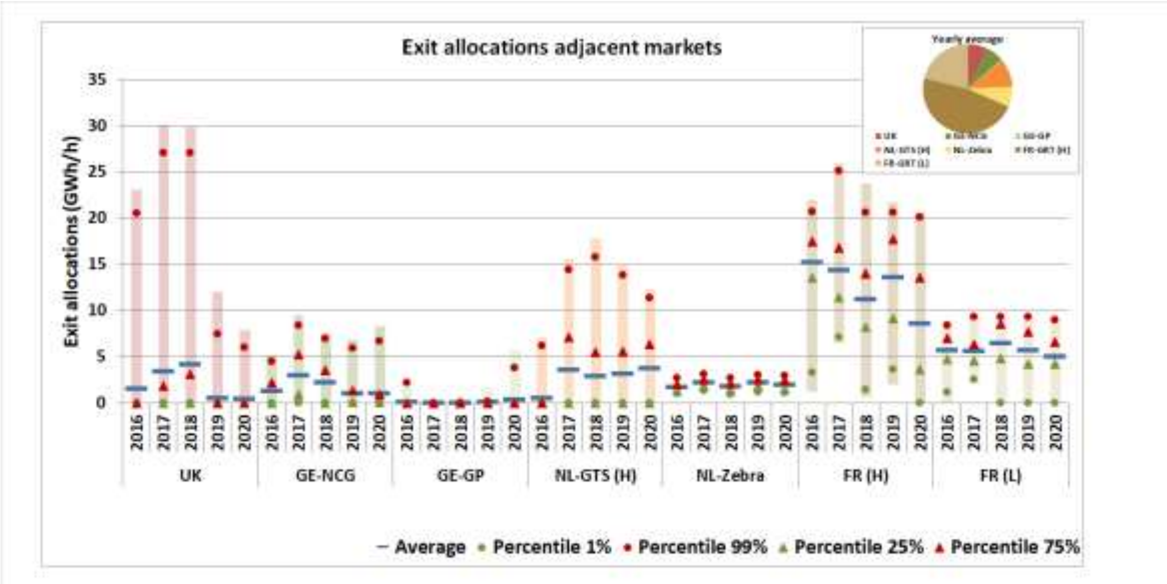


Figure 32: Exit allocations, neighbouring markets

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

Change in domestic demand and transit

Domestic demand

Fluxys Belgium updates its projections 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 an analysis of past consumption, the latest studies conducted by the gas sector (coordinated by Gas.be), various (inter)national reports and analyses on energy conversion, market surveys and Elia's latest adequacy studies for power stations.

These projections are used to evaluate the transmission system. ENTSOG also requires these projections when drafting the TYNDP, which is compiled every two years at European level.

Consumption projections are studied for different scenarios. The figure below shows the range within which the predicted total annual consumption fluctuates in each scenario (calculated for years with a climate average temperature). Consumption remains fairly consistent until 2024-2025, after which an increase is expected based on the increase in natural gas consumption for electricity generation. This is expected to subsequently experience a decline, the scale of which depends on the scenario under consideration.

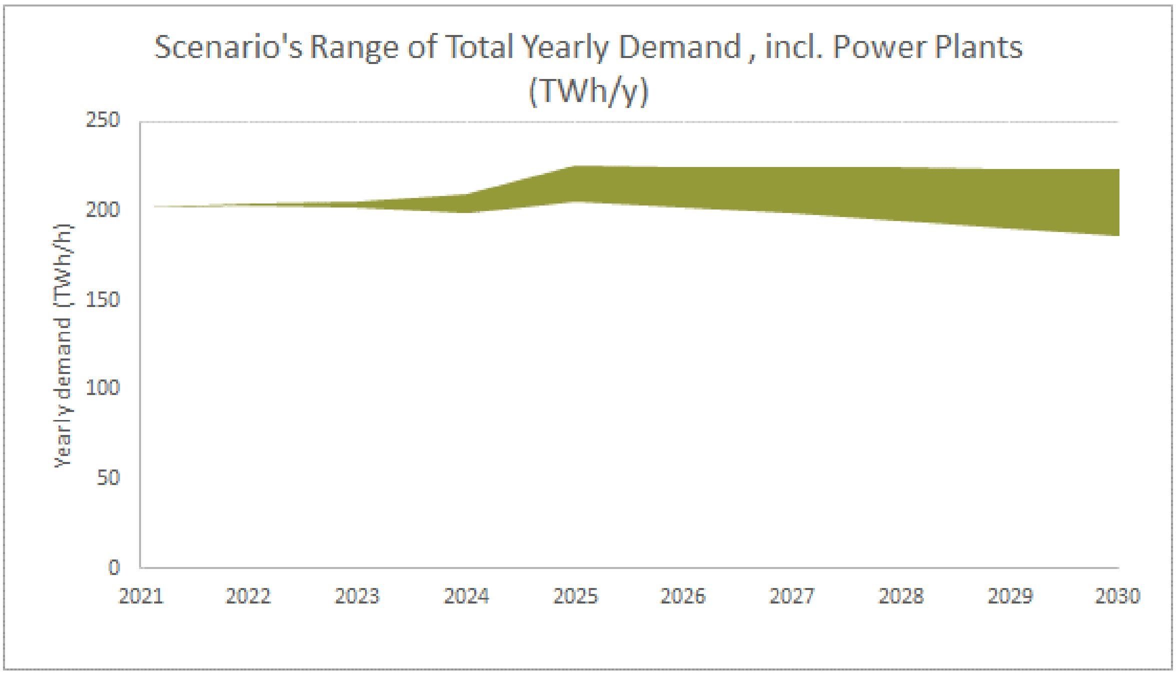


Figure 33: Projection of annual natural gas consumption (H- and L-gas)

