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Natural gas in national Long-Term Strategies of EU Member States

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Executive summary

National long-term strategies (hereinafter referred to as "**LTS(s)**"), as long-term energy policy documents submitted by EU Member States to the European Commission, give an insight into the envisioned decarbonisation pathways of particular countries. In this report, we look at these pathways through the lens of natural gas and its role in the low-carbon transition. The analysis encompasses 22 of 27 EU Member States (i.e. those which submitted their LTSs to the Commission as of 18 May 2022) and is limited to the natural gas policies outlined in the LTSs only. The developments in national energy policies which occurred after the submission of the LTS have, therefore, not been taken into consideration. Nevertheless, an adjustment of the EU energy policy following the Russian invasion of Ukraine has been addressed to some extent since a preliminary assessment of fitness of the LTSs with the targets set in the REPowerEU Plan has been provided.

Based on the decarbonisation scenarios provided in the LTSs, natural gas consumption pathways in the EU Member States have been determined until 2050. At least 8 EU Member States have envisioned a **temporary switch to natural gas** at the expense of other fossil fuels or nuclear power in any sector of the energy system. In the longer term, however, every EU country may enter the **natural gas phase-down path** (except for 6 states which either did not provide information sufficient to deduce the natural gas consumption trend or whose current share of natural gas in gross inland energy consumption is already negligible, e.g. Sweden). The **natural gas phase-out**, not including essential and negligible natural gas residues in hard-to-abate sectors, is expected to be achieved by at least 8 EU Member States. Overall, the natural gas consumption is to be significantly reduced in the EU by 2050, but exact estimates cannot be provided since the majority of LTSs do not include numerical projections of natural gas consumption.

The national LTSs present a diverse approach to natural gas, which results from many preconditions characteristic of a given country, such as a current and historic dependence on natural gas and other fossil fuels in particular sectors, politics, geography, existing infrastructure, resource availability, etc. However, the uniform nature of the low-carbon transition challenge translated into the development of some patterns in the decarbonisation process of particular sectors. In the **energy sector**, natural gas-fired capacities may replace those fired by coal (e.g. in Czechia) or nuclear power plants (in Belgium). Some already existing natural gas facilities might also act as an operating reserve (e.g. in Portugal in the transition period) or even still be fully operational in 2050 and beyond (e.g. in Italy, with CCS applied). In the **industrial sector**, natural gas is commonly perceived as an alternative to coal in high-temperature processes which cannot be electrified. When it comes to **transport**, EU Member States agree that CNG and LNG are only to be temporarily consumed as transition fuels. As for **residential & tertiary**, natural gas already holds a substantial share in total energy consumption in this sector in the EU (i.e. 31% as of 2019[1], which was the highest value among all sectors) and over the coming decades the efforts will be focused on reducing this share (except for Croatia, where natural gas is to remain an important heat source for households). The role of natural gas in **agriculture** has not been covered in the great majority of the LTSs.

The future of natural gas has also been discussed in terms of the potential deployment of alternative fuels which can replace natural gas as low or zero carbon substitutes. In the long term, **electricity** is to prevail in final energy consumption in the EU. This may translate into increased consumption

[1] Eurostat. Complete energy balances.

of natural gas in those countries which aim to use natural gas in electricity generation. Primarily **hydrogen** and then other alternative fuels are to replace natural gas in sectors which are hard to electrify or as an operating reserve. However, hydrogen is not to be derived from natural gas, especially in the long term.

The emergence of alternative fuels, especially the so-called drop-in fuels, enables extending the operationality of natural gas infrastructure even in case of a fossil fuel phase-out. **Blending** natural gas with alternative fuels in the natural gas grid is a quite commonly recognised opportunity (a measure to be adopted by at least 10 EU countries). However, the possibility of switching power and heating plants, filling stations and storage sites to alternative fuels is mentioned only by a few countries and the issue of LNG terminals in terms of alternative fuels imports has not been discussed in the LTSs, although these terminals already operate or their commissioning is due in 18 EU Member States[2] and they could be switched to hydrogen or ammonia imports.[3]

