Indicative Investment Plan Fluxys Belgium & Fluxys LNG 2023-2032

November 2023

Contents

Purpose

The indicative investment plan 2023-2032 sets out all investments needed to keep up with changes in Belgium's natural gas market (taking into account new West-East flow patterns), maintain and upgrade the infrastructure 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 to the Zeebrugge LNG terminal.

Fluxys is committed to ensuring that new major investments are compatible with the energy transition either by reducing its carbon dioxide emissions, or by building new infrastructure that is hydrogen compliant.

This document is established in accordance with Art 15/13, §2- 3° of the Gas Decree dd April 12th, 1965.

Geopolitical situation

Since the start of the war in Ukraine in February 2022 we have been facing a structural change in flow patterns across Europe. Historically, the European gas market has been fed for one third by Russian gas, one third by Norwegian gas and the remaining third by a combination of European production, imports from North Africa through pipelines and imports of LNG.

The gradual reduction in 2022 of Russian gas imports through pipelines, culminating with the explosion of 3 pipelines out of 4 of the Nord Stream I and II pipelines on Sep 26th, 2022 forced the European market to be reorganized rapidly.

On Mei 18th, the European Commission presented the plan RepowerEU aiming at reducing before 2030 the dependence on Russian gas. This plan consists of three main axes: diversify the natural gas sourcing, reduce the domestic consumption, and accelerate the energy transition.

The diversification of the gas imports led to an increase of LNG imports at record levels for all existing LNG terminals, mainly situated at the western European coasts, leading to huge gas flows from west to east to feed Germany and Central European countries.

At the same time, Germany, France, The Netherlands, Italy, Estonia, Poland and Greece decided to invest in Floating Storage and Regasification Units (FSRUs) that will be commissioned from Q4 2022 till Q4 2023.

Therefore, both LNG terminals of Zeebrugge and Dunkirk have been used at maximum capacity to flow gas to Germany and The Netherlands (exporting to Germany as well) through Belgium, using the Fluxys transit capacities well above usual values, peaking to 1,3 TWh/d of export during the summer 2022, which is close to the capacity of the Nord Stream I (1,7 TWh/d). As such, Belgium brought a huge contribution to the security of supply of Europe. During the half of the year, Belgium exported to Germany and The Netherlands more than 1,2 TWh each day for a global export to these countries in the calendar year 2022 of 386 TWh. This represents 46% of the whole German consumption in 2022 (Source Enerdata: Germany consumed 847,5 TWh in 2022).

This new paradigm led Fluxys to evaluate its existing gas infrastructure and identify new investments, required by the new gas flow situation together with the acceleration of the energy transition, as per the RepowerEU plan. Moreover, each new major identified investment is evaluated according to its contribution to building the infrastructure of the future and is designed as hydrogen compliant.

One major decision was made by the Fluxys Board of Directors on November 30th, 2022: the construction of a new pipeline of 50 km, hydrogen compliant, to improve the gas throughput of the zone of Zeebrugge. This pipeline is expected to be commissioned by the end of 2023.

Other similar investments are being analysed considering security of supply, congestion and energy transition.

Outlook for 2023-2032

Changes in the market in Europe and in Belgium lead to big investments and adjustments of Belgium's natural gas transmission infrastructure. This is especially true for the consequences of the change of flow patterns; for the L/H conversion, which is needed because of the upcoming end of gas supplies from the Groningen gas field in the Netherlands; for the construction of two new gas fired power stations; and for market demand for more regasification capacity at Zeebrugge LNG Terminal.

"Changes in the market in Europe and in Belgium lead to big investments and adjustments of Belgium's natural gas transmission infrastructure."

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 and new industrial customers, considering on the one hand new connections requests and on the other hand structural consumption decline due to better insulation of households or switch to heat pumps.

Fluxys is also working hard to reduce its CO_2 footprint and the 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 2023-2032, 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.*

The European gas market

Consumption trends in Calendar Year (CY) 2022

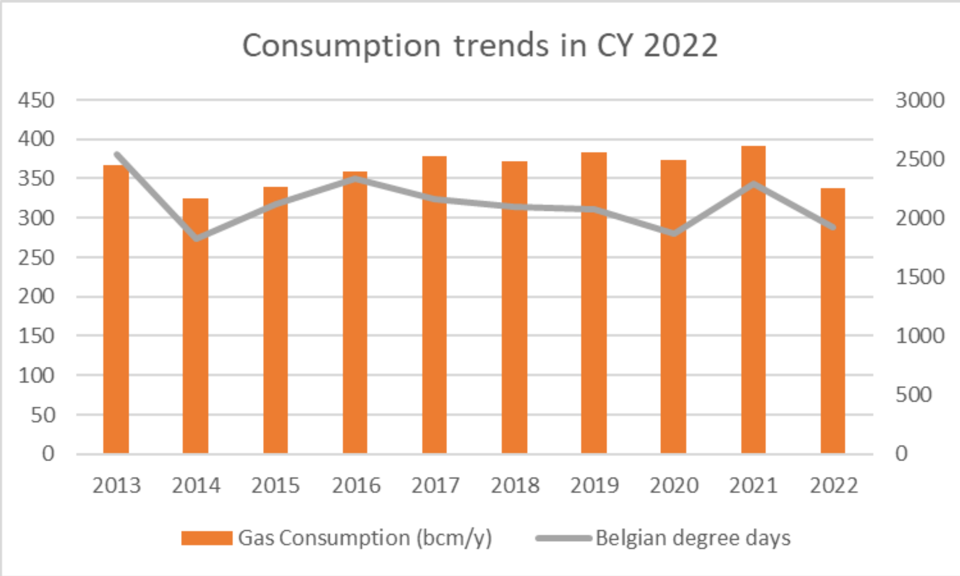

FIGURE 1 : : GAS CONSUMPTION IN THE EU 27 AND THE IMPACT OF THE WEATHER (SOURCES: EUROSTAT AND GAS.BE)

In 2022, European gas consumption in the EU 27 was 337 bcm, down from 391 in 2021 and 374 bcm in 2020, (Eurostat). 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 2022, mitigating demand for gas to heat buildings. After an increase of 4,3% in 2021, EU inland natural gas demand decreased by 13,2% to 337 bcm. This reduction is in line with the reduction target of 15% that has been set by the Council Regulation on Coordinated Demand Reduction Measures for Gas adopted in August 2022 (Target for all Member States to reduce gas demand by 15% between 1 August 2022 and 31 March 2023, with respect to the previous 5 years).. For the period August 22 to March 23, the consumption dropped by 17,7% for the same period compared to previous 5 years mainly as a consequence of high prices on the market due to the war in Ukraine and the fears, during the summer 2022, of not being able to fil the storages for the winter. In 2022, all largest natural gas consumers (Germany, Italy and France) reduced significantly their demand vs 2021 (respectively -15,4%, -9,9% and -9,6%).

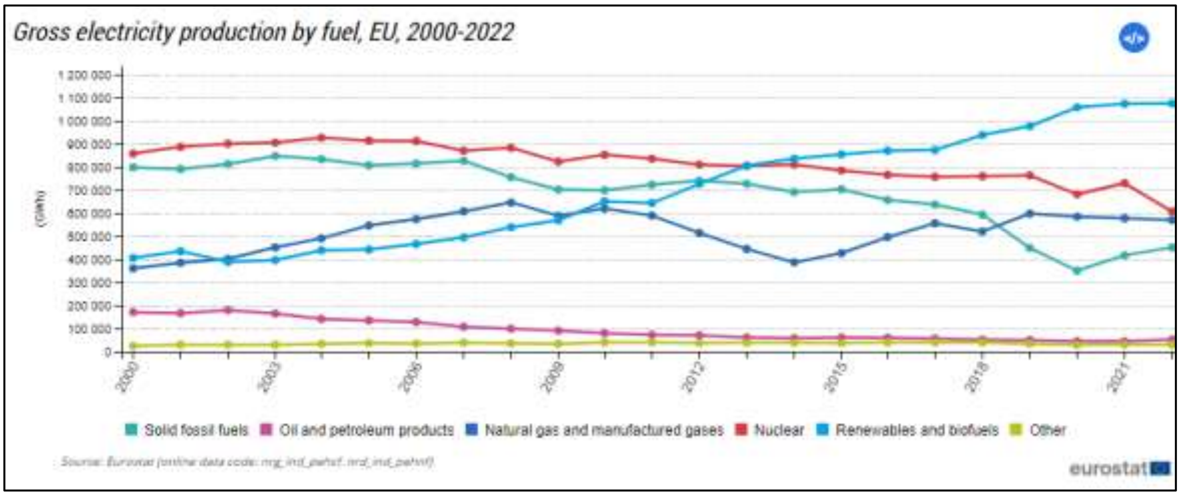

FIGURE 2: MONTHLY ELECTRICITY GENERATION MIX IN THE EU 27 (SOURCE: EUROSTAT, 2023)

Overall, in 2022, the electricity consumption in EU27 has been 4% lower than in 2021. This decrease is partly due to a very mild winter (temperatures were in 2022 0n average 1°C above the 1990-2020 reference period). The energy crisis caused by the war in Ukraine also led to a reduction of the electricity consumption during the last quarter of 2022.

In terms of electricity production per mode:

- Massive decrease of hydropower generation (more than 27% on average in February) due to severe droughts in multiple regions in Europe.
- Nuclear power generation much lower in 2022 compared to 2021 due to many maintenances in France and to nuclear phase-out plans in Germany and Belgium.
- Coal production increased from February to August 2022 compared to 2021 levels due mainly to the high natural gas prices resulting from the war in Ukraine. Some retired coal power plants were restarted to ensure security of supply.
- The gas power production has remained quite stable despite many tensions in the natural gas market, as high market prices do not translate necessarily in high supply prices for producers depending on their contracts.
- Renewable electricity production kept increasing, reflecting the addition of new solar and wind capacity across Europe.

Supply trends in CY2022

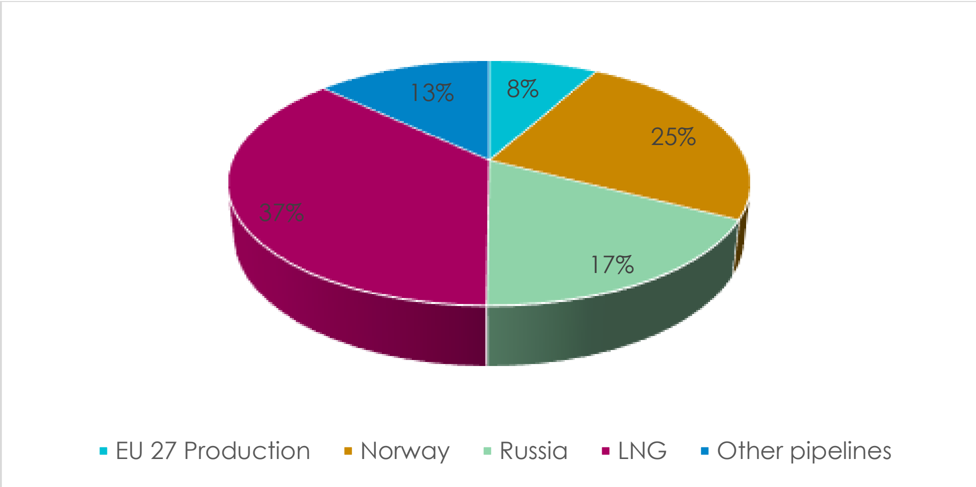

FIGURE 3: GAS SUPPLY MIX IN 2022 (EU 27 AND RUSSIA) (SOURCE: ENERGY INSTITUTE STATISTICAL REVIEW OF WORLD ENERGY, 2023)

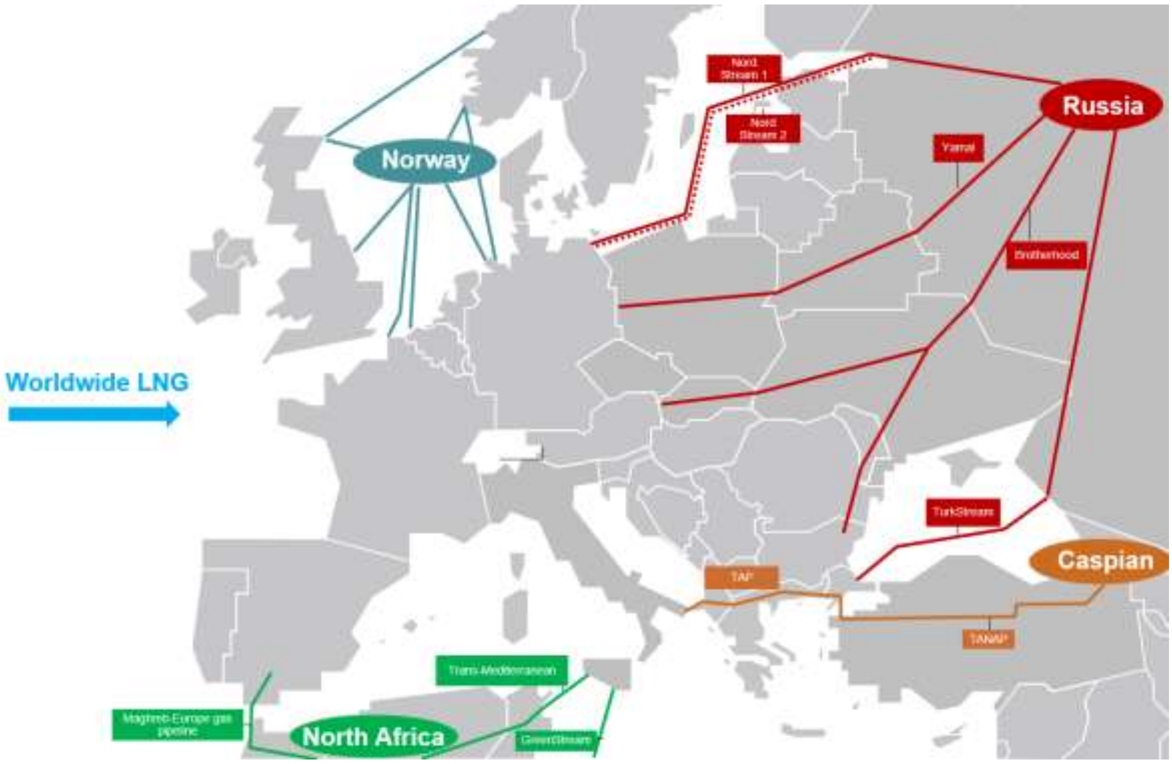

FIGURE 4: EUROPE'S SUPPLY ROUTES PRE-UKRAINIAN WAR

Before 2022, Russian pipeline gas supplies to Europe in 2020 came via Ukraine, the Nord Stream pipeline, Belarus, the Baltics and the TurkStream pipeline, which was commissioned on 8 January 2020. After the start of the war in Ukraine in 2022, the flows through the Nord Stream and the Belarus route progressively closed and the flow through the Ukraine route was strongly reduced.