Simulations indicate that, should new power stations be built by 2025, the total entry capacity of the H network would remain much higher than peak demand, even after the complete integration of the current L network into the H network.

Outlook for exports (transit)

In addition to supplying the Belgian market, the network is also used to transport natural gas to neighbouring countries.

Transmission to France

In its Ten-Year Development Plan 2019-2030,[11] GRTgaz sets out four scenarios based on different levels of natural gas demand. All scenarios show a decline in both annual consumption and peak demand, especially from 2023 onwards, though no decrease in H-gas capacity from Belgium is foreseen.

Furthermore, in the context of the L/H conversion, the volume of L-gas transported by Fluxys Belgium to the French market will gradually decrease, halving in 2025 and ceasing completely after 2029. There is currently no need to offset this reduction by increasing the transmission of H-gas to France.

In short, Fluxys will not change the capacity to transmit H-gas to France for the coming years for the time being in order to offer the market sufficient flexibility and avoid jeopardising security of supply.

Transmission to the UK

National Grid's Gas Ten Year Statement[12] describes four possible gas-demand scenarios ranging from a slight dip to a significant decline in the UK's gas demand, for both annual volume and peak demand. At the same time, the country's own gas production levels continue to fall. Imports from the continent (via Interconnector or BBL) would remain fairly stable until 2040.[13]

At present, the available transmission capacity towards the UK (via Interconnector) is sufficient to respond to market signals (arbitrage flows) while contributing to the country's security of supply. Any analysis of the future role of this infrastructure should take into account this security of supply.

Transmission to Germany

Germany's Network Development Plan 2020-2030[14] makes extensive reference to the L/H conversion (converting approximately 30 mcm/year). This plan provides for the construction of a new pipeline from the Eynatten border point to the German regions requiring conversion. This pipeline (Zeelink) will strengthen the link with the Zeebrugge area, which is itself directly connected to the new Dunkirk LNG terminal via 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.

Transmission to the Netherlands

In its published investment plan 2020-2030[15] and draft investment plan 2022-2032,[16] GTS sets out three scenarios showing falling gas demand. The capacity of the Groningen field and other small fields is also set to fall substantially in the next few years. Additional imports will likely prove necessary and are expected to comprise Russian gas (via Germany) or LNG (via Gate Terminal

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11 https://www.grtgaz.com/sites/default/files/2022-04/GRTgaz-ten-year-development-plan-2019-2030.pdf
12 https://www.nationalgrid.com/uk/gas-transmission/insight-and-innovation/gas-ten-year-statement-gtys
13 https://www.nationalgrideso.com/uk/electricity-transmission/future-energy/future-energy-scenarios/fes-2021/system-view/natural-gas
14 https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/ElectricityGas/Gas_grid/Draft_NDP2020_2030.pdf?__blob=publicationFile&v=1
15 https://www.gasunietransportservices.nl/en/gasmarket/investment-plan/investment-plan-2020
16 https://www.gasunietransportservices.nl/en/gasmarket/investment-plan/investment-plan-2022

and/or Belgium). In this respect, an increase in volumes transported from Belgium to the Netherlands is not unrealistic.

Outlook for imports

Imports from Norway

Imports from Norway are Fluxys Belgium's main source of natural gas, which is delivered with a fairly stable base load. No significant change in the quantities supplied is expected in the near future.

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 in the future will also depend, among other factors, on the availability of LNG (contingent on demand in Asia as well as South and Central America) and the available capacity to transport Russian gas to Europe. There are already plans to expand Zeebrugge LNG Terminal with a view to accommodating greater volumes of LNG.

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. There is a noticeable trend towards higher volumes being transported from Alveringem to Belgium. LNG's role in supplying Europe will be a decisive factor in the further development of this entry point too.

Imports from the UK

Imports from the UK (via Interconnector) vary greatly depending on the country's overall supply/demand balance and are substantially influenced by 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.

Imports from Germany

As Zeelink is to be bidirectional, increased imports from Germany cannot be ruled out. Imports from Germany mainly serve as transit flows to the UK and will be greatly influenced by supply and demand in the UK and by market forces.

Imports from the Netherlands

L-gas imports will gradually decline as a result of the L/H conversion. H-gas imports are highly dependent on market forces, but a fall in annual volumes cannot be ruled out, given the situation described in GTS's investment plan. A reduction in peak capacity is not expected.