Upon the Russian invasion of Ukraine, which resulted in the reluctance of EU as a whole and individual EU countries to continue importing fossil fuels from Russia, the issue of ensuring security of supply and energy security gained importance, especially in the case of natural gas, since in 2019 38% of natural gas imported to the EU came from Russia.[4] Given the infrastructure constraints, the possibilities of supplier diversification are limited to an increase in LNG imports from other countries. However, the LTSs generally do not address this issue and **rarely do they outline how the security of supply is to be ensured** (both in the case of natural gas and alternative fuels), whereas this is of particular importance for countries already highly dependent on Russian natural gas and considering not to reduce the natural gas consumption over the coming decades (e.g. Czechia under one of the low-carbon transition scenarios). For this reason, the LTSs are poorly consistent with the policy of withdrawal natural gas of Russian origin from the European energy system (such as the REPowerEU Plan).

Based on findings and assessment shared in this report, a set of recommendations for the future updates of long-term strategies has been developed in order to improve the way how the so-called natural gas issue is covered in the LTSs. Since the main takeaway from the analysis of the LTSs is that this issue is described superficially, every state, but in particular top European natural gas consumers, i.e. Germany, Spain and notably the Netherlands (which account for 40% of natural gas consumption in the EU in total), should describe the role of natural gas in the low-carbon transition in more detail. This could be done for example through providing detailed, justified and comprehensive **projections on the share of natural gas in particular sectors until 2050**. The security of supply should be also discussed more broadly and the role of natural gas should be revised in view of the policy of withdrawing Russian natural gas from the energy systems, especially by these EU countries which planned to temporarily switch to natural gas as a transition fuel.

[2] European Commission. (2022). EU-US LNG Trade.
[3] "After an adaptation process, LNG terminals can be ready to import and store hydrogen [and ammonia] in various forms". ENTSOG, Gas Infrastructure Europe and Hydrogen Europe. (2021). How to transport and store hydrogen – facts and figures. p. 12.
[4] Eurostat. Complete energy balances and Imports of natural gas by partner country.

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Abbreviations and units used

Table 1. Abbreviations and units used

CCGT	Combined cycle gas turbine
CCS/CCU	Carbon capture and storage/carbon capture and utilisation
CHP	Combined heat and power
CNG	Compressed natural gas
EU	European Union
FEC	Final energy consumption
GHG	Greenhouse gases
GIC	Gross inland (energy) consumption
ktoe	Kiloton(s) of oil equivalent
LNG	Liquefied natural gas
LTS(s)	National long-term strategy(ies)
Mtoe	Megaton(s) of oil equivalent
NG	Natural gas
PEC	Primary energy consumption
RES	Renewable energy sources

1 Introduction and context

Natural gas is already a very important fuel for the European energy system. As of 2019, this fuel was the second most consumed in the EU after crude oil – it accounted for 23% of gross inland energy consumption[5]. On the path to climate neutrality this share could even increase, as although natural gas is a fossil fuel, its CO_2 emissions are significantly lower compared to crude oil and coal (56.1 tCO_2/TJ compared to 73.3 tCO_2/TJ and 98.3 tCO_2/TJ for crude oil and hard coal, respectively[6]). For this reason, natural gas may be considered as a fuel which would replace other fossil fuels and thus facilitate fast emission reductions in the short term until low and zero carbon alternatives become more feasible. As this report shows, some EU Member States do actually perceive natural gas as a so-called transition fuel allowing to reduce GHG emissions in the sectors reliant on oil and coal.

This is also because natural gas has more advantages. In many sectors (in particular in hard-to-abate industrial branches which require high temperatures), natural gas is an economically viable option in the short term compared to other low-carbon alternatives. Moreover, natural gas infrastructure can be used (or adapted) to blend natural gas with alternative fuels or can be even entirely switched to alternative low and zero carbon gases[7], which is lowering the value of stranded assets and risks regarding carbon lock-in. Moreover, power plants with gas turbines are capable of fast start-up time. Therefore, in view of the deployment of RES, which are intermittent by nature, natural gas-fired power plants could supplement the energy mix in case of bad weather conditions as well as act as an operating reserve, ensuring the overall security of the energy supply. For these reasons natural gas might be a halfway solution to the challenge of achieving climate neutrality since it responds to the technical difficulties of moving away from fossil fuels, especially in the short term.