As a result, the Russian share of natural gas feeding Europe by pipeline has dropped to 17% in 2022. The reduction of imports of Russian gas were compensated in 2022 by a reduction of the consumption of 13.2%, an increase of the shares of import from Norway, LNG and other pipelines (Azerbaijan, Algeria and Libya) respectively to 25%, 37% and 13% (coming from 24%, 20% and 8% in 2021)

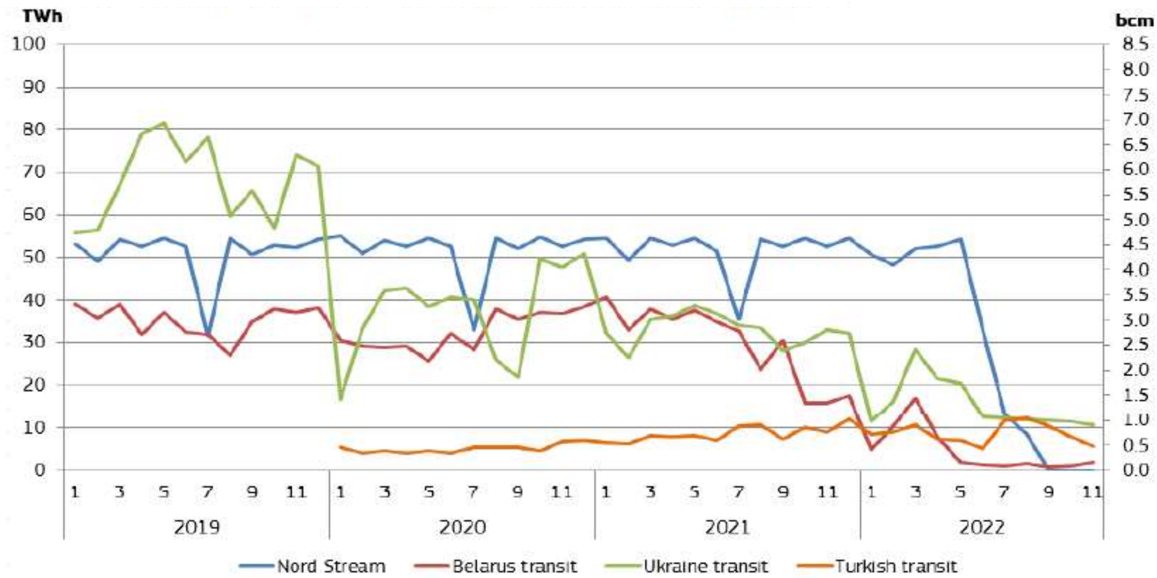

FIGURE 5: EU IMPORTS OF GAS THROUGH RUSSIAN SUPPLY ROUTES (SOURCE: EUROPEAN COMMISSION, 2023)

LNG imports to Europe have experienced a strong 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 EU terminals increased significantly from October 2018 onwards, reaching 80 to 120 bcm/year until the first five months of 2020. It then dropped sharply down to 40 bcm/year in January 2021 due to the COVID-19 pandemic and the very low gas prices worldwide due to excess LNG production. LNG supplies raised back to 80-100 bcm/y until June 2021, but the economic recovery and the transition from coal to natural gas (especially in Asia) triggered a shortage of global LNG supply and a strong increase of wholesale prices. During the winter 2021/2022, European LNG imports recovered to around 60 bcm/y, before a strong increase since the start of the war in Ukraine to reach finally 130 bcm in 2022 (source IEA).

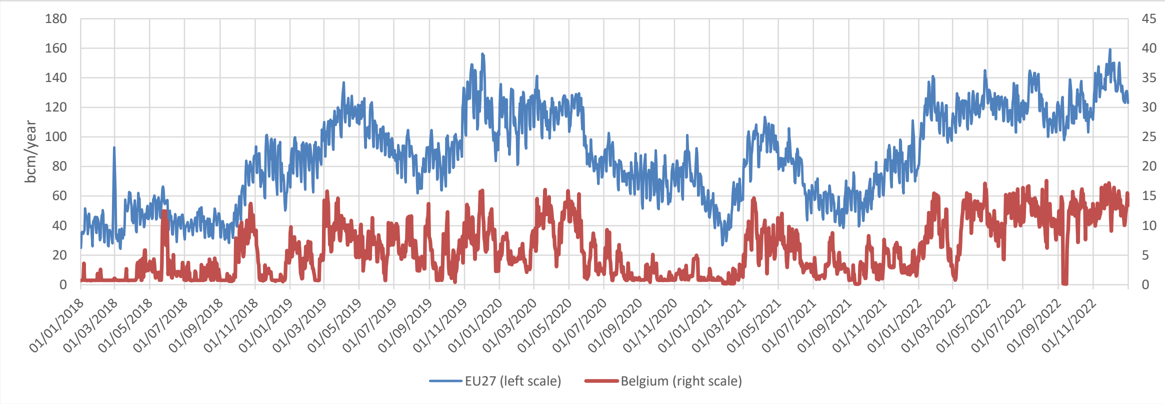

FIGURE 6: SEND-OUT FROM LNG TERMINALS IN THE EUROPEAN UNION (SOURCE: GLE TRANSPARENCY PLATFORM)

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.

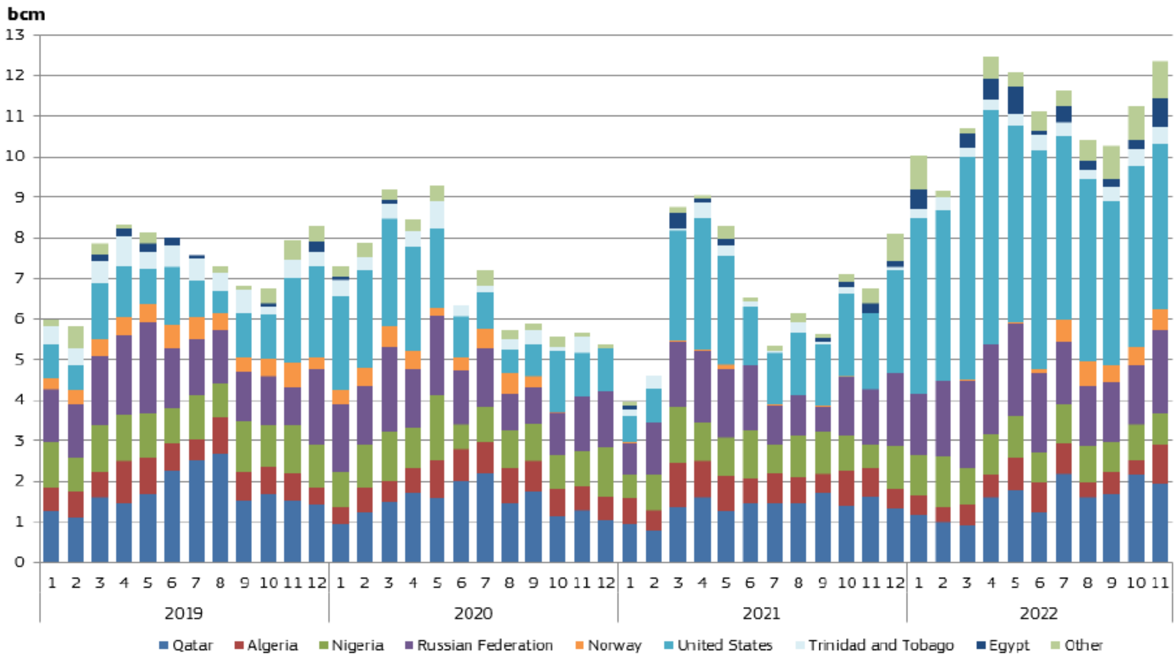

FIGURE 7: CUMULATIVE LNG IMPORTS TO THE EU BY SOURCE (SOURCE: EUROPEAN COMMISSION, 2022)

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) become depleted. Dutch L-gas production is declining due to natural depletion and regulatory measures taken because of earthquakes in the region, with a closure scheduled for 2025 (still to be confirmed), though some facilities will continue operating to supply additional gas in emergencies. 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.

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 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.

As a result of the geopolitical situation, LNG is expected to make up the bulk of any additional imports required by Europe. New liquefaction and regasification infrastructure (FSRUs and land-based LNG terminals) is being built, which will increase the LNG import capacity and pave the way for the diversification of supply.

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.

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

ENTSOG & ENTSO-E Scenario Report for the TYNDP 2022

In connection with Regulation (EU) no 347/2013, the ENTSOs for gas and electricity have published in April 2022 their updated joint Scenario Report, the third report of its kind.[1] The common scenarios described in the Scenario Report serve as a basis for spotlighting future gas and electricity infrastructure needs in the upcoming TYNDPs that will be published in 2023 and will support the assessment for the European Commission's Projects of Common Interest (PCI) list for energy.

Three differing future energy scenarios have been developed (National Trends, Distributed Energy and Global Ambition), allowing the TYNDP to assess European energy infrastructure requirements considering the entire integrated energy system thoroughly and comprehensively. Moreover, these scenarios are assumed to be aligned with the European energy policies.

It is important to highlight that the most recent energy policy objectives that were adopted following the start of the war in Ukraine are not yet reflected in this Scenario Report. As a result, some assumptions in this report regarding gas supply may be impacted by the recent change in the situation for the short and longer terms.

It should also be noted that for the first time a sector-coupling between electricity and hydrogen has been considered for the scenarios and the modelling.

National Trends scenario

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 scenarios

Two contrasting top-down scenarios with an all-energy perspective (all sectors, 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 (basically high electrification), Global Ambition focuses on more larger scale solutions, with the EU as an actor of the global energy transition (basically considering more import of molecules to ensure energy supply).

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.

Scenario results 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 (e.g. hybrid heat-pumps).

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

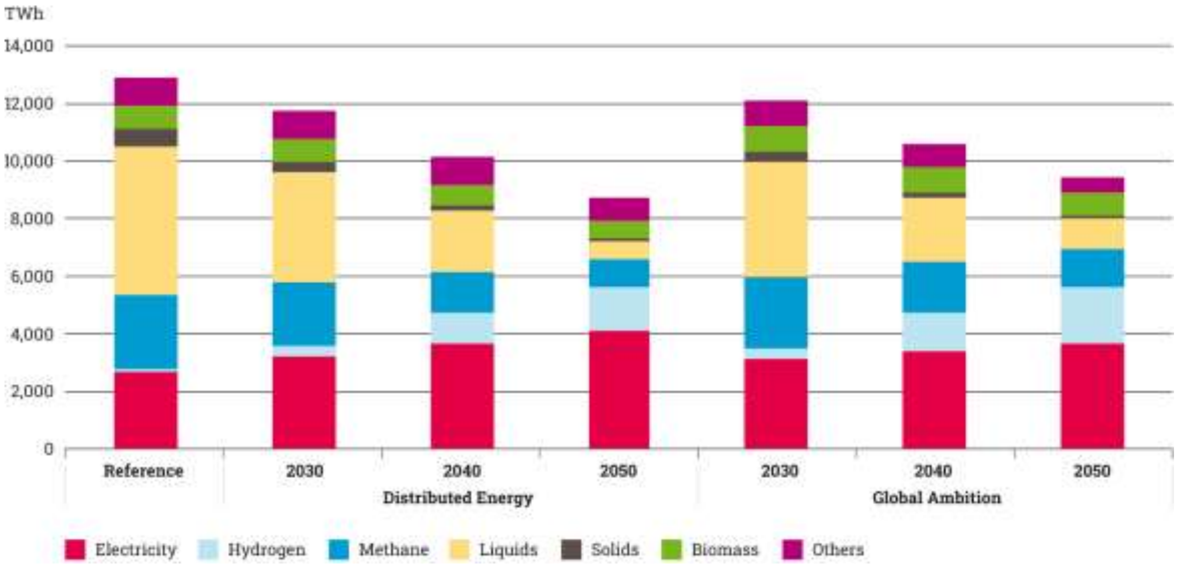

FIGURE 8: FINAL ENERGY DEMAND PER CARRIER (ENERGY AND NON-ENERGY USE FOR FEEDSTOCK) FOR EU27 (SOURCE: TYNDP 2022 SCENARIO REPORT)

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 (with CCS).

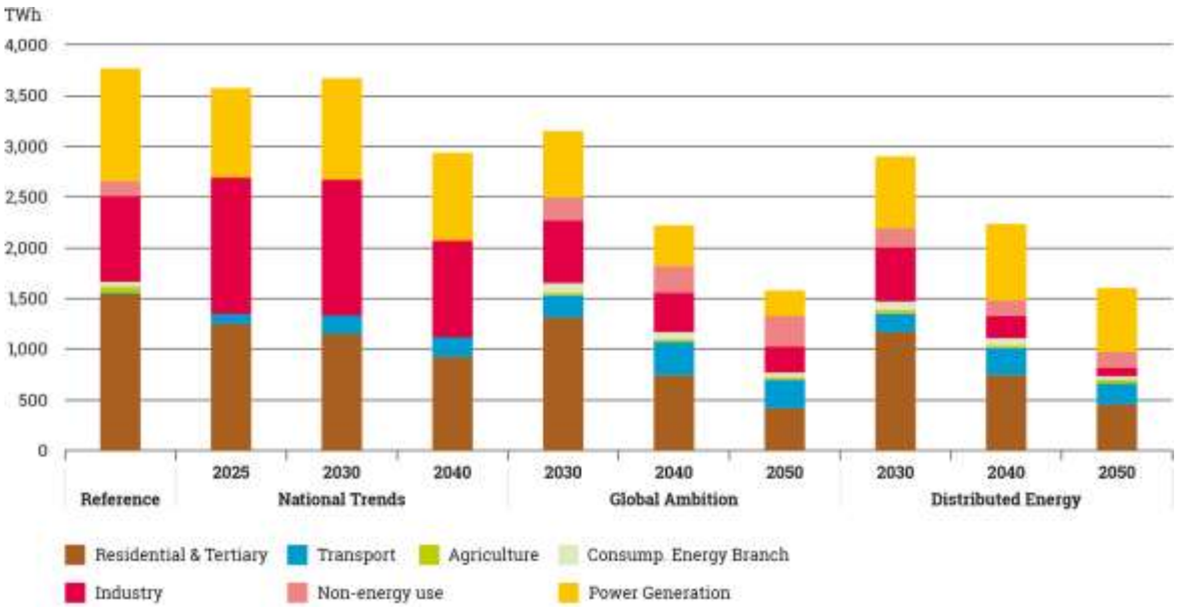

FIGURE 9: METHANE DEMAND PER SECTOR FOR EU27 (SOURCE: TYNDP 2022 SCENARIO REPORT)

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.