L/H conversion

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. As such, production for the gas year 2021-2022 is estimated at 3.9 bcm. The Dutch authorities consider that production in Groningen will no longer be necessary from mid-2022 onwards. However, the production site will remain active to provide back-up when needed, such as during a severe cold snap or in the event of a fault at a nitrogen injection site. The complete shutdown of production is scheduled for 2022-2023.

At the request of the Belgian authorities, Synergrid has devised an indicative conversion schedule.[17] 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.

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 **Error! Reference source not found.**. This schedule was confirmed by the Synergrid Board of Directors in December 2021 and therefore forms the basis for the system operators' work for the next two years.

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

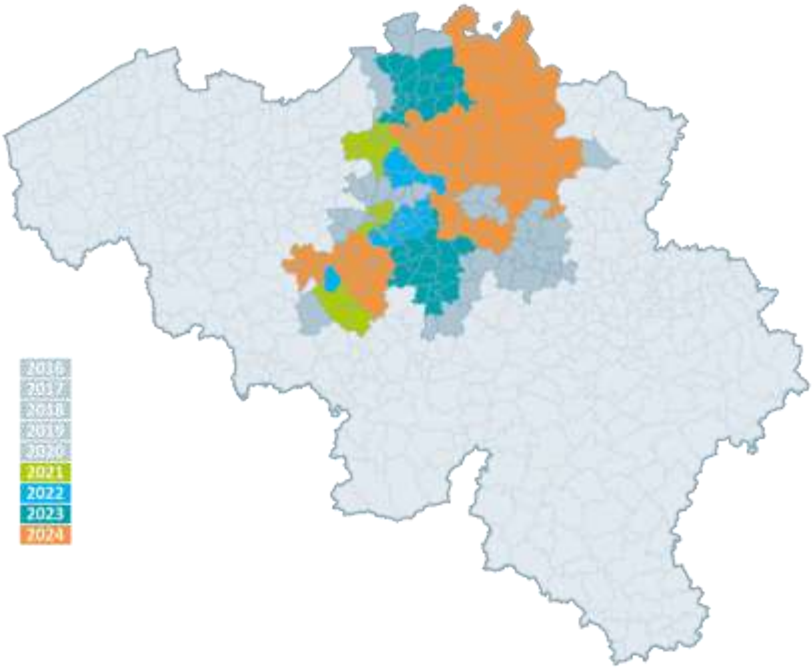

Figure 10: Indicative schedule for the L/H conversion by municipality (source: Synergrid)

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

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[18] and the Dorsales[19]).

However, 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.

As such, the Belgian market can only be converted by gradually supplying H-gas to 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 Winksele, 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.

[18] Major H-gas transmission pipeline between Zeebrugge and the German border.
[19] The pipelines transmitting L-gas from Hilvarenbeek to the south are known as the 'Dorsales'.

Adjustments to the Fluxys Belgium network

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, Beuzet and Antwerp CGA interconnection hubs. Only the conversion of the Brasschaat-Wuustwezel area required a new pressure-reducing station at Kalmthout.

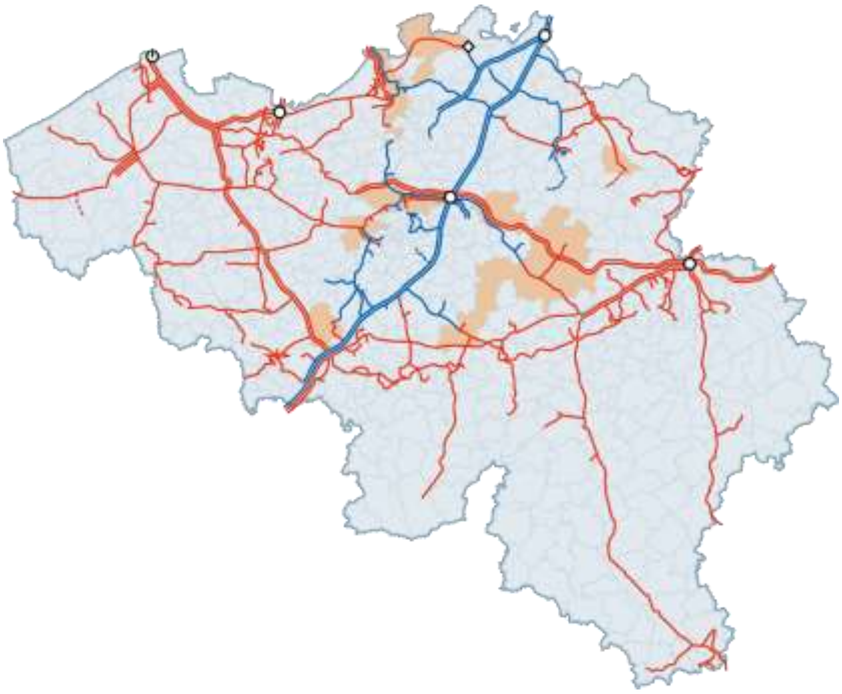

Figure 35: Adjustments to the Fluxys Belgium network in 2016-2020 (source: Synergrid & Fluxys Belgium)

The 2021 conversion phase began in early June 2021 and involved the migration of approximately 200,000 connections, a significant number of which were located in the north of Brussels.