However, these advantages of natural gas lose relevance given the GHG emissions to which natural gas use is still associated, low domestic availability of this resource in the EU and high volatility of natural gas prices.

When it comes to GHG emissions, they are lower for natural gas compared to oil and coal, but still substantial. Therefore, in order to achieve climate neutrality by 2050, as it is required by the EU, natural gas will have to eventually be phased out, especially in transport, agriculture and residential & tertiary sector, where carbon capture technologies might not be feasible on a large scale. Natural gas-based installations in power and heat generation and in the industrial sector could be operational in 2050 and beyond, but only with CCS/CCU applied, which might be costly.

As far as limited domestic availability of natural gas is concerned, in 2019 the indigenous production of natural gas in the EU satisfied only 16% of gross inland consumption of natural gas.[8] A major part (approx. 90%[9]) of the natural gas consumed in the EU was imported and high reliance on imports implies lower energy security. This disadvantage of natural gas became particularly crucial upon the Russian invasion of Ukraine which met with an immediate response by the EU as whole

[5] Eurostat. Complete energy balances.
[6] IPCC. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Chapter 2. Stationary combustion. p. 16.
[7] ACER. (2021). Transporting Pure Hydrogen by Repurposing Existing Gas Infrastructure: Overview of existing studies and reflections on the conditions for repurposing.
[8] Eurostat. Complete energy balances.
[9] Ibidem. Complete energy balances and Imports of natural gas by partner country.

and individual EU countries – they decided to reduce their dependence on Russian fossil fuels, e.g. through the implementation of the REPowerEU Plan presented by the European Commission. However, in 2019 natural gas imports from Russia accounted for 46% of net natural gas imports to the EU[10], so these decisions have put the energy security of the European Union at risk and have questioned the prospects for the natural gas use in the future. In the meantime, Russia decided to halt natural gas exports to some EU countries which refused to pay in roubles[11].

In addition, natural gas prices have recently proved to be highly negatively affected by crises, such as the one triggered by the COVID-19 pandemic. Although these surges are of temporary nature, they significantly impact the profitability and predictability of the natural gas use.

These developments have provoked a shift in the debate on pathways to climate neutrality in the EU, as the EU countries might no longer rely on natural gas as a low-carbon alternative.

Therefore, given the above-mentioned advantages and disadvantages of natural gas, the question is how do the EU Member States approach the natural gas issue. Pursuant to Article 15 of the EU Regulation on the Governance of the Energy Union and Climate Action[12] (hereinafter referred to as the "**Governance Regulation**") every EU Member State is obliged to submit a national long-term strategy (LTS) for the economy-wide low-carbon transition until 2050. By definition, LTS should also give an insight into the transition process in terms of fossil fuel consumption, including natural gas. Therefore, this report aims to assess how the EU Member States address the so-called natural gas issue in the LTSs, including in view of the recent developments in the EU energy policy.

Based on what is literally stated in the LTSs, the development of natural gas consumption both in the energy system as a whole and in the particular sectors have been determined. The issue of alternative fuels, which might replace natural gas in the longer term, has been also covered; and having taken the natural gas phase-out into account, the LTSs have been examined in terms of the future of the natural gas infrastructure. Moreover, the issue of ensuring the security of supply of both natural gas and alternative fuels has been included in this document. And the **main aim** of the analysis provided below was to **verify whether and to what extent do the LTSs cover the natural gas issue, to review proposed measures, to identify best practice, and, hence, to provide recommendations that will help EU Member States prepare good updates of their LTSs**.

This methodology of assessing the role of natural gas in the EU until 2050 has however some limitations, not only because the developments that happened after a submission of a given LTS to the European Commission have been on principle ignored. These limitations also stem from the flaws of the LTSs themselves and they are outlined in detail in National long-term strategies – the overall outlook.