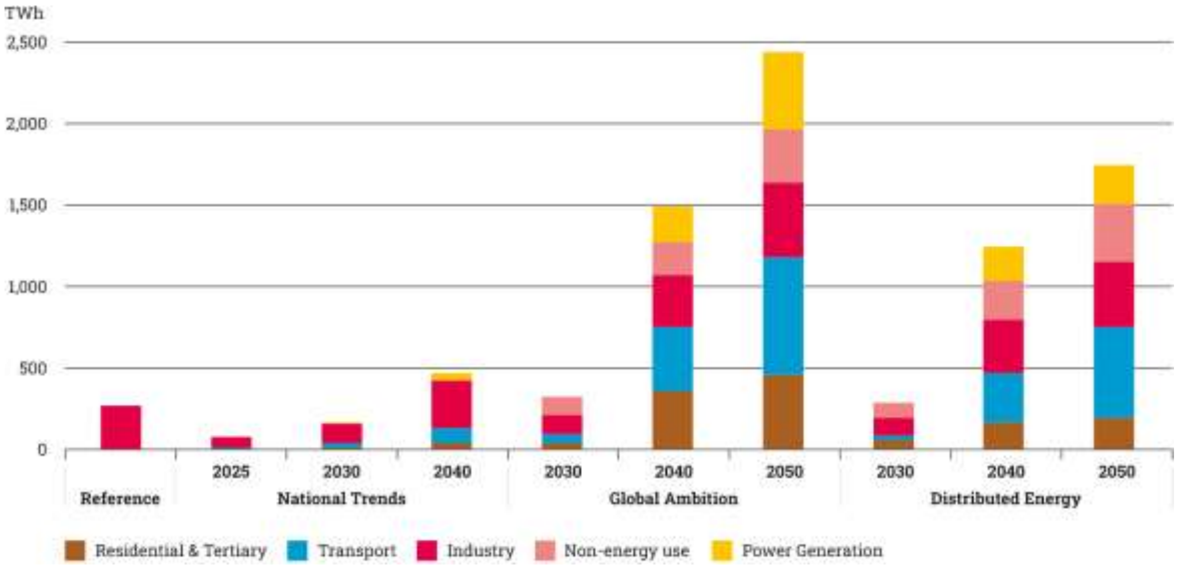

FIGURE 10: HYDROGEN DEMAND PER SECTOR FOR EU27 (EXCLUDING HYDROGEN FROM BY-PRODUCTS AND FOR CONVERSION [P2M/P2L])[2] (SOURCE: TYNDP 2022 SCENARIO REPORT)

The development of significant 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.

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[2] P2M = Power to Molecules; P2L = Power to Liquids

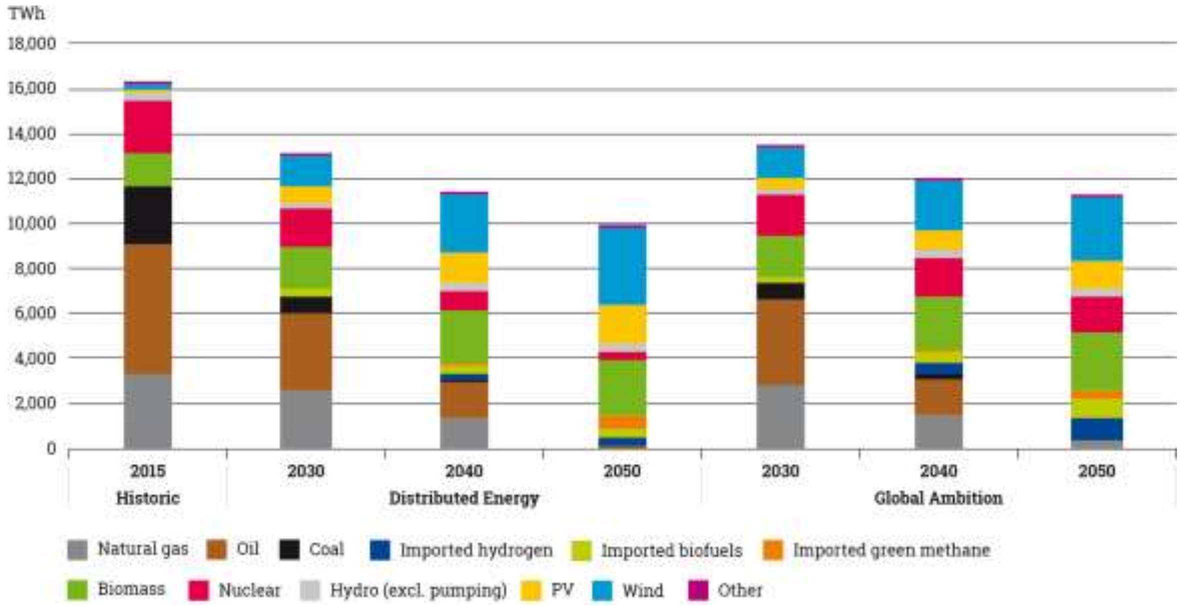

FIGURE 11: PRIMARY ENERGY SUPPLY IN THE TWO COP 21 SCENARIOS (FOR ENERGY AND NON-ENERGY USE) FOR EU27 (SOURCE: TYNDP 2022 SCENARIO REPORT)

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 limited.

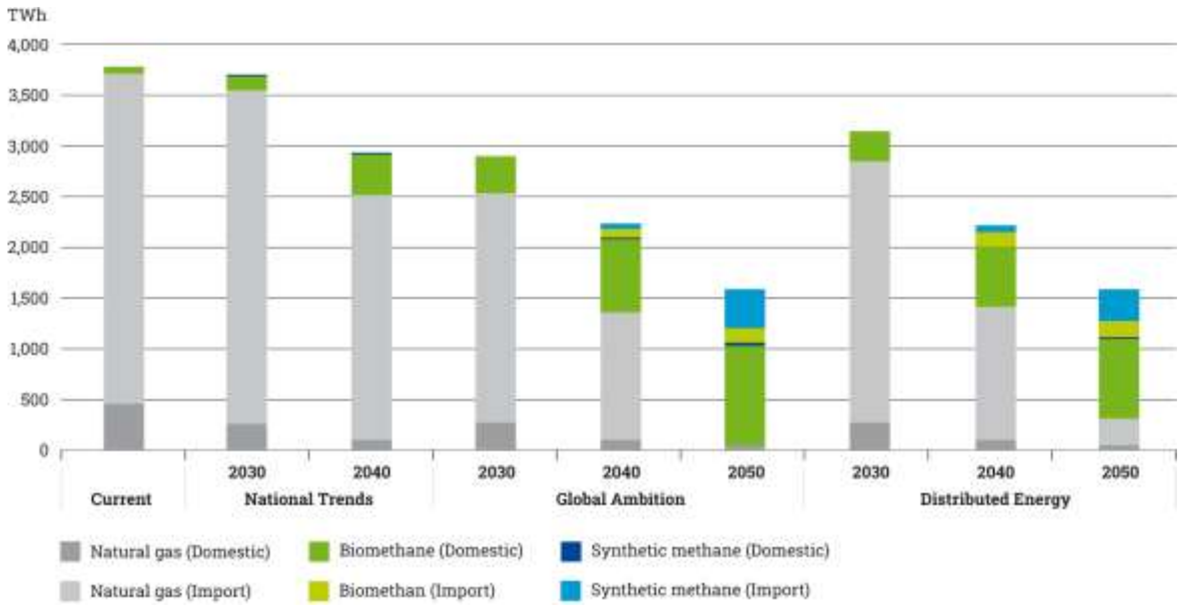

FIGURE 12: METHANE SUPPLY FOR EU27 (SOURCE: TYNDP 2022 SCENARIO REPORT)

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.

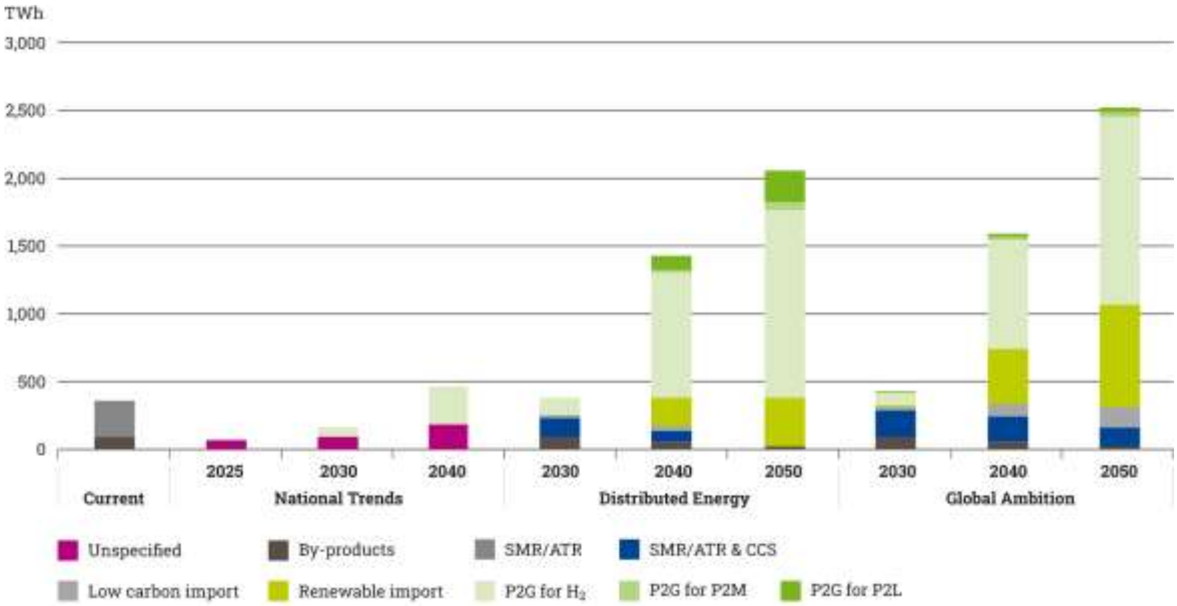

FIGURE 13: HYDROGEN SUPPLY FOR EU27 (SOURCE: TYNDP 2022 SCENARIO REPORT)

Indigenous production of clean hydrogen within the EU, as included in the scenarios, will require a sharp increase of installed electrolyser capacity up to 300 to 400 GW in 2050, combined with significant growth in renewable electricity generation to satisfy P2G demand.

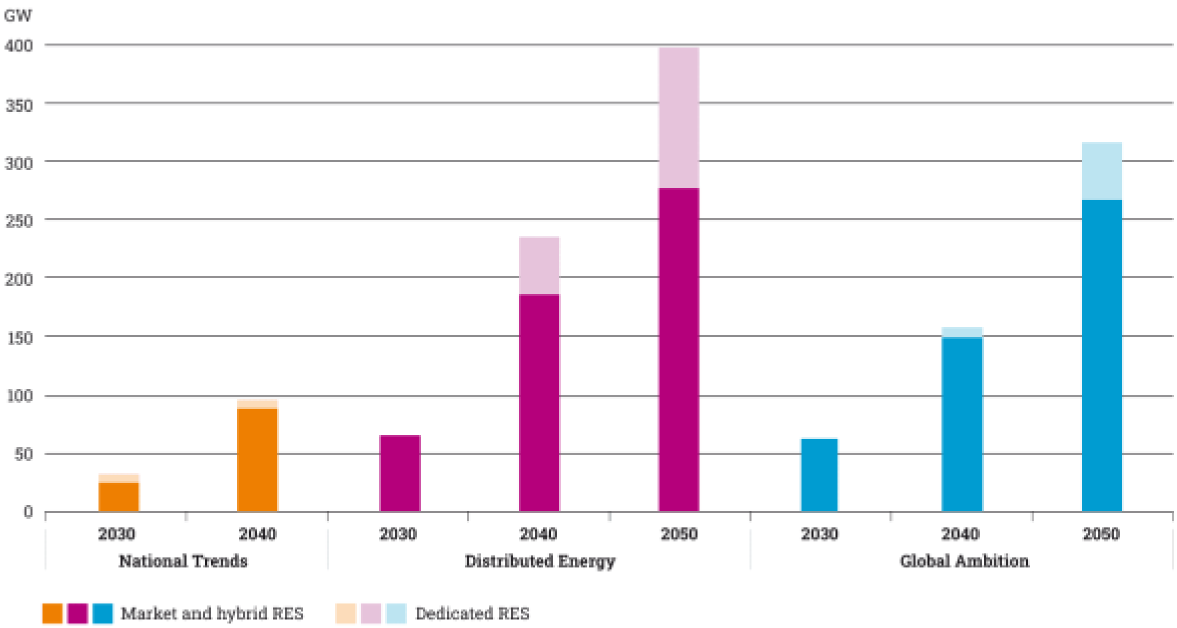

FIGURE 14: ELECTROLYSER CAPACITY FOR EU27 (SOURCE: TYNDP 2022 SCENARIO REPORT)

North-West Gas Regional Investment Plan (NW GRIP)

Following the previous European regulation, TSOs were asked to publish every 2 year a gas regional investment plan (i.e. GRIP) that complements the European TYNDP from ENTSOg.

In 2022, nine countries (i.e. Belgium, Denmark, France, Germany, Ireland, Luxembourg, Sweden, The Netherlands and the Czech Republic) participated in the preparation of the fifth edition of the North West Gas Regional Investment Plan (i.e. NW GRIP).

The fifth edition of the NW GRIP focuses on the following key challenges:

- The gaining momentum of the energy transition and the role of gas infrastructure and green molecules in developing a sustainable system and society for Europe
- The security of gas and energy supplies that has received significantly more attention in past months, with associated solutions to improve this security of supply at European level.
- The switch from low calorific gas (L-gas) to high calorific gas (H-gas) in the NW Region with associated conversion infrastructure projects.