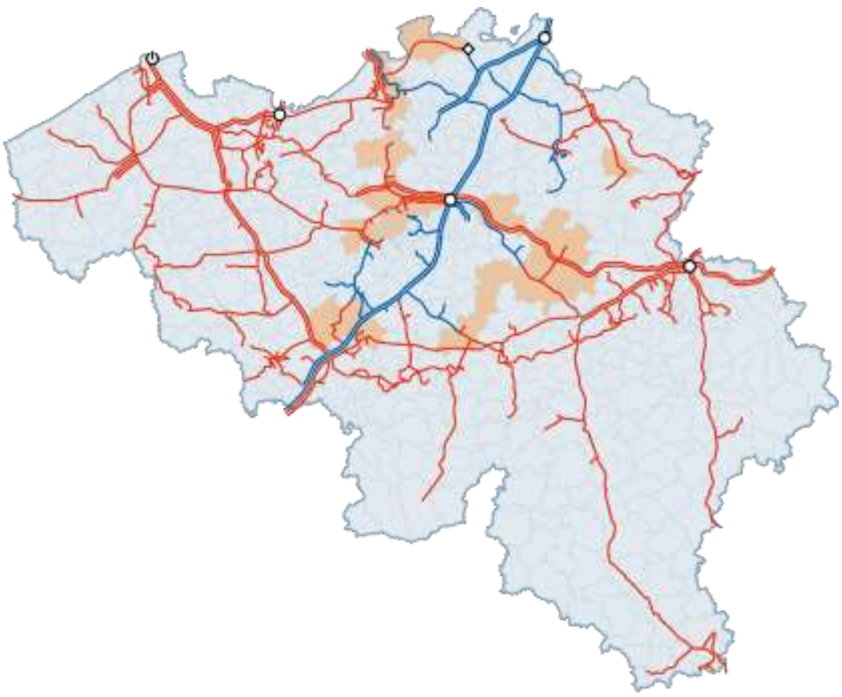

Figure 36: Adjustments to the Fluxys Belgium network completed in 2020 (source: Synergrid & Fluxys Belgium)

Next steps

South of the Zeebrugge-Eynatten pipeline

Additional adjustments need to be made to the Winksele station 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 2022. All the other regions south of the Zeebrugge-Eynatten pipeline and supplied by the Dorsales will be converted by 2024.

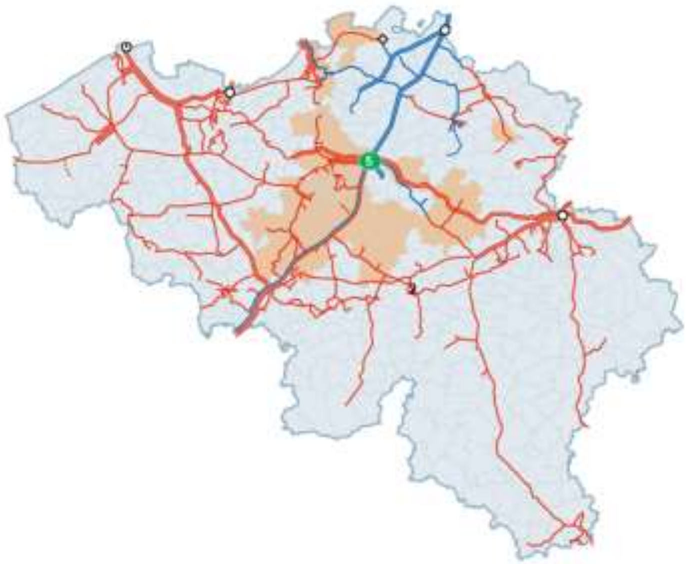

Figure 37: Adjustments to the Fluxys Belgium network south of the Zeebrugge-Eynatten pipeline (source: Synergrid & Fluxys Belgium)

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).

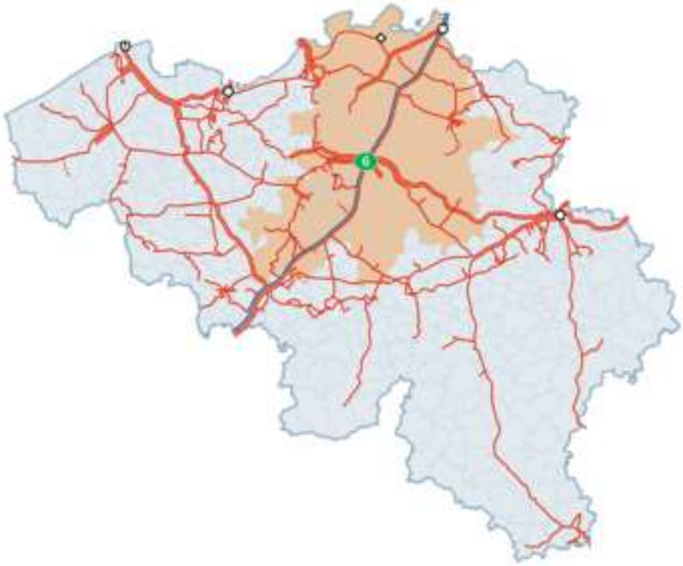

Figure 38: All adjustments to the Fluxys Belgium network (source: Synergrid & Fluxys Belgium)

Entry capacity for the new H market

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 at present, 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 currently suggest that there is enough H-gas entry capacity to absorb the needs of the 'new 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.