The data for natural gas presented in this document are no more recent than from 2019. One should bear in mind that in 2020-2021 the long-term natural gas use trends might have been distorted due to the COVID-19 pandemic. For this reason, it was decided not to rely on the data from this period. However, this report is largely an ex-ante assessment. Therefore, the lack of the most recent data did not affect the understanding of the circumstances in which the LTS were developed and looking at them through the prism of the enormous changes that happened over the past three years provides an additional insight that may contribute to the aims of this report. Thus, the presented

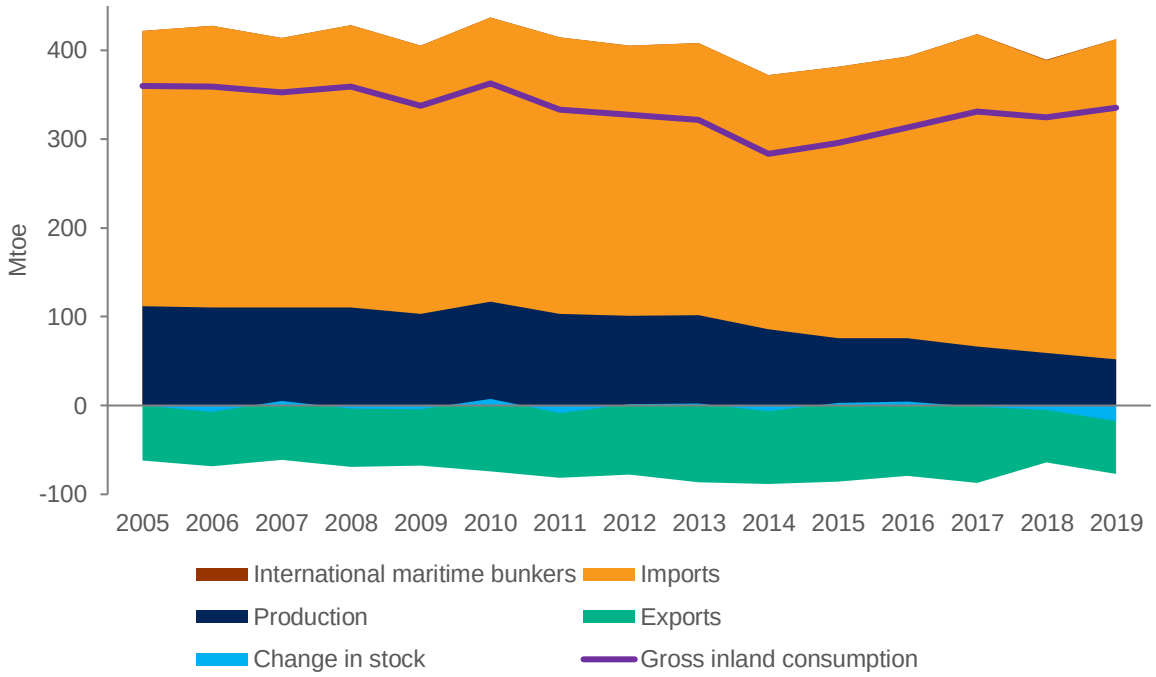
[10] Ibidem. Complete energy balances, Imports of natural gas by partner country and Supply, transformation and consumption of gas.
[11] *Russia cuts gas supplies to Finland for 'refusing to pay in roubles'*.
[12] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action.

recommendations are also useful in view of the consequences of the war in Ukraine for the energy policies.

2 Natural gas use in the European Union

In recent years, natural gas consumption in the European Union has followed the upward trend that began in 2014. Due to limited domestic resources, Europe has relatively small natural gas production compared to consumption, especially since indigenous natural gas extraction has been continuously declining since 2005 (see: Figure 1). Most of the demand is, therefore, covered by imports, mainly from Russia and Norway (a more detailed breakdown is provided in Figure 4).