The Belgian natural gas market

Fluxys Belgium and Fluxys LNG natural gas infrastructure

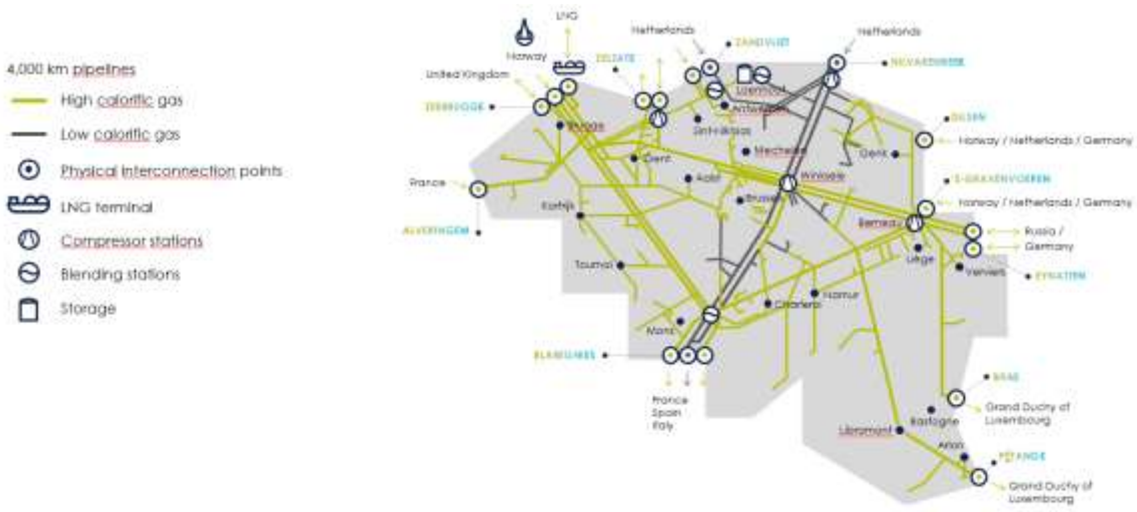

FIGURE 15: FLUXYS BELGIUM AND FLUXYS LNG NATURAL GAS INFRASTRUCTURE

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 (NL) 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 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 system operators, 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 2252 degree days.[3]

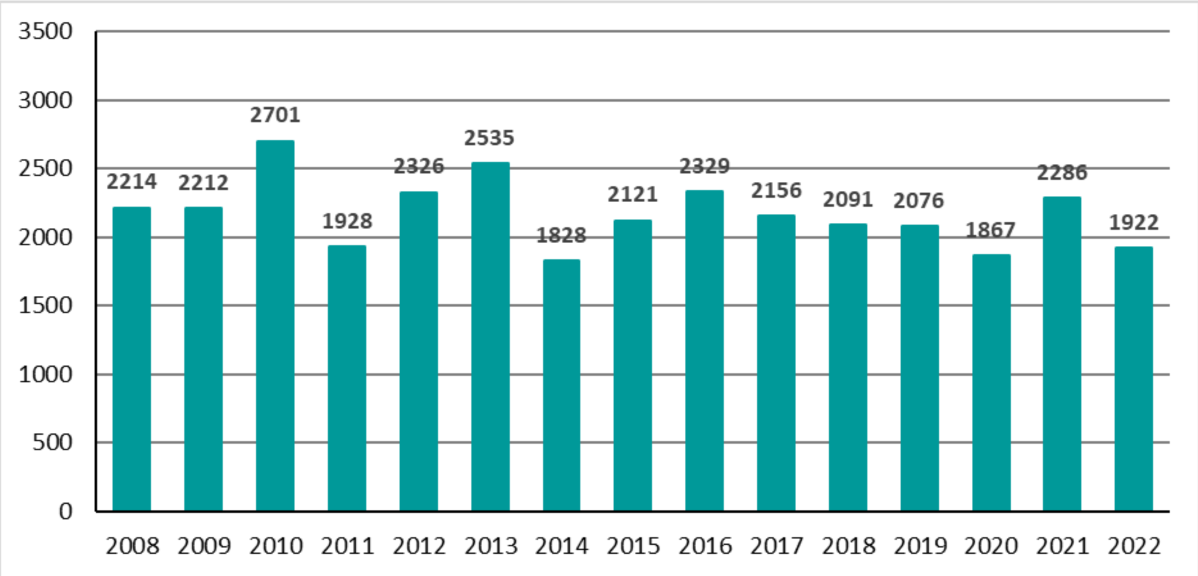

FIGURE 16: DEGREE DAYS (CALENDAR YEAR)

Annual volumes for the Belgian market

In 2014, the year with the lowest total degree days 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 of a colder winter period. The total consumption was stable in 2020 and 2021, but the low amount of stored gas reserves in Europe caused a rise in gas prices at the end of the year. In 2022 the annual consumption had a sharp decline because of the start of the war in Ukraine which had a strong amplifying effect on the gas prices and on the consumption behaviour of end consumers (domestic and industrial).

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[3] 1991 to 2020, Synergrid benchmark (calendar year)

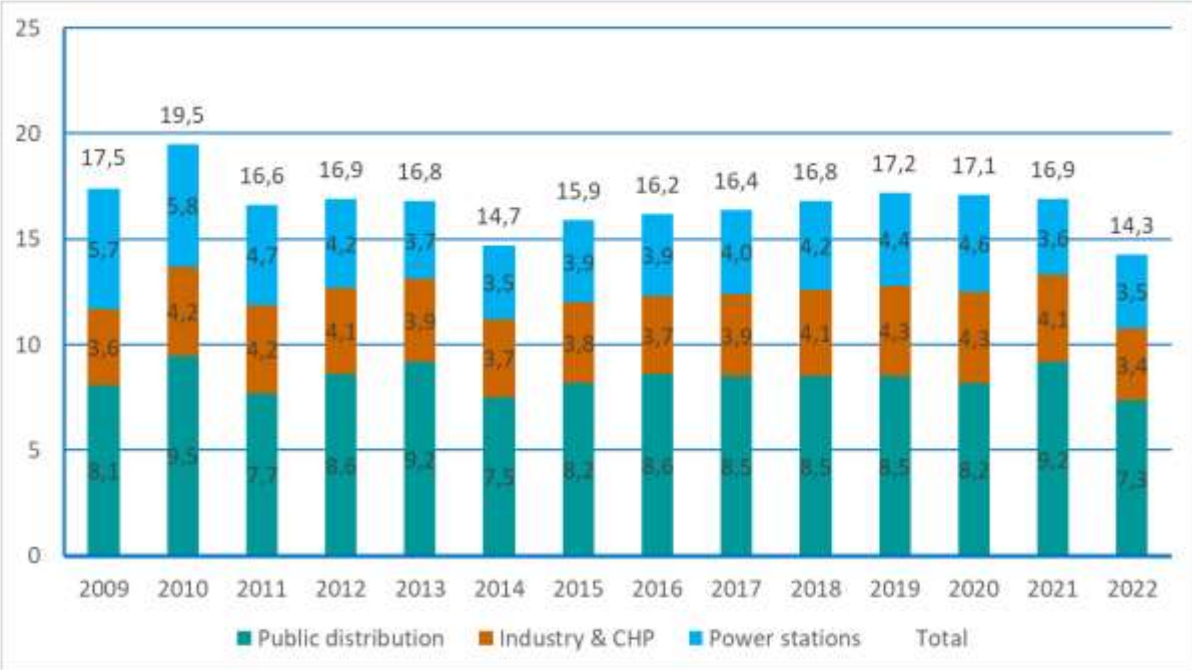

FIGURE 17: CHANGES IN GAS CONSUMPTION IN BELGIUM (IN BCM/YEAR)

Public Distribution

Consumption of the public distribution is strongly dependant on the temperatures during the year. As earlier stated, 2014 was the year with the lowest amount of degree days, which has resulted in a lower annual consumption. 2010 and 2013 had cold winters and the same can be stated for 2021 that had a cold winter period in February of 2021. In 2022 the impact of the rising gas prices combined with calls from authorities to reduce consumption with at least 15% resulted in a sharp decline in annual consumption.

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 because of new connections. 2021 shows a slight decline following the rising gas prices in the last quarter of the year and a sharp decline in 2022 when gas prices exponentially increased.

Power stations

The offtake of power stations depends on a wide range of parameters. The amount of renewables, accounting for a rising and remarkable share of the generation mix, will certainly have an impact. Moreover, the offtake pattern of power stations can 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. Other important parameters are the availability (or not) of nuclear power stations, the demand of neighboring countries and the energy prices.

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.

Public distribution

Method

Consumption peaks are partly linked to the severity of winter weather and must therefore be analysed considering 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 2021/2022

The winter period from November 2021 up to and including February 2022 was fairly mild, with 1.292 degree days (a benchmark winter[5] has 1.400 degree days) and is comparable with winter 2020-2021. Wednesday, 22 December 2021 was the coldest day, with an equivalent temperature of --0.1 °C recorded in Uccle.

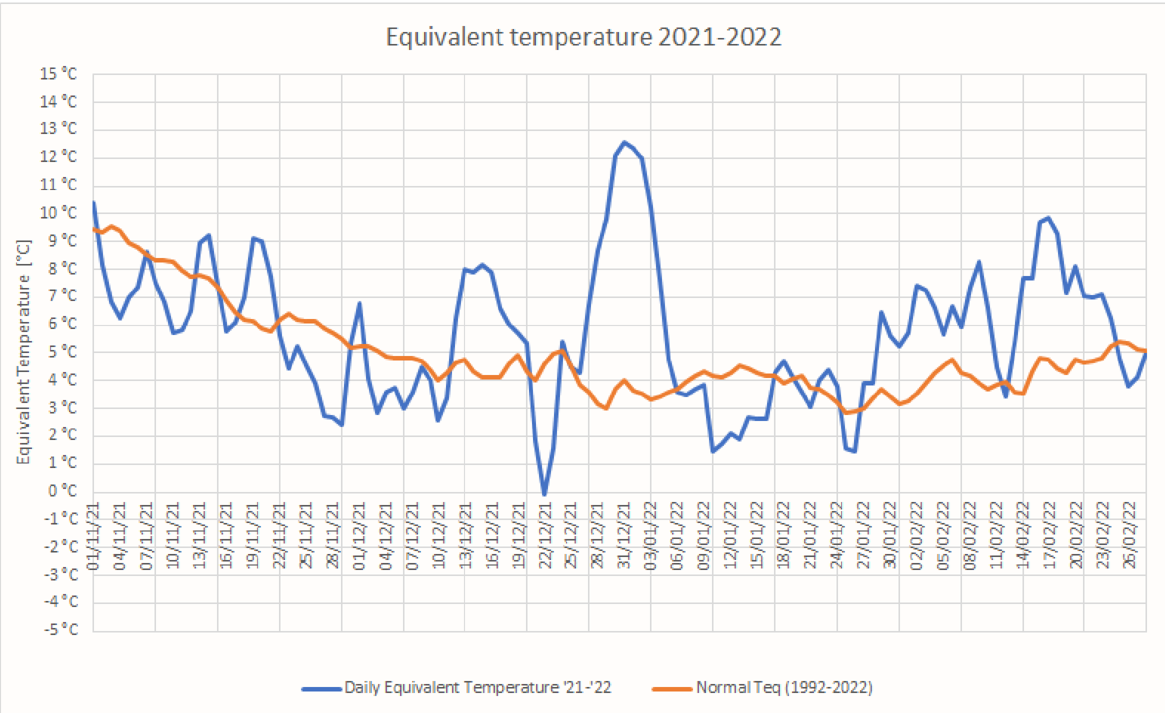

FIGURE 18: TEMPERATURE PROFILE FOR WINTER 2021/2022

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[4] The concept of 'equivalent temperature' was introduced to take into account 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] 1991 to 2020 (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.

Power stations, CHP units and industrial customers

Method

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.

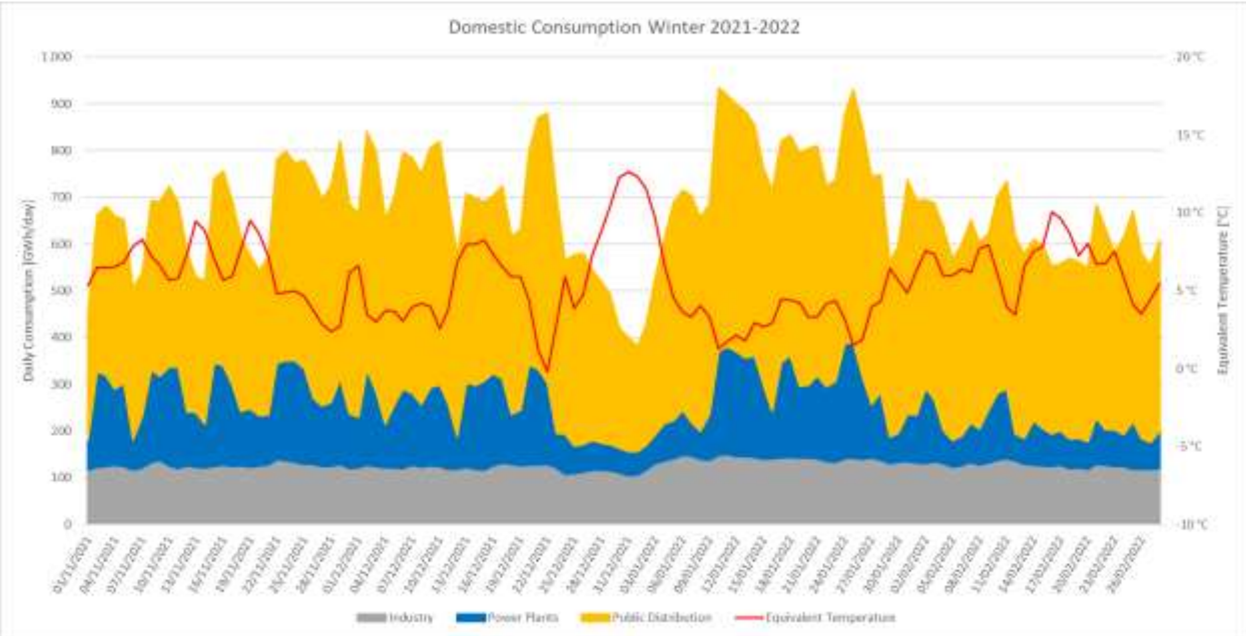

FIGURE 19: DOMESTIC CONSUMPTION IN WINTER 2021/2022

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. Measures to reduce natural gas demand are even reinforced due to the Ukrainian crisis. Moreover, the increasing energy prices have resulted in an important decline of the consumption of natural gas.

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[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.

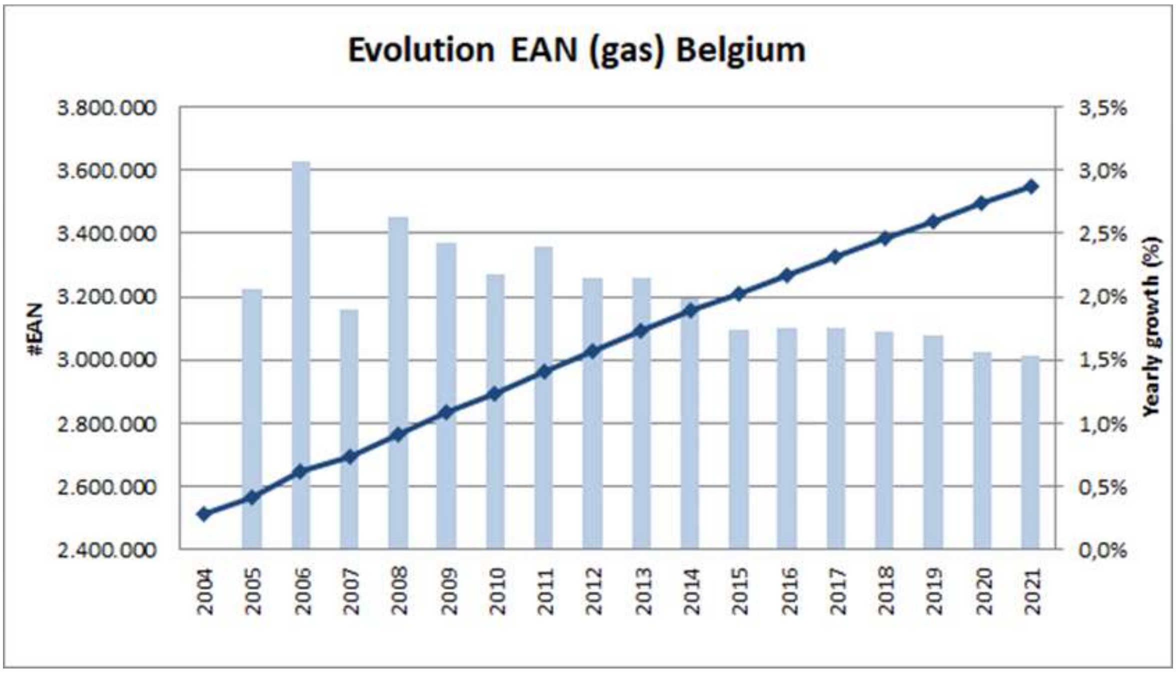

FIGURE 20: INCREASE IN THE NUMBER OF EAN ACCESS POINTS (SOURCE: SYNERGRID)

Due to the combination of these erosion factors and the change in the potential number of new connections to the public distribution network, a decline of the natural gas consumption is plausible, although local growth in some areas is not excluded.