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.

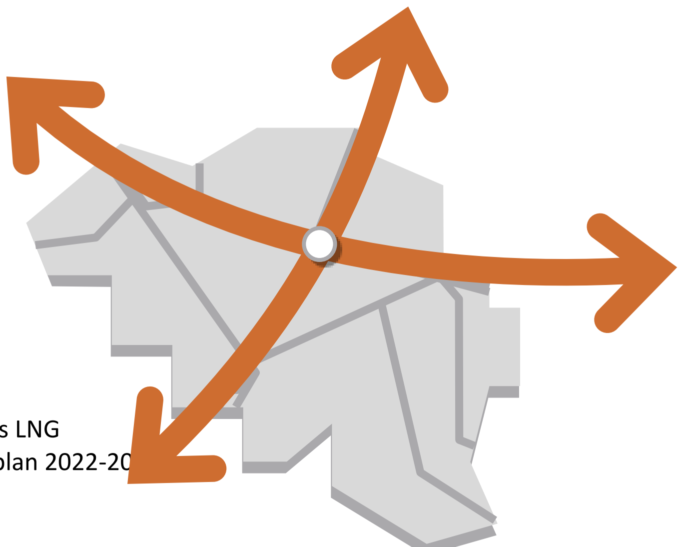

Figure 39: Potential contribution of the Fluxys Belgium network to the H-gas supply in Europe (source: Fluxys Belgium)

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.

Developments concerning LNG

In light of the market interest in LNG supplies at Zeebrugge, Fluxys LNG looked into 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 showed 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 therefore made the investment decision to expand regasification capacity on 15 February 2021, with an additional 8.2 GWh/h available from 2024 onwards, reaching 10.5 GWh/h as of 2026.

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

Figure 40: Zeebrugge LNG Terminal

Moreover, in light of the success of LNG truck-loading activities, largely due to the rapid rise in the number of trucks powered by LNG, Fluxys Belgium has decided to build four additional truck-loading bays. While the average annual number of loading operations has been around 1,450 since 2017, it is expected to rise to 6,000 in 2021, approaching the maximum capacity of 8,000 loading operations.

These four new loading bays should be operational in 2024.

Finally, it is worth mentioning here that in 2020, Zeebrugge became the first LNG terminal in Europe to obtain official certification to make available bio-LNG. Bio-LNG is carbon-neutral and offers both freight companies and shipowners the opportunity to take the step towards complete decarbonisation.

Developments concerning biomethane

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[20] by 2030, equivalent to around 8% of Belgium's natural gas consumption in 2019.

Figure 41: Biomethane production

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 also able to inject biomethane into the Fluxys Belgium network was commissioned.

Over the next few years, the expectation is that new facilities will be built to inject biomethane into the distribution system and also directly into the natural gas transmission system. Many projects are currently under consideration.

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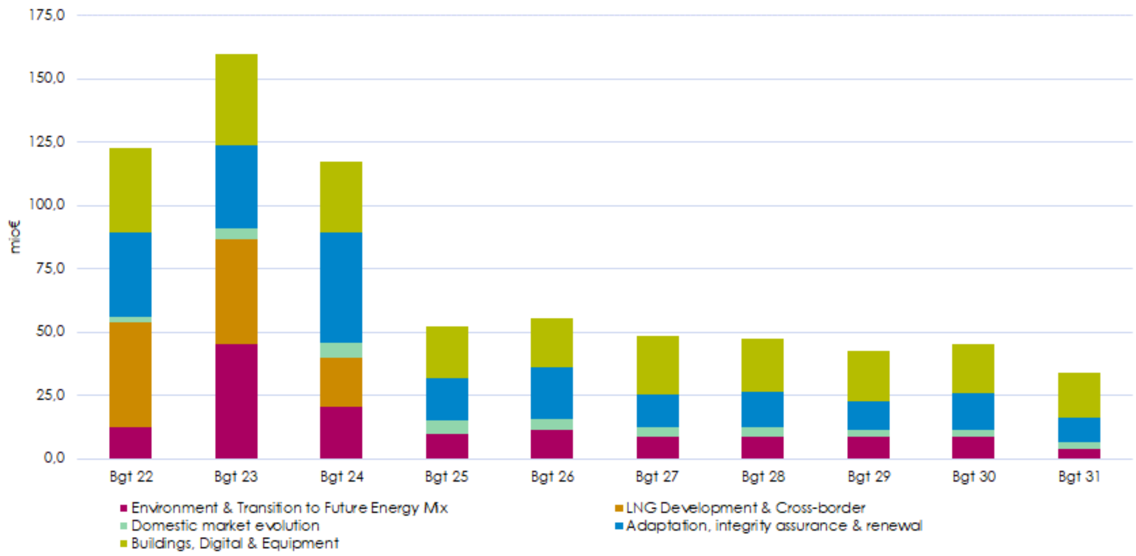
[20] 'Quelle place pour le biométhane injectable en Belgique' study conducted by the non-profit Valbiom at the request of Gas.be into the potential of injectable biomethane in Belgium: https://www.gas.be/sites/default/files/pdf/laybrochPotentielBiomethaneFRv10BAT.pdf (in French)