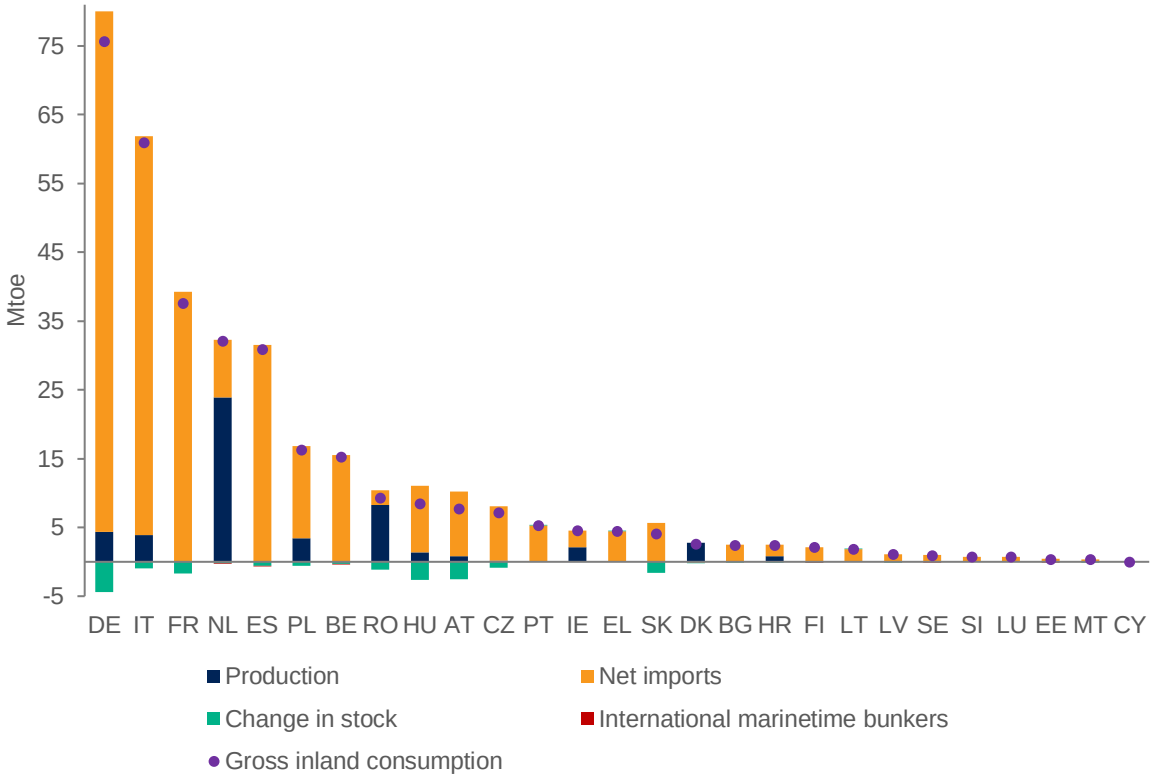
Figure 1. Gross inland consumption of natural gas in the EU in 2005-2019



Source: WiseEuropa based on the Eurostat data (Complete energy balances)

Natural gas production in the EU is in decline, while consumption is rising, which means that import dependency has increased significantly. A breakdown by EU Member States shows that this dependency varies by country (see: Figure 2). However, nearly all of them are dependent mostly on imports with a few exceptions like the Netherlands, Denmark and Romania, which have a high level of indigenous production. Germany is the largest consumer of natural gas, followed by Italy, France, the Netherlands and Spain. These countries alone consume 70% of the natural gas consumed in the European Union.