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 several industrial customers wind down their production operations in Belgium, new industrial projects are also launched. Only limited investment is required to create local connections. Overall, 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 (partly) shutdown of Belgium's nuclear generation facilities during the coming years is enshrined in law. As a result, an important amount 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, including the replacement of 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 several sites, preferably close to the backbone of the high-pressure transmission system.

More specifically, the Capacity Renumeration Mechanism (CRM) launched by the government will result in the construction of two additional CCGT generation facilities for a capacity of 1,7 GW by 2025.

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 several 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 gas 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.*[7]*, reduces NO_x by 70% and CO_2 by 20%*

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).

With the rise in biomethane production, bio-CNG & bio-LNG become attractive fuels to decarbonate transport. Bio-LNG can be loaded at the Zeebrugge LNG Terminal.

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.

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

[8] This trading point will disappear shortly

- 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 could be traded via the Fluxys Belgium network at the Belgian gas trading point, which until 30/9/2023 was divided into two services:

- ZTP-P (Zeebrugge Trading Point – Physical Trading Services)[8]
- ZTP-N (Zeebrugge Trading Point - Notional Trading Services), which encompasses ZTP (for the H-gas network) and ZTPL (for the L-gas network)

With the aim of simplifying Belgian commercial model, both services were merged on 1/10/2023 into a single ZTP notional service.

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**:
    -
    - Zee Platform is a Shorthaul service for transporting unlimited quantities of natural gas between two or more interconnection points in the Zeebrugge area (IZT, ZPT, ZEE, ZEE LNG terminal).

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

[8] This trading point will disappear shortly

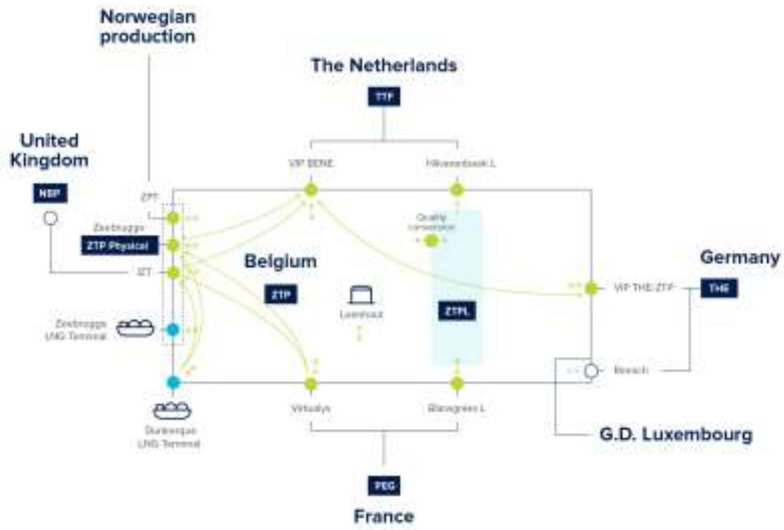

FIGURE 21: FLUXYS BELGIUM INTERCONNECTION POINTS (SITUATION 01/01/2023)

Overview of annual allocations at border points (grouped by country)

The overview in this section covers the period up to and including 2022.

The figure below provides an overview of the average volumes (allocations) imported and exported in 2018-2022.

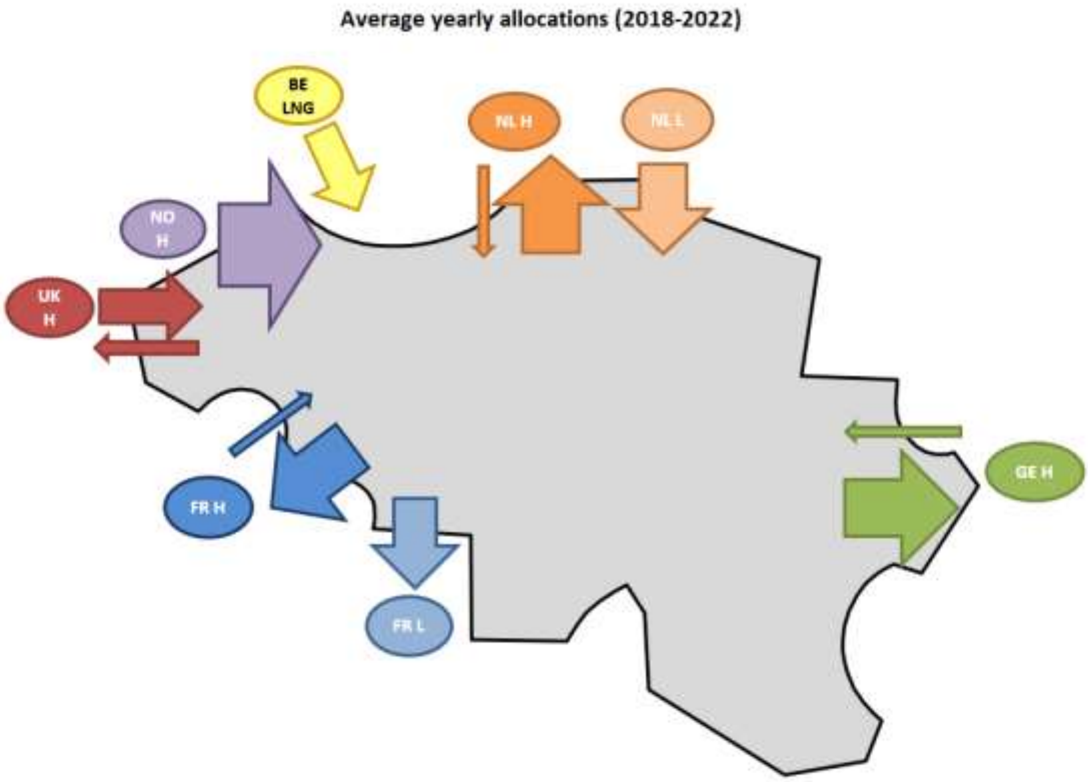

FIGURE 22: ALLOCATIONS AT BORDER POINTS, 2018-2022

Natural gas imports

The total annual average volume of gas entering the Fluxys Belgium network amounts to approximately 400 TWh per year (2018-2021), peaking to 600 TWh in 2022.

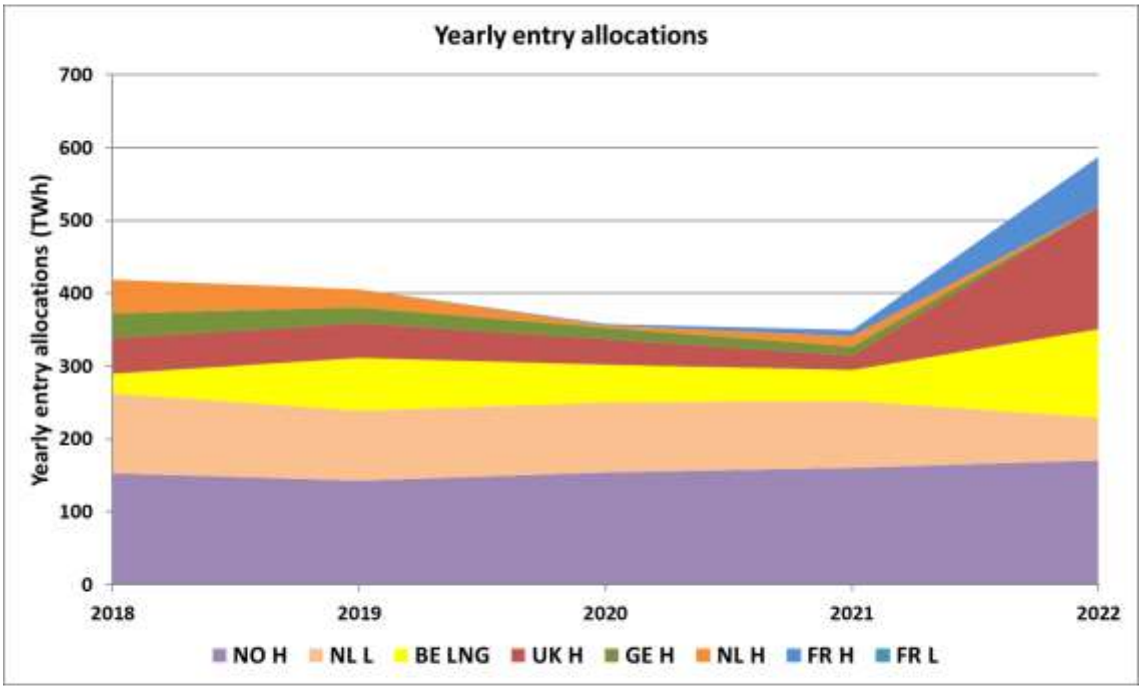

FIGURE 23: ANNUAL ENTRY ALLOCATIONS

The Norwegian gas pipe is the main entry route, coming into Belgium through the Zeepipe (around 150 TWh). H-gas supplies from the Netherlands have been falling since 2017, with significantly lower volumes being supplied since 2019. L-gas from the Netherlands, entering the country via the Hilvarenbeek entry point, is declining due to the L-H conversion process.

Volumes from the UK fluctuate usually between approx. 25 and 50 TWh per year but increased sharply in 2022 to satisfy the high requirement of natural gas for continental Europe due to the reduced supply of Russian gas. The increase of LNG volumes and – to a lower extend – of supply from France can be explained in the same context.

The volumes imported from Germany before 2021 were relatively low. It is worth noting that virtually all imports came from the (former) Gaspool market area. It is not surprising that the supply from Germany has disappeared in 2022.

Natural gas exports

The total annual average volume of gas (L- and H-gas) transported to neighbouring markets was approximately 200 TWh in 2018-2021, with a downward trend since 2018. In 2022 a significant peak of more than 400 TWh has been realised.

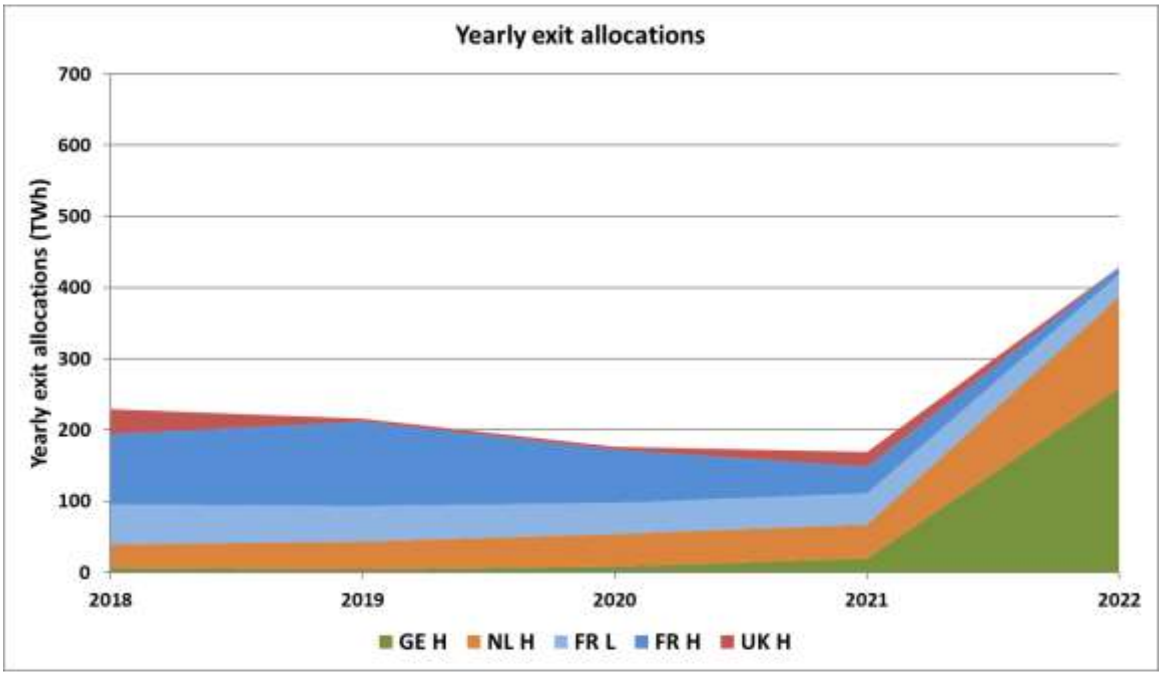

FIGURE 24: ANNUAL EXIT ALLOCATIONS

Until 2021, between 50% and 85% of this volume was intended for the French market. The share of L-gas was fairly stable (approx. 50 TWh), whereas the transmission of H-gas was 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 and – to a lower extend – to the Netherlands have been sharply increasing in 2022, due to the war in Ukraine and the significant reduction of supply of Russian gas.

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 (2018-2022). Until 2021, an average of around 40-50 GWh/h of gas is injected into the Fluxys Belgium network, with peaks of over 80 GWh/h. During 2022, the total amount of injected gas has significantly increased, although the peak value did not exceed the maximum amount of 2018-2021.