Indicative investments up to 2031

Fluxys Belgium and Fluxys LNG plan to make investments totalling **€726 million[21] over the period 2022-2031.**



Investments will be made in the following five areas:

- **Environment and the transition to the future energy mix**: €139 million
- Adjustments to the network to maintain its integrity and **renewals**: €210 million
- Adjustments to the network to meet the changing needs of **end users**: €38 million
- **LNG initiatives and cross-border projects**: €102 million
- **Miscellaneous** investments [buildings, ICT, etc.]: €237 million

Thanks to the investments made in recent years, the Belgian gas network is sufficiently dimensioned, has significant entry capacity (>10 mcm(n)/h), and is bidirectional, congestion-free and well integrated with other gas transmission systems in North-West Europe.

Approved projects account for €154 million, or 21% of the total amount. These are projects scheduled to be rolled out in the near future (2022-2024). For most of the allocated amounts (€401 million), the projects have been identified but no decision has as yet been made. In addition, an annual amount of €171 million has been earmarked for needs that have not yet been precisely defined.

The total value of the investment plan is higher than the previous version of the plan (€644 million for the period 2021-2030).

The amounts shown are indicative and may change depending on whether the projects in question are given the final go-ahead or on changes to the planned technical solutions or market conditions.

Environment and the transition to the future energy mix

[21] In constant euros

Earmarked amount: €139 million

This investment category encompasses all planned projects intended to reduce the environmental impact of Fluxys Belgium and Fluxys LNG operations (their carbon footprint in particular) as well as network developments to transport the energy carriers of the future.

Adaptation, integrity assurance and renewal

Earmarked amount: €420 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.

Changing needs of end users

Earmarked amount: €38 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.

LNG initiatives and cross-border projects

Earmarked amount: €102 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.

Miscellaneous

Earmarked amount: €265 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 CO2 transmission systems

Context

European energy and climate policy

The European Union aims to achieve **carbon neutrality by 2050** by means of the **Green Deal**[22] adopted by the European Parliament in January 2020. The European Commission also announced in September 2020 a goal 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.

As such, an EU **Strategy for Energy System Integration**[23] 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 wide-reaching 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**[24] (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 40 GW of renewable hydrogen electrolysers and production of 10 million tonnes of renewable hydrogen
- 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

[22] European Commission, The European Green Deal, COM(2019) 640, December 2019
[23] European Commission, Powering a climate-neutral economy: An EU Strategy for Energy System Integration, COM(2020) 299, July 2020
[24] European Commission, A hydrogen strategy for a climate-neutral Europe, COM(2020) 301, July 2020

As part of the post-COVID-19 **recovery plan for Europe,**[25] the Commission focused on investments to accelerate the energy transition, such as technologies for producing renewable energy and green hydrogen, and sustainable energy infrastructure.

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).

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.[26] 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 the transition of industrial processes or for transport.

[25] NextGenerationEU, European Commission, May 2020

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

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 2020, Belgium's total CO_2 emissions amounted to 106.4 million tonnes of carbon dioxide (Mt CO[27]2 excluding LULUCF). Figure 42 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), followed by transport (26.0 Mt) and residential heating (22.1 Mt).

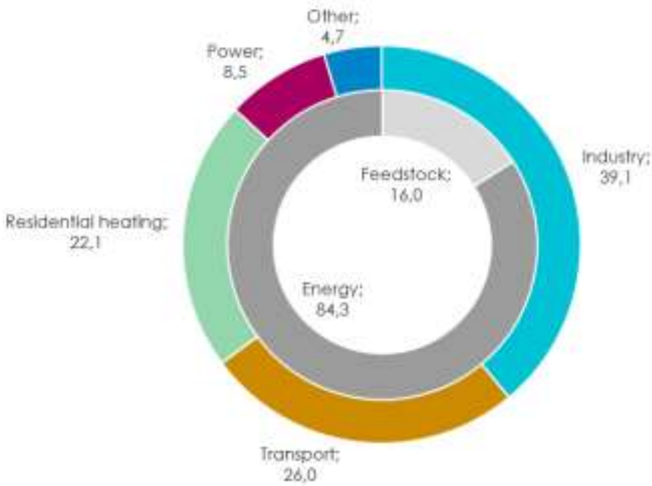


Figure 42: CO_2 emissions in Belgium linked to the use of energy and feedstock per sector in Mt (2018)

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.

Technical studies

Fluxys has invested in determining the conditions for reusing existing pipelines to transport hydrogen and/or CO_2. Partnerships with other TSOs (National Grid, GRTgaz in particular) have been established.

Preliminary results show that the lion's share of existing infrastructure is fully compatible, with only a few operational adaptations needed, including the maximum operating pressure.