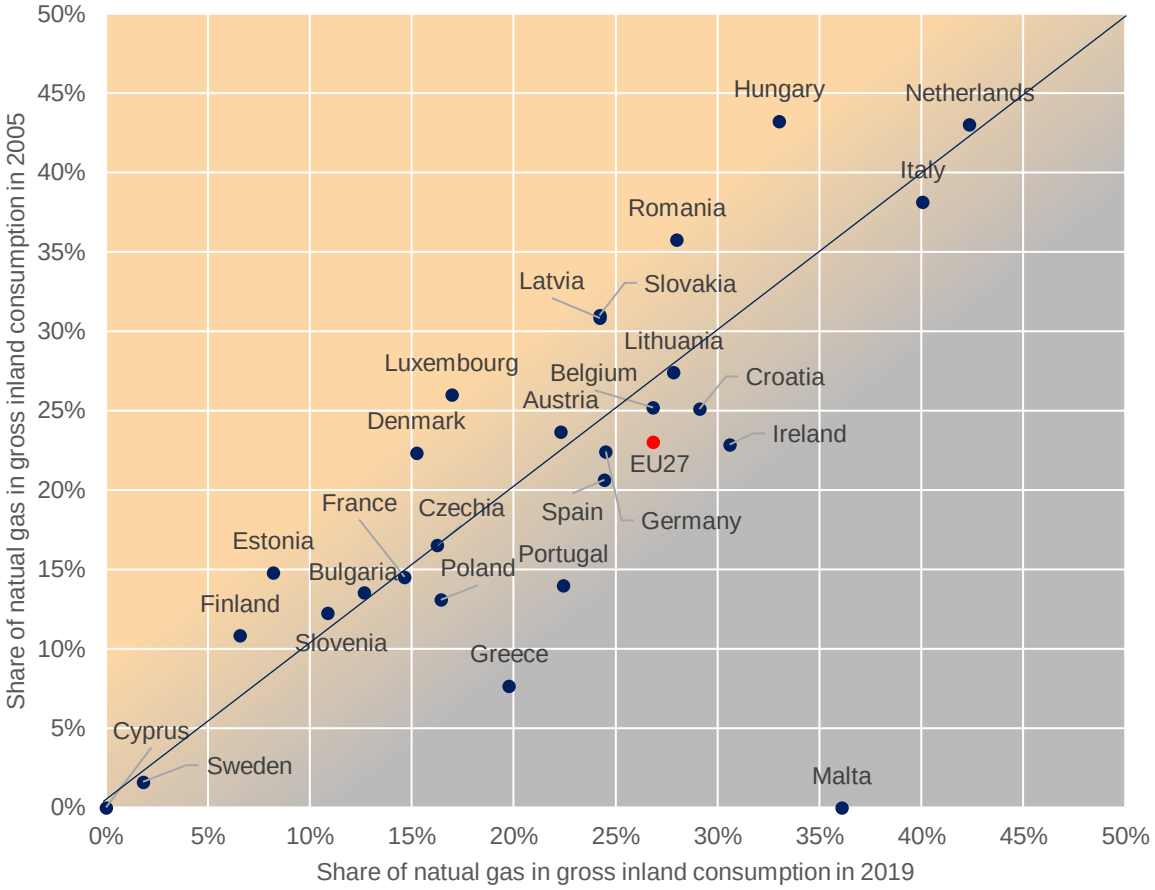
Figure 2. Member States' gross inland consumption of natural gas in 2019



Source: WiseEuropa based on the Eurostat data (Complete energy balances)

Natural gas import dependency should also be considered in terms of how much the share of natural gas is in gross inland energy consumption. As shown in Figure 3, some EU Member States have significantly increased this share by deploying natural gas as a substitute for coal (like Greece) or reduced it (such as Hungary, by increasing the share of nuclear power, bioenergy and renewables). However, overall, the EU slightly increased the share of natural gas in gross inland energy consumption and still follows this upward trend.

Figure 3. Change in the share of natural gas in gross inland energy consumption in 2005-2019



Source: WiseEuropa based on the Eurostat data (Complete energy balances)

As already indicated, imports are the main source of natural gas in the European Union and, therefore, securing its supply is of crucial importance for the energy security of the EU. One way to do this is to diversify the suppliers. Over the years, Russia has been the main supplier of pipeline natural gas, followed by Norway (see: Figure 4). On the other hand, there is a growing share of LNG in natural gas imports – in 2019, it amounted to 28% of total natural gas imports, which is the highest value recorded so far.[13] This has been driven by an overall increase in natural gas consumption with a corresponding decrease in indigenous production and the freedom advantage that LNG offers over pipelines both geopolitically and geographically – LNG terminals allow natural gas to be received from anywhere, while pipelines are often tied to a specific direction, which also affects energy and supply security. Following the trend, this share is expected to further increase, also given the moving away from supplies provided by pipelines from Russia following the invasion of Ukraine.

[13] European Commission. (2020). Report on European Gas Markets. p. 3.