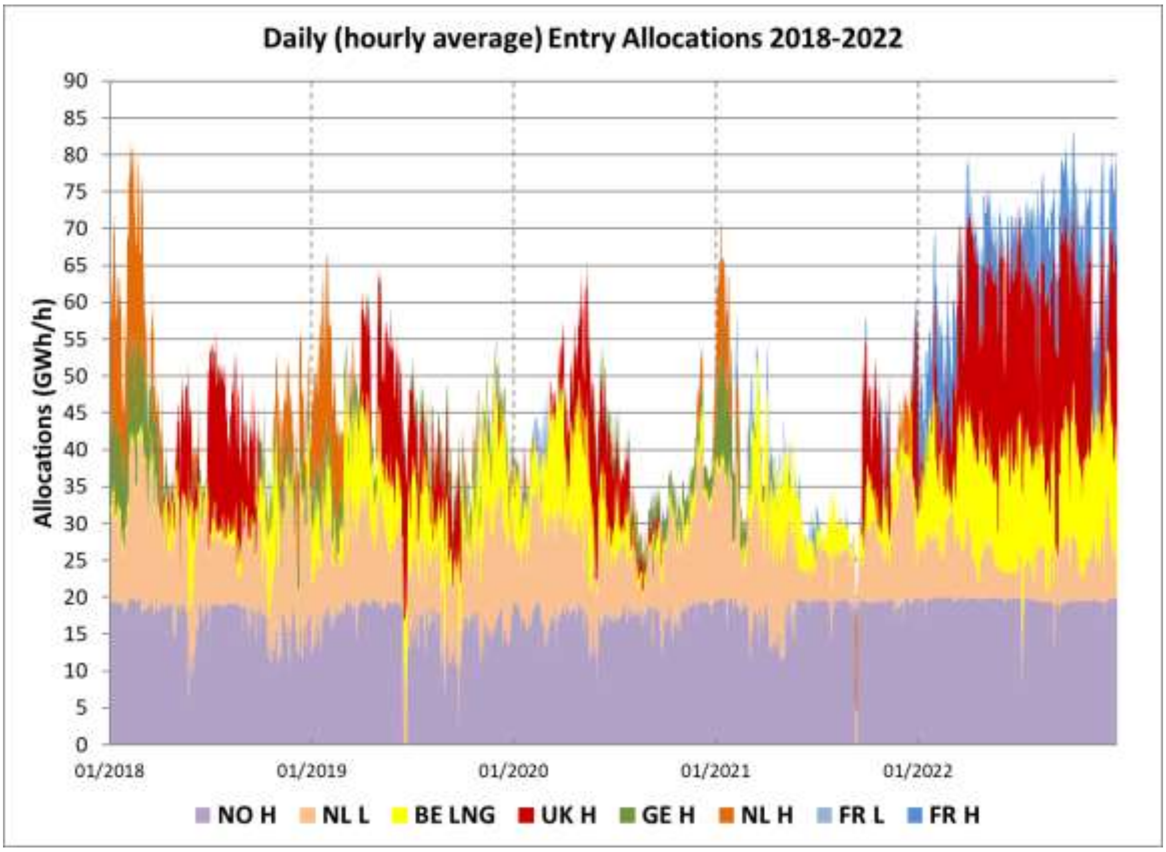

FIGURE 25: DAILY ENTRY ALLOCATIONS, 2018-2022

The graph[9] below provides details of the use of injected capacity in 2018-2022.

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

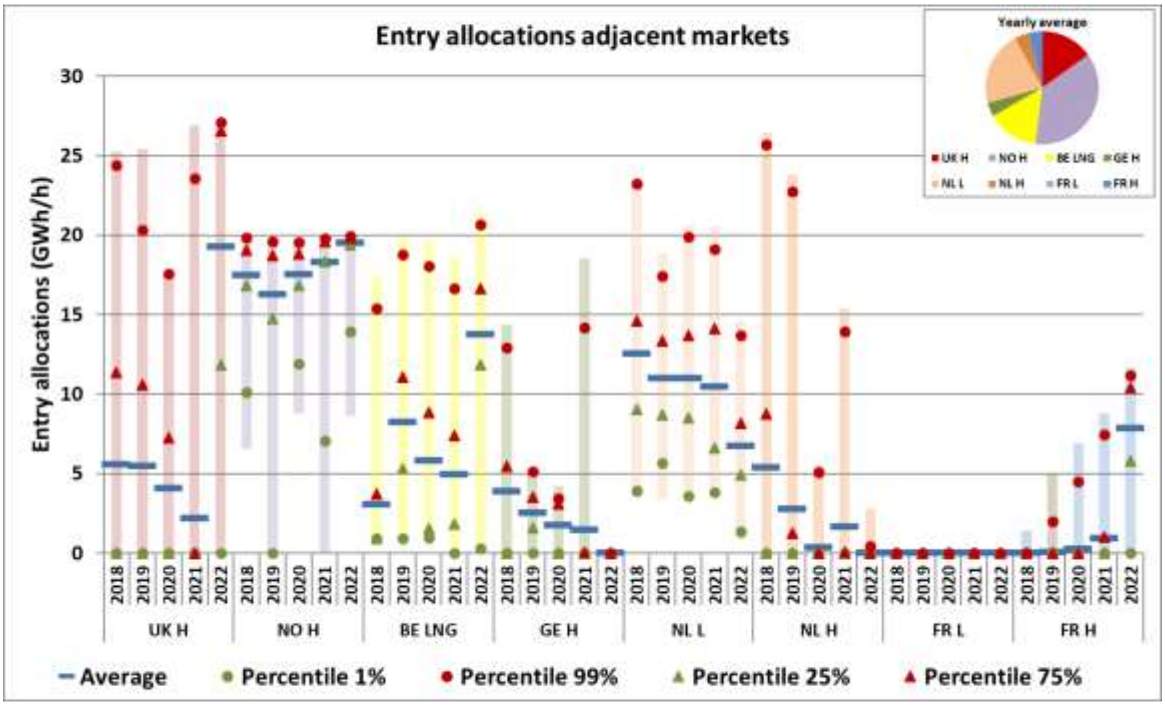

FIGURE 26: ENTRY ALLOCATIONS, NEIGHBOURING MARKETS

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 generally lower and/or more variable (except for 2022, with high average volumes from UK, LNG and France).

The total import capacity of the H-gas network is sufficient to compensate for an increase in the domestic market (e.g., because of the L/H conversion and the planned new power plants).

Natural gas exports

The following graph shows the change in daily flows simultaneously exiting various border points on the Fluxys Belgium network (2018-2022).

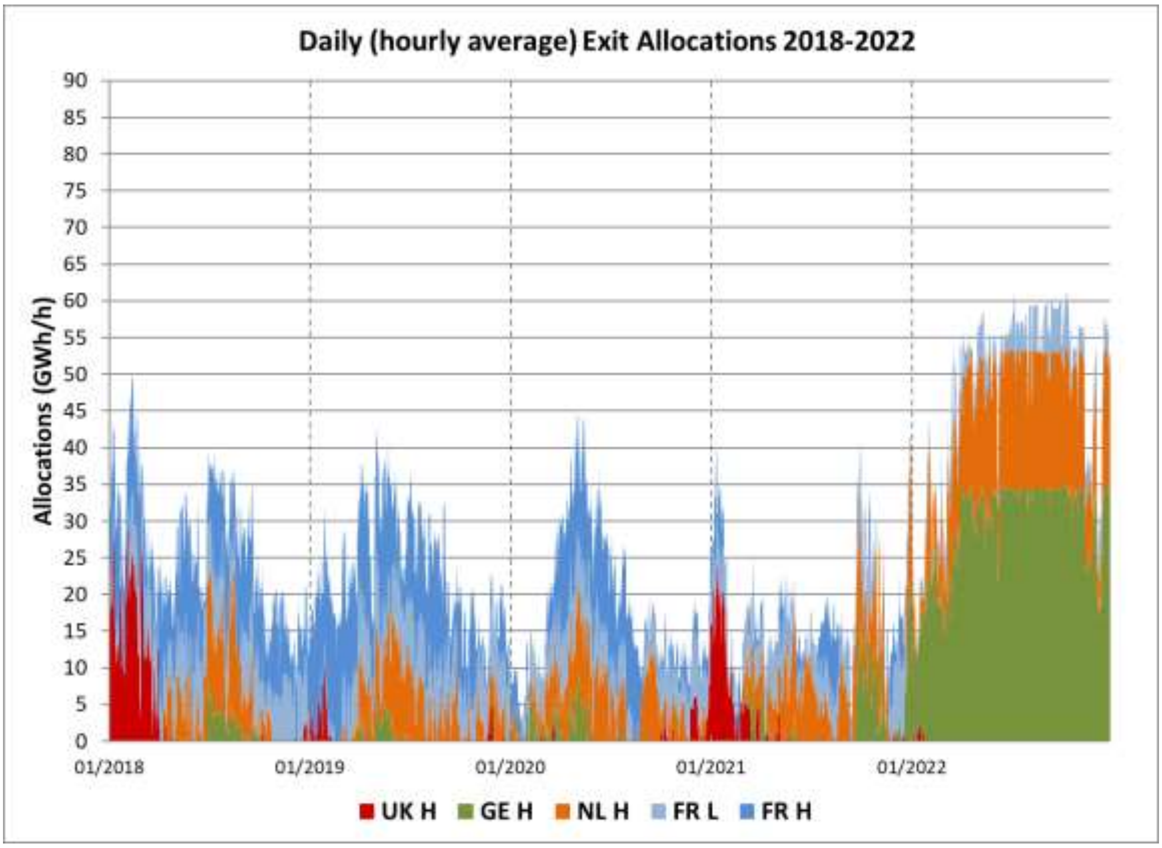

FIGURE 27: DAILY EXIT ALLOCATIONS

Until 2021, the average daily flows simultaneously exiting the Fluxys Belgium network amount to 20-30 GWh/h. There were substantial transit flows towards the UK in winter 2017-2018 and 2020-2021. In 2022 new peak flows, up to 65 GWh/h, have been reached. 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 2018-2022.

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

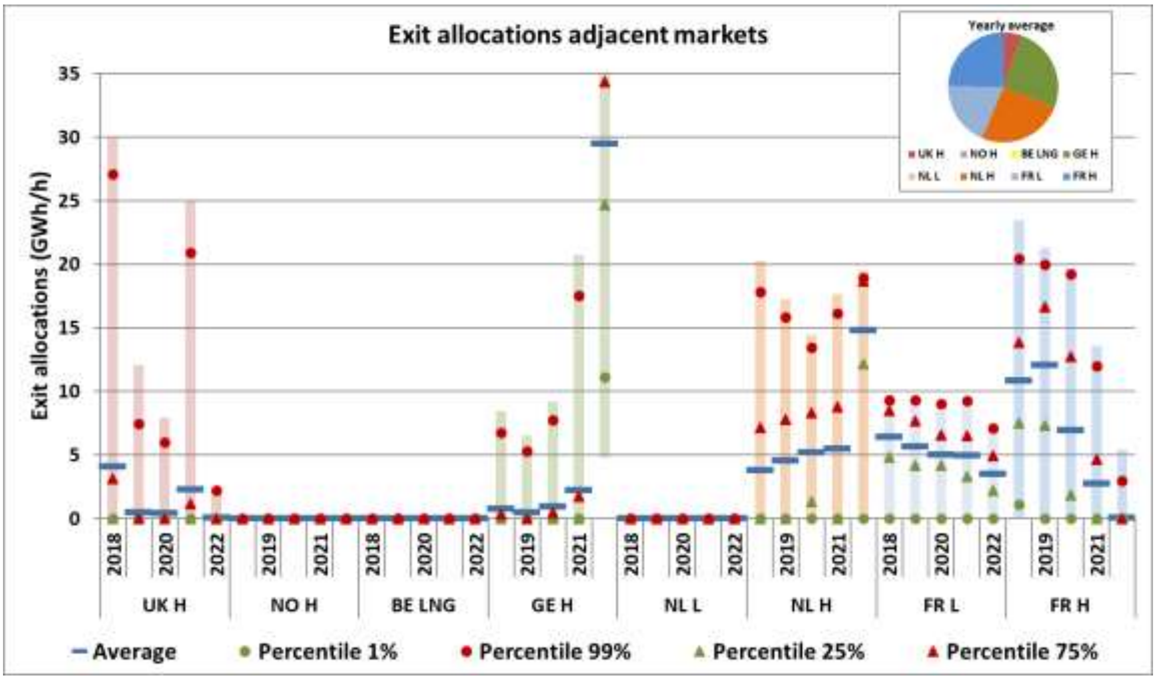

FIGURE 28: EXIT ALLOCATIONS, NEIGHBOURING MARKETS

Until 2021, the highest average daily flow was transported to the French market (H- and L-gas). The French market also had the average closest to peak consumption (higher load factor). In 2022, the flows to Germany and the Netherlands significantly increased, while the transport to France sharply decreased, certainly for the H-gas market.

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 a statistical analysis of past consumption, internal analyses of future demand, various (inter)national reports 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). An alternative consumption range is shown for remaining high energy prices, with a decrease of the demand in the public distribution and the industry sectors (except for power plants) of 15%.

The increase in 2025 is expected based on the growth of natural gas consumption for electricity generation. This is expected to subsequently experience a decline, the scale of which depends on the scenario under consideration.

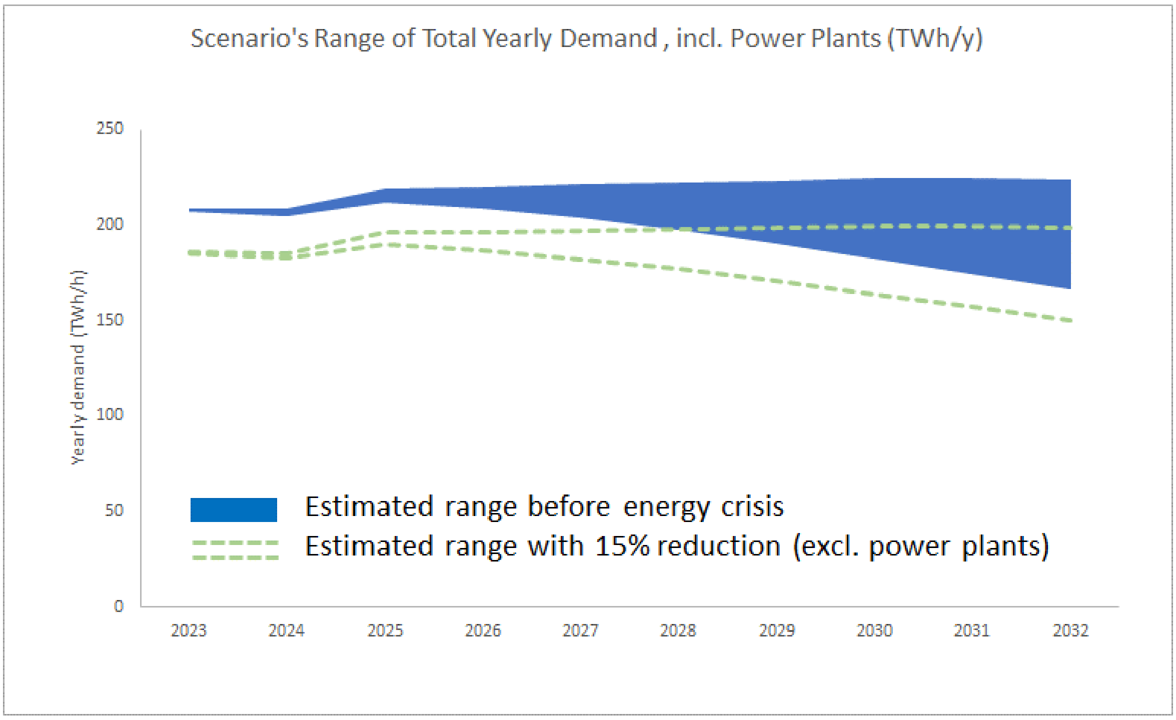

FIGURE 29: PROJECTION OF ANNUAL NATURAL GAS CONSUMPTION (H- AND L-GAS)

Simulations, taking into account new power plants to be built by 2025, indicate that 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.