Development of future hydrogen and CO_2 transmission systems

Europe's backbone for hydrogen transmission

The figure below is the result of an exercise to define 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

[27] Source: www.climat.be (in Dutch or French)

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.

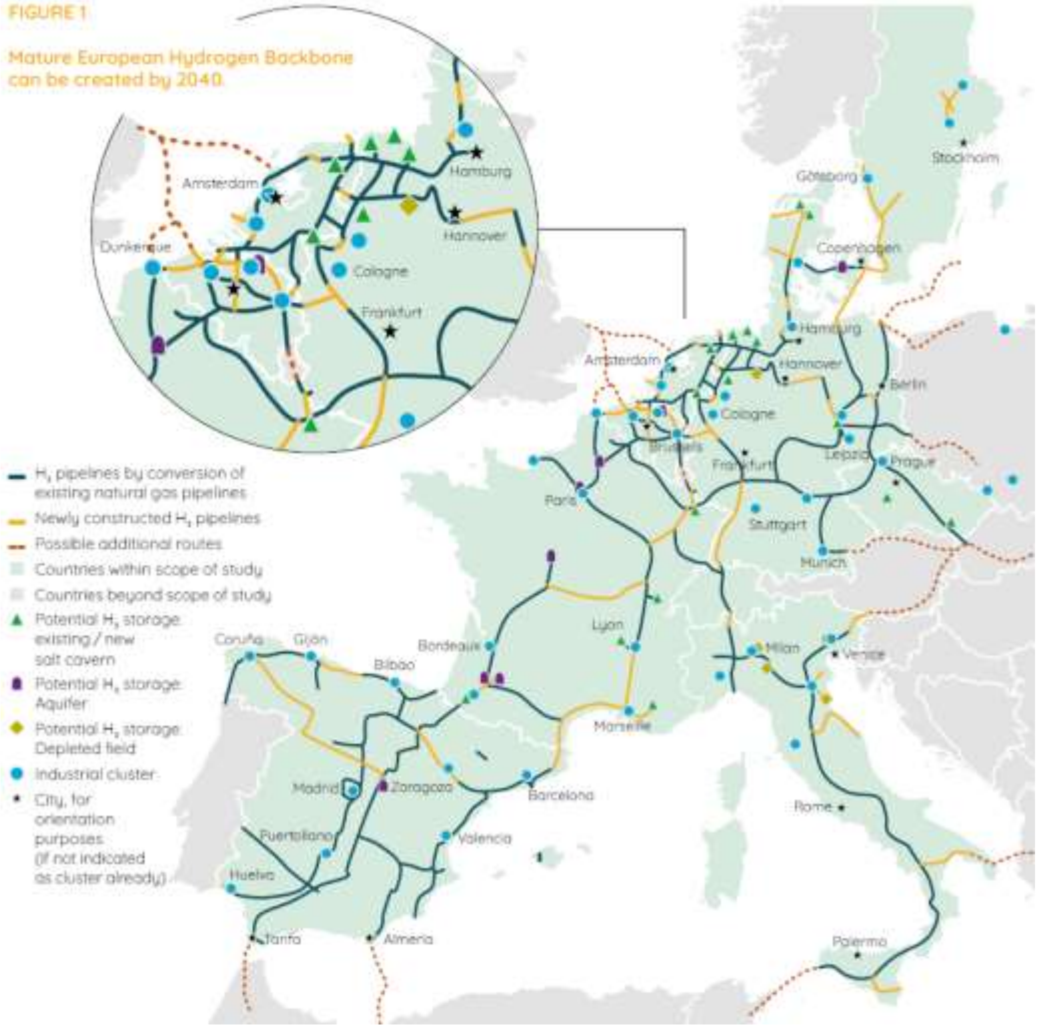


Figure 11: European hydrogen backbone[28] (source: Guidehouse, July 2020)

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.

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

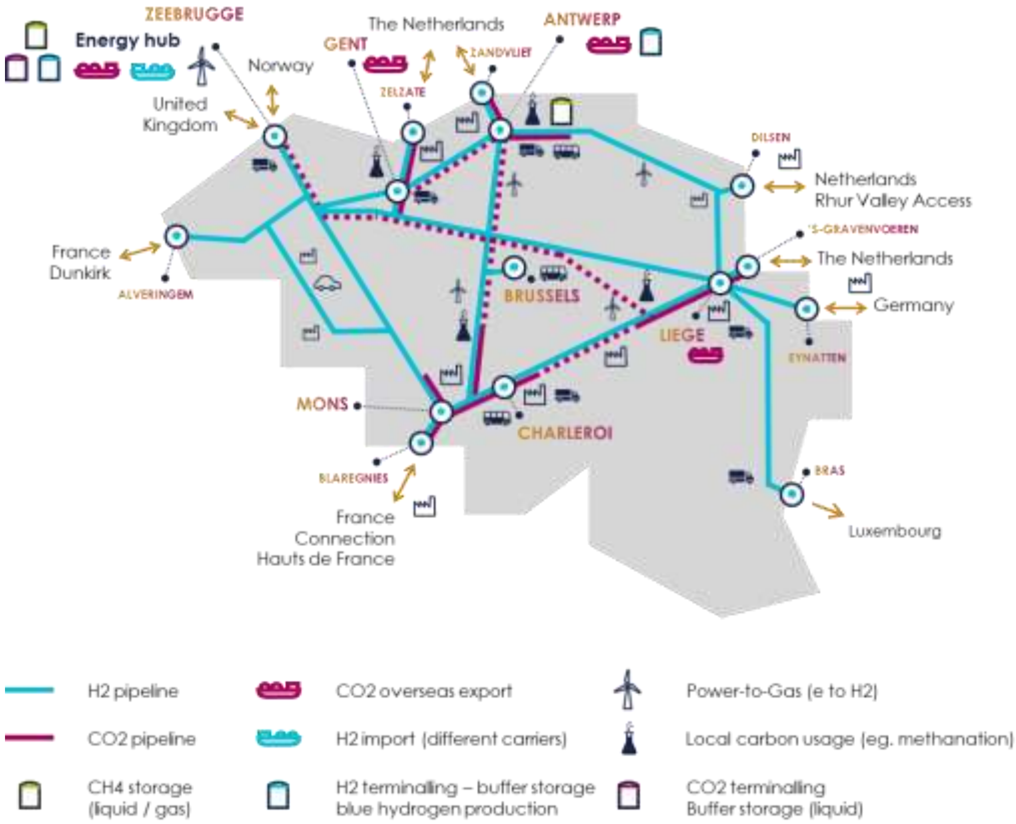


Figure 44: Long-term vision of the H_2/CO_2 backbone

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 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.

Short-term options

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

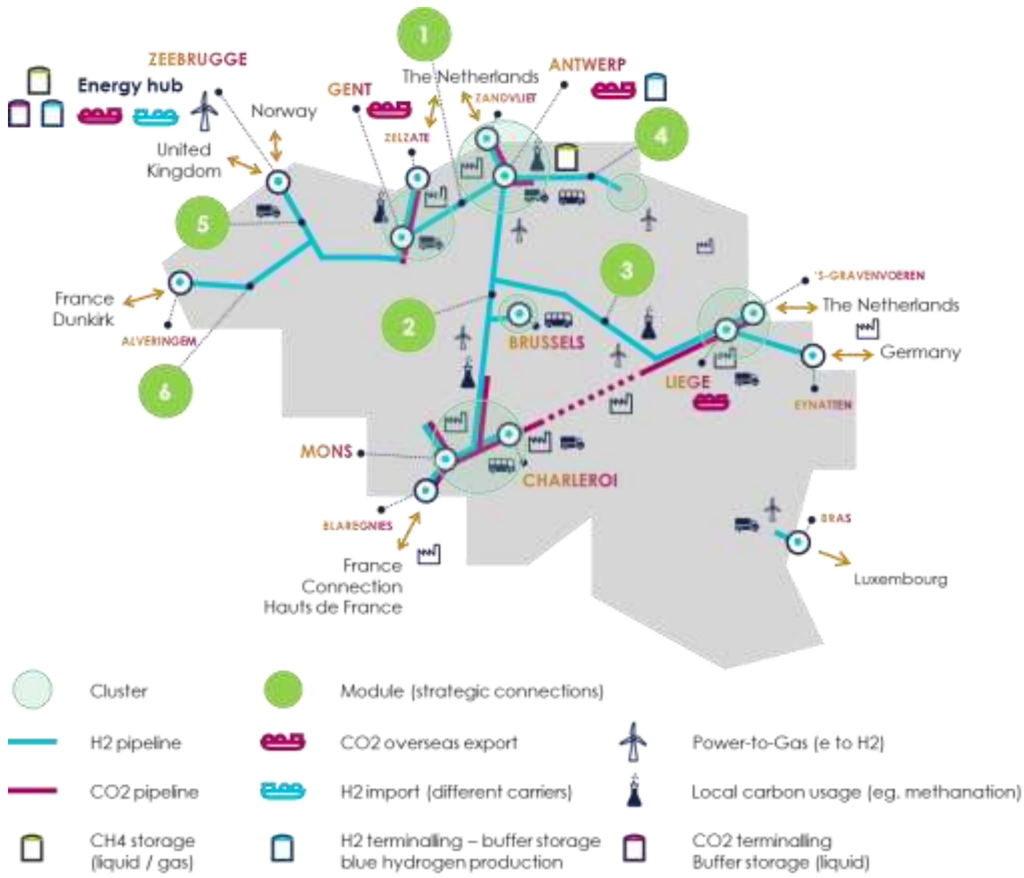


Figure 12: Short-term options for the deployment of the H_2/CO_2 backbone

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.

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 H2 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

Modules for connecting clusters for H_2

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.

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.

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.

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.

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.

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 vital.

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.

Interconnections with neighbouring countries

'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.

'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.

'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.

''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.

'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.

'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.

Indicative investments up to 2030

Indicative estimates have been made to meet 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.

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 **€408.1 million (in constant euros) by 2031**.

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 **€386.6 million (in constant euros) by 2031**.