Nevertheless, if we consider a structural west-east flow pattern (entry exclusively from the Zeebrugge zone), the current main west-east axis needs to be reinforced to give some flexibility and eventually allow exports to Germany, the Netherlands and France.

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 the integrated report of 2021 'GRTGaz, in motion',[11] GRTgaz predicts a decrease of the gas consumption in FR. By 2030 gas consumption will drop with 17% under the combined effect of energy efficiency measures and transfers to other energies.,

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.

Transmission to the UK

National Grid's Gas Ten Year Statement 2022[12] describes four possible gas-demand scenarios ranging from a slow decrease 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. As indicated in the Winter Outlook 2022-2023[13], gas from national production and Norway continue to be the main source of supply to GB, with LNG, GB storage, and the European interconnectors providing flexible supplies to meet total demand. 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.

Transmission to Germany

Germany's Network Development Plan 2022-2032 has been postponed due to the current geopolitical situation. The BNetzA has asked the TSOs to calculate (LNG) variants, especially with a view to replacing Russian natural gas volumes.

On the Belgian-German border in Eynatten, record volumes to Germany have been measured since the beginning of the Ukrainian war due to the decreasing flow from Russia. For the coming years remaining high flows are expected as long as the Russian supply to Germany is not restored, even considering the LNG facilities planned in Germany. Investments on the VTN pipeline in Belgium could even increase the transported volumes.

Transmission to the Netherlands

In its published investment plan 2022-2032[14] , GTS sets out three scenarios showing falling gas demand. The capacity of the Groningen and other small fields is also set to fall substantially in the next few years. Together with an increasing transit from the Netherlands to Germany, additional exports to the Netherlands can be expected.

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[11] https://www.grtgaz.com/sites/default/files/2022-05/GRTgaz-integrated-report.pdf

[12] https://www.nationalgrid.com/gas-transmission/document/141321/download

[13] https://www.nationalgrid.com/gas-transmission/document/140921/download

[14]https://www.gasunietransportservices.nl/en/gasmarket/investment-plan/investment-plan-2022

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 soon.

LNG imports

It is clear that LNG will play a key role in the security of supply for the European countries. With the war in Ukraine, a sharp increase in imports of liquified natural gas (LNG), particularly from the US has been observed. Fluxys' LNG terminal in Zeebrugge already has a capacity of 22 GWh/h and an extension, with a view to accommodating greater volumes of LNG, is foreseen for the coming years.

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, certainly since the start of the Ukrainian war. 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. As indicated in the Winter Outlook 2022-2023[15], we have seen record levels of interconnector exports to continental Europe over recent months. The rise in exports of gas from GB to Europe is largely due to the impact of reduced gas flows from Russia, combined with Europe's target to have storage stocks at 90% of their full capacity by November 1st. The future usage rate is hard to predict, but the inter-market balancing function is expected to retain its importance and peak use is expected to continue.

Imports from Germany

The import capacity from Germany will remain at the same level, although important volumes are not expected if the Russian supply to Germany remains very low.

Imports from the Netherlands

L-gas imports will gradually decline because of the L/H conversion, which should be finalised at the end of 2024 in Belgium. Nevertheless, transit of L-gas will continue until the L-H conversion is finished in France.

H-gas imports are highly dependent on market forces, but a fall in annual volumes can be expected.

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[15] https://www.nationalgrid.com/gas-transmission/document/140921/download

L/H conversion

Introduction

Exports of L-gas from the Netherlands to Belgium, France and Germany will cease by 2030. To guarantee security of supply, Belgium, France, and Germany decided to convert the L-gas market to H-gas. Two reasons for that: there is sufficient H-gas available and existing L-gas transmission infrastructure can be used for H-gas or repurposed for new usages.

It should be noted that the Dutch government has decided to close production at the Groningen site as soon as possible to alleviate the earthquakes experienced in the region. Despite the Ukrainian war production for the gas year 2022-2023 is intended to be reduced at 2,8 bcm. The Dutch authorities are still evaluating whether the production in Groningen is still necessary from winter-2023-2024 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 depends on the evolution of the geopolitical situation and is at the time being scheduled for gasyear 2023-2024, latest GY 2024-2025.

At the request of the Belgian authorities, Synergrid has devised an indicative conversion schedule.[16] 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.

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. This schedule was confirmed by the Synergrid Board of Directors in December 2021 and therefore forms the basis for the system operators' work until the total fade out from the Belgian domestic market.

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

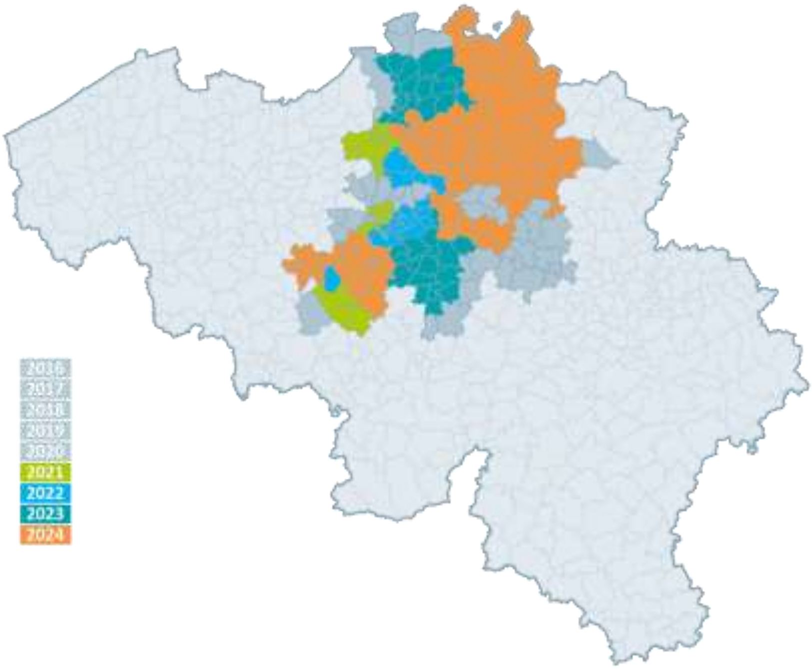

FIGURE 30: INDICATIVE SCHEDULE FOR THE L/H CONVERSION BY MUNICIPALITY (SOURCE: SYNERGRID)

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

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, to selectively supply H-gas to DSOs and industrial customers.

In some parts of the network some modifications are being made, especially at connections between the major L-gas and H-gas transmission routes which are operated at different pressure levels (such as the connection between the RTR[17] and the Dorsales[18]).

However, maintaining transmission capacity to the non-converted L-gas market is a significant constraint, especially regarding 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 2029 when the conversion of the French market is completed.

As such, the Belgian market can only be converted by gradually supplying H-gas to the second Dorsale, primarily from an 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 is

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[17] Major H-gas transmission pipeline between Zeebrugge and the German border.

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

implemented from south to north, gradually pushing back L-gas to the entry point at Hilvarenbeek/Poppel.

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.

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.

South of the Zeebrugge-Eynatten pipeline

Adjustments have been 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 and part of its periphery has already been achieved in 2022. All other regions south of the Zeebrugge-Eynatten pipeline and supplied by the Dorsales will be converted by June 2024.

Next steps

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 autumn 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). In the North both blending sites at Lillo and Loenhout will be repurposed as a regular pressure reducing station in order to be able to flow in winter time H-gas from the Loenhout storage facility towards the Antwerp and Brussels regions.

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 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. Higher future flows from West to East were already strongly related to the replacement of L-gas in France and Germany or the Netherlands. In the current geopolitical situation very high future flow rates are expected towards the German market, so these assessments have been reviewed concluding that despite disposing of enough Entry capacity, transmission capacity from West to East has to be increased, mainly to debottleneck the entry zone of Zeebrugge. This involves completion of the second RTR pipeline between Desteldonk and Opwijk in a first phase, that is currently scheduled to be commissioned by the end of 2023.

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.

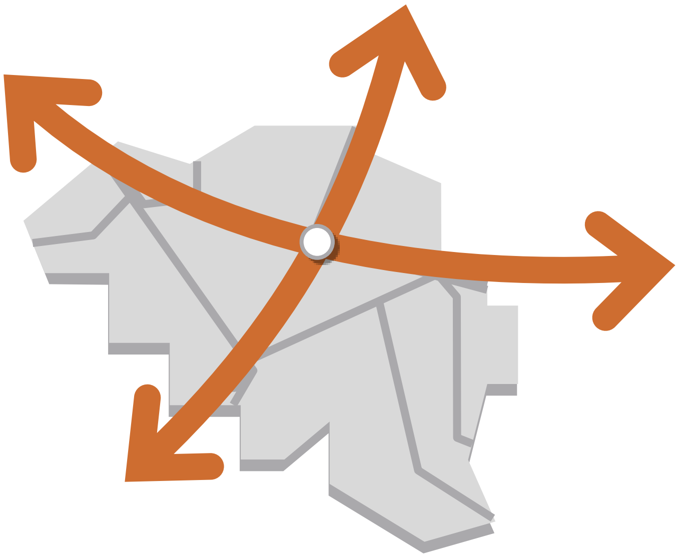

FIGURE 31: POTENTIAL CONTRIBUTION OF THE FLUXYS BELGIUM NETWORK TO THE H-GAS SUPPLY IN EUROPE (SOURCE: FLUXYS BELGIUM)

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 have been implemented since 2020.
- The adjustment of certain pressure-reducing stations to ensure optimal operation of the H-gas market after the conversion, i.e., both Lillo and Loenhout H2L conversion sites.
- 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 have also been implied.

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

Considering 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 10.2 GWh/h as of 2026.

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

FIGURE 32: ZEEBRUGGE LNG TERMINAL

Moreover, considering 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 reminding 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 the Green Gas Platform (a joined initiative between Gas.be, Valbiom & Biogas-e) has shown that realistically, biomethane could generate 15.6 TWh[19] by 2030, equivalent to around 8% of Belgium's natural gas consumption in 2019. A new study has been launched by Gas.be to evaluate the additional potential offered when including other production techniques than anaerobic digestion like pyro-gasification. Results are expected in 4/2024.

FIGURE 33: 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.

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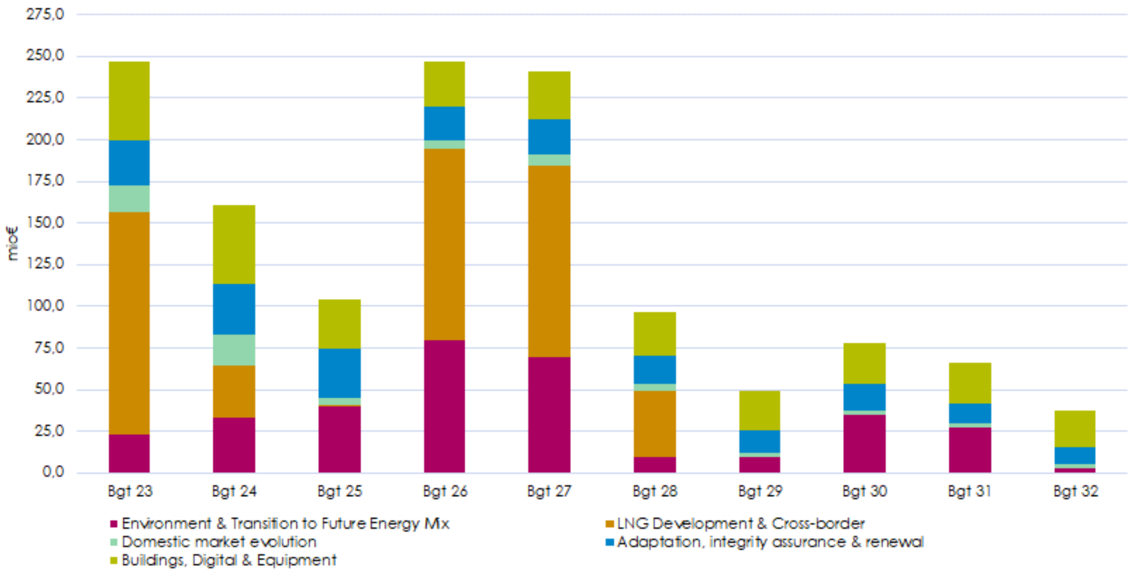
[19] 'Quelle place pour le biométhane injectable en Belgique' study conducted by the non-profit Valbiom at the request of Gas.be into the potential of injectable biomethane in Belgium: https://www.gas.be/sites/default/files/pdf/laybrochPotentielBiomethaneFRv10BAT.pdf (in French)

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 2023, 7 facilities are injecting biomethane in the distribution networks.

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. The first to inject in Fluxys Belgium transport grid will be Green Logix in Lommel end of 2024.

Indicative investments up to 2032

Fluxys Belgium and Fluxys LNG plan to make investments totalling **€1,327 million[20] over the period 2023-2032.**



Investments will be made in the following five areas:

- **Environment and the transition to the future energy mix**: €329 million
- Adjustments to the network to maintain its integrity and **renewals**: €197 million
- Adjustments to the network to meet the changing needs of **end users**: €65 million
- **LNG initiatives and cross-border projects**: €434 million
- **Miscellaneous** investments [buildings, ICT, etc.]: €302 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, and well-integrated with other gas transmission systems in North-West Europe.

Approved projects account for €243 million, or 18% of the total amount. These are projects scheduled to be rolled out in the near future (2023-2025). For most of the allocated amounts (€922 million), the projects have been identified but no decision has as yet been made. In addition, an annual amount of €162 million has been earmarked for needs that have not yet been precisely defined.

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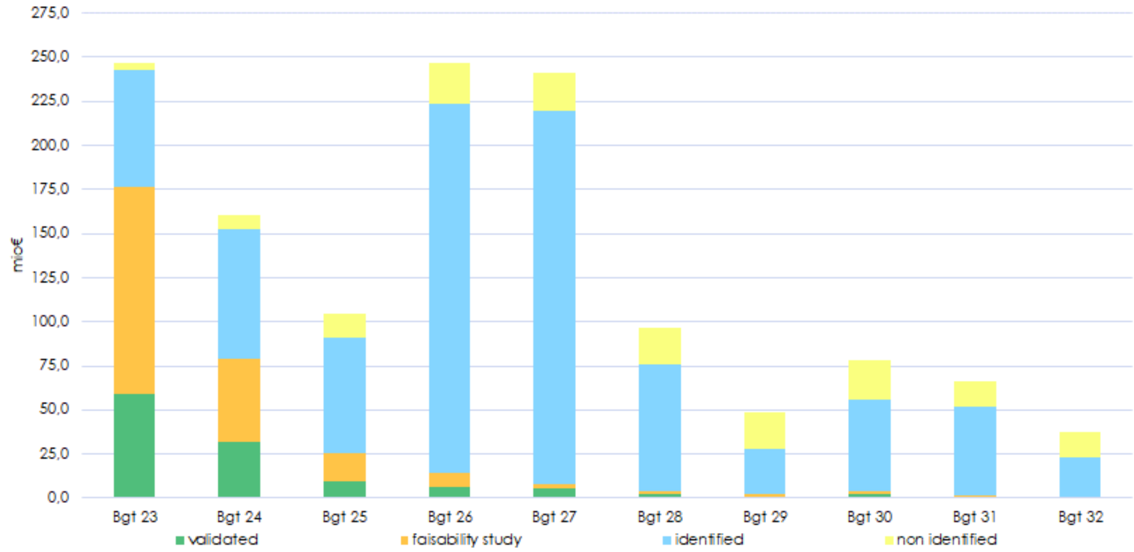
[20] In constant euros



The total value of the investment plan is higher than the previous version of the plan (€726 million for the period 2022-2031).

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

Earmarked amount: €329 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. This includes plans to reduce the emissions at the LNG Terminal in Zeebrugge and in the storage plant of Loenhout.

Adaptation, integrity assurance and renewal

Earmarked amount: €197 million

This investment primarily encompasses the adaptation and adjustment of the infrastructure to ensure the integrity of the network and of the facilities, including the LNG Terminal in Zeebrugge and the storage plant in Loenhout. The amount includes renewal of valves and facilities, LH conversion and restructuring of pipelines.

Changing needs of end users

Earmarked amount: €65 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. This also includes the connection of two new gas-fired power plants to the network.

LNG initiatives and cross-border projects

Earmarked amount: €434 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. It also includes the reinforcement of the pipeline network required due to the change of the flows pattern because of geopolitical situation.

Miscellaneous

Earmarked amount: €302 million

This amount encompasses the investments required 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

Context

European energy and climate policy

The European Union aims to achieve **carbon neutrality by 2050** by means of the **Green Deal**[21] 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**[22] 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**[23] (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

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

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

[23] 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,**[24] the Commission focused on investments to accelerate the energy transition, such as technologies for producing renewable energy and green hydrogen, and sustainable energy infrastructure.

On May 18th, the European Commission presented the plan RepowerEU aiming at reducing before 2030 the dependence on Russian gas. This plan consists of three main axes: diversify the natural gas sourcing, reduce the domestic consumption and accelerate the energy transition.

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.[25] 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.

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[24] NextGenerationEU, European Commission, May 2020

[25] 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[26] (Mt CO_2 excluding LULUCF). Figure 34 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).

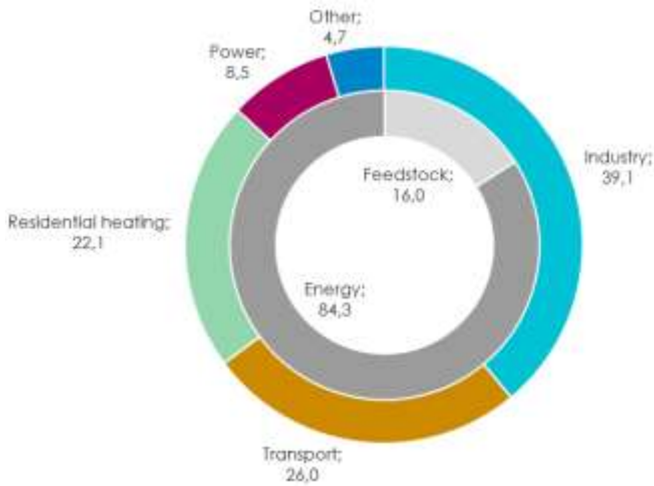

FIGURE 34: CO2 EMISSIONS IN BELGIUM LINKED TO THE USE OF ENERGY AND FEEDSTOCK PER SECTOR IN MT (2018)

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 and OGE 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

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

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 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.

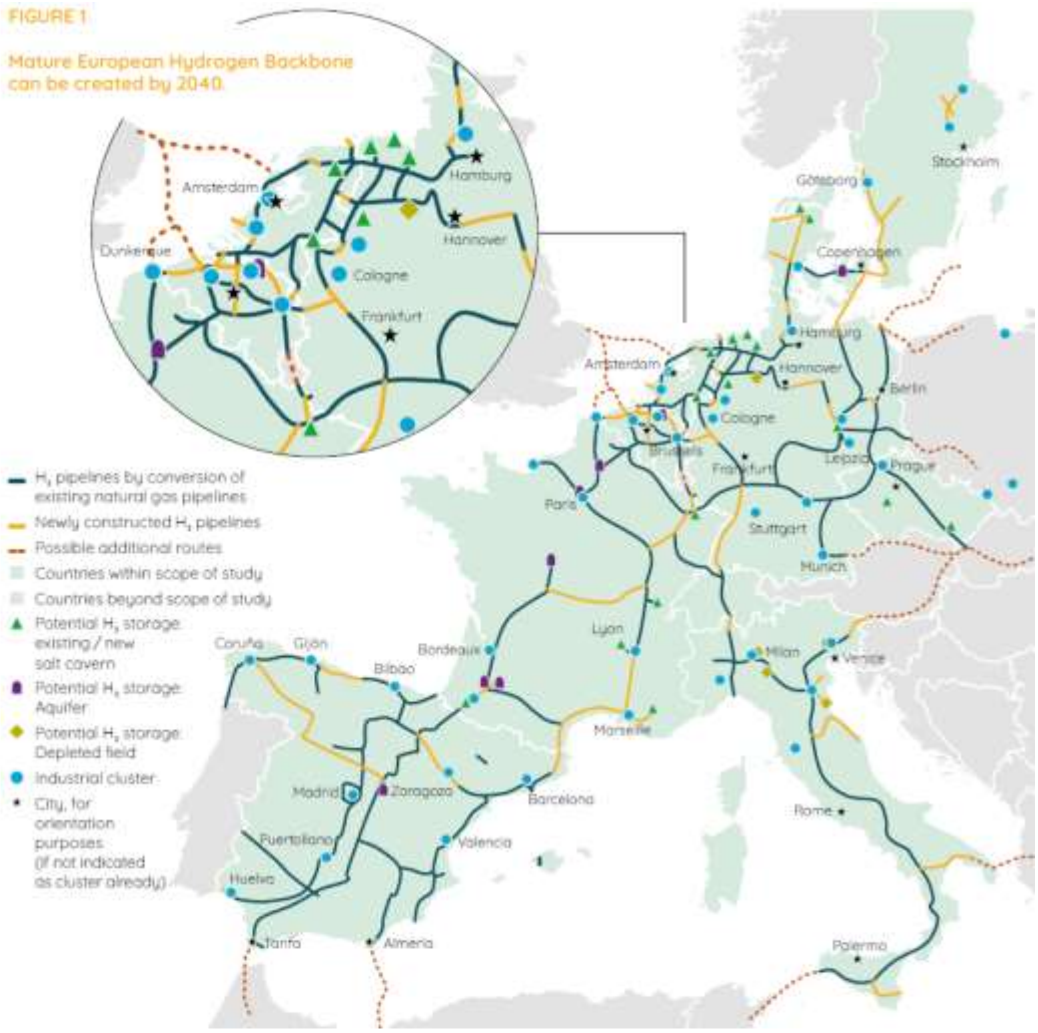

FIGURE 35: EUROPEAN HYDROGEN BACKBONE (SOURCE: GUIDEHOUSE, JULY 2020)

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.

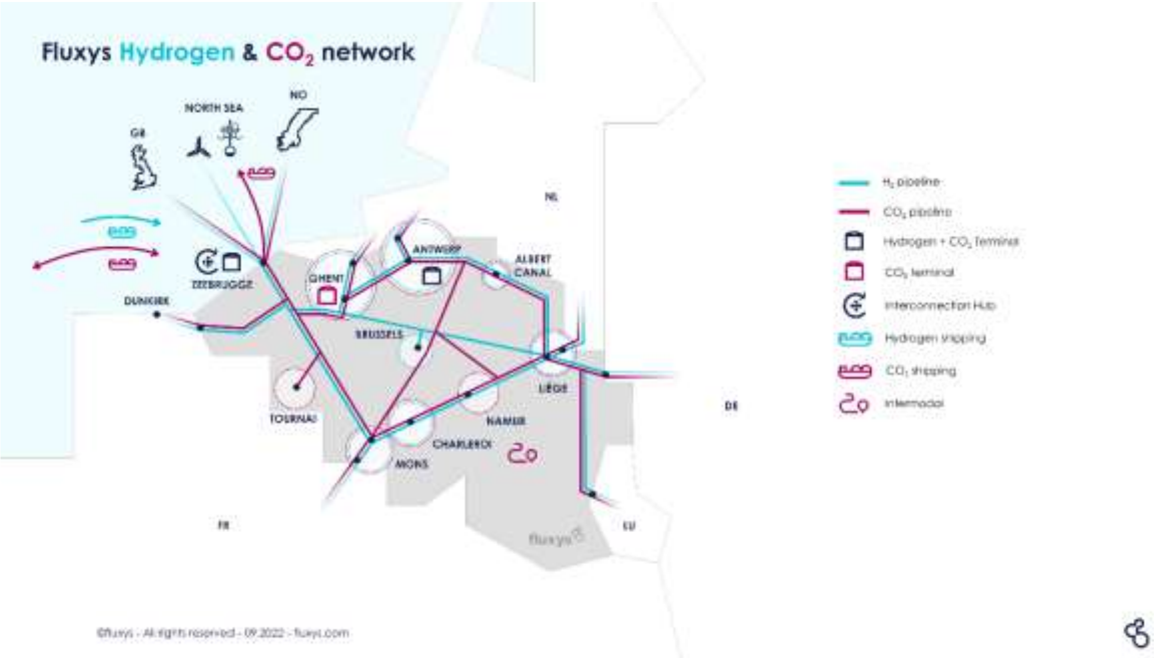

FIGURE 36: LONG-TERM VISION OF THE H2/CO2 BACKBONE

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.

Vision on the hydrogen and carbon dioxid backbones

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

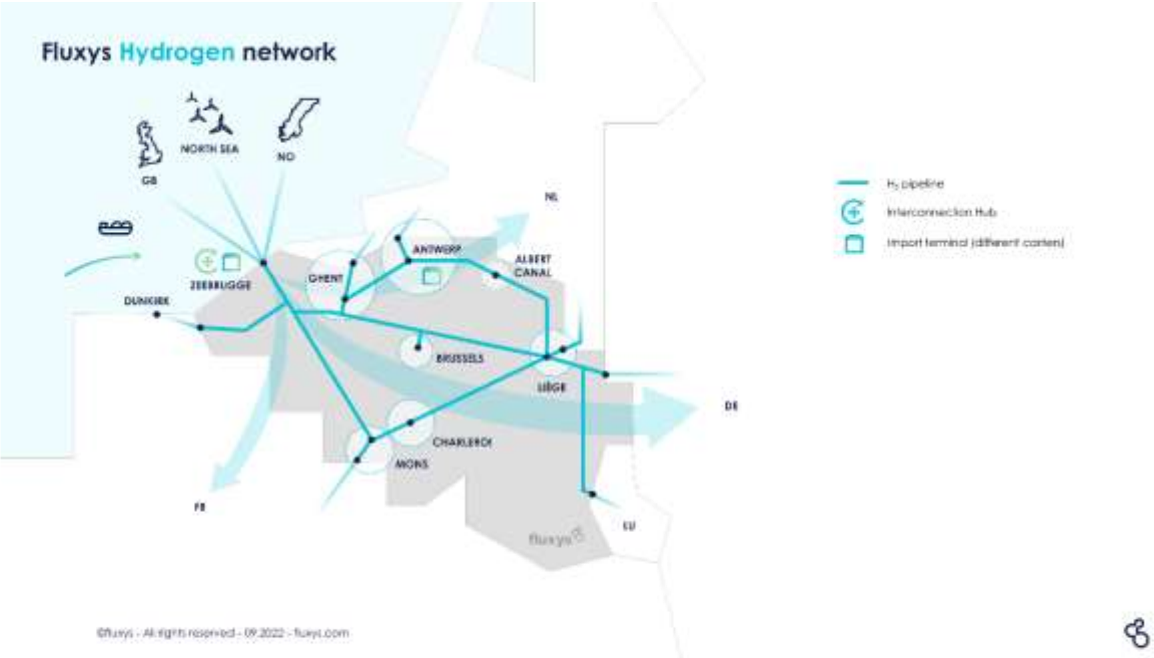

FIGURE 37: VISION FOR THE DEPLOYMENT OF THE H2 BACKBONE

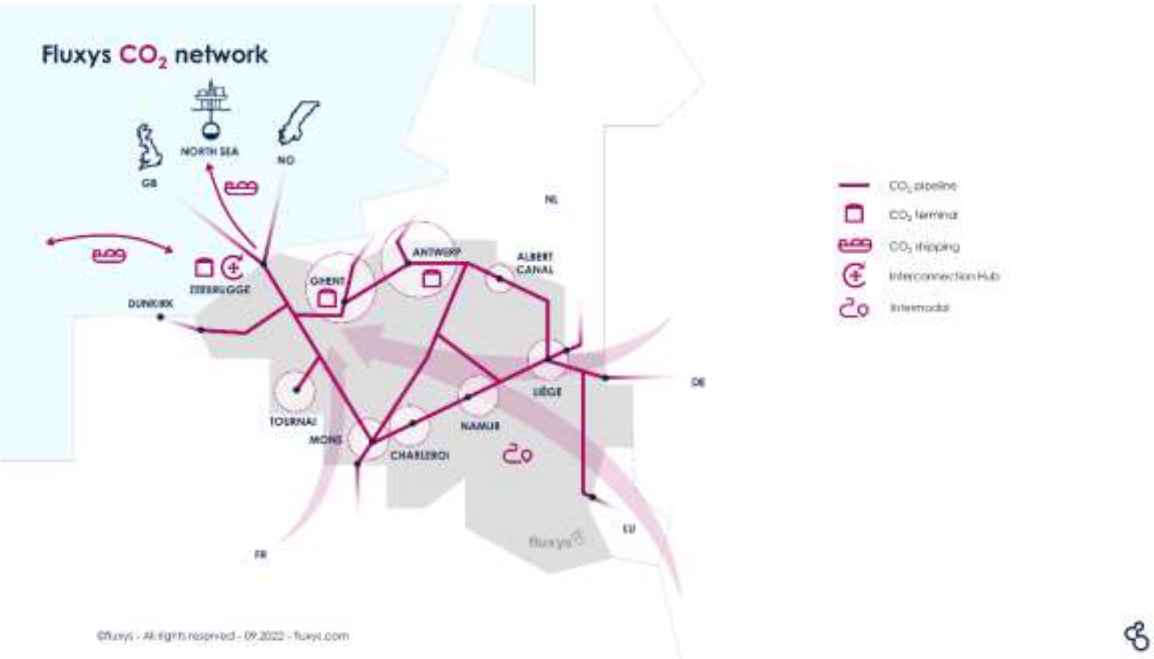

FIGURE 38 : VISION FOR THE DEPLOYMENT OF THE CO2 BACKBONE

Eight H_2 production/consumption and CO_2 emission clusters, six H_2 connection modules between clusters, and eight 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 (see figure 37):

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

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 2032

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 **€676 million (in constant euros) by 2032**.

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 **€861 million (in constant euros) by 2031**.