Figure 4. Share of cumulated natural gas imports by pipelines and LNG by country in 2019

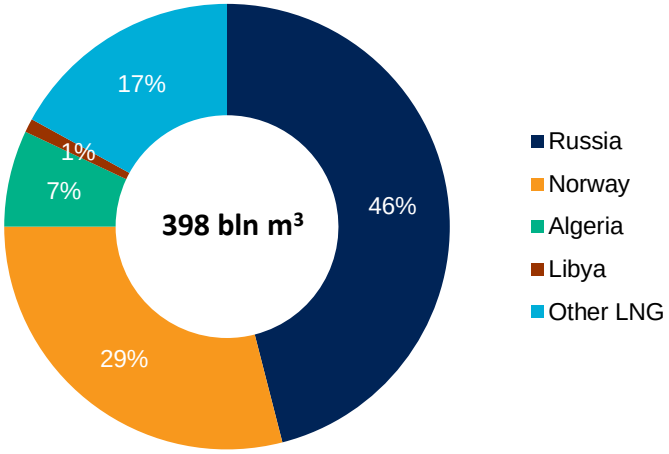
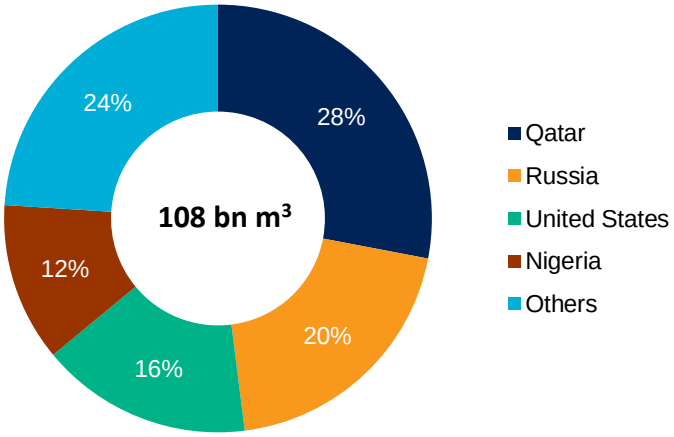


Figure 5. Share in LNG imports by partner country in 2019



Source: WiseEuropa based on the European Commission data (Report on European Gas Markets)

3 European regulations on natural gas

Due to the large share of imported natural gas in its consumption and insufficient own resources, the Member States, and the EU itself, take legislative actions to secure the natural gas supply. Pursuant to the Regulation of the European Parliament and of the Council (EU) 2017/1938 of 25 October 2017[14] EU's activities aim at ensuring uninterrupted gas supplies in its territory. Under the common EU policy, Member States are required to establish preventive action plans (e.g. national storage or LNG-related strategies) and to fulfil several obligations relating to the infrastructure capacity and gas supply.

Besides, regional cooperation is tightened, including:

(i) development of the internal energy (gas) market;
(ii) commissioning of the new LNG hubs in the southern and eastern regions of the Union;
(iii) completion of the North-South and Southern Gas Corridors.

In addition, in December 2021, the Commission presented a gas legislative package on the market of hydrogen and decarbonised gases – a proposal to amend[15] the Gas Directive 2009/73/EC. The initiative supplements the Fit for 55 package with additional legislative proposals, including:

(i) decarbonisation of the energy sector through the increased consumption of renewable and low-carbon gases;
(ii) development of hydrogen infrastructure and reduction of barriers in the hydrogen markets;
(iii) coordination of the planning and operation in the entire EU energy system.

The Commission's proposal is also a response to the surge of the prices of energy carriers in autumn 2021, especially natural gas, which had a strong impact on the decline of the volume of stored natural gas in the EU (a drop from 68% to 56% in December 2021, and to 39% in January 2022[16]). At present, this trend is highly dependent on severe weather conditions in winter and the volume of imports[17], so the Commission considers introducing medium- and long-term measures to increase the resilience of the energy system. One of them is the common European system of gas storage facilities, which will strengthen regional cooperation by enabling groups of several countries to conclude voluntary agreements to jointly purchase gas and create strategic reserves.

The Russian invasion of Ukraine provoked the reorientation of some national and EU natural gas policies. Imports from Russia are to be substantially limited or discontinued (also in the longer term) – either as a result of a unilateral decision made by particular EU Member States or Russia itself (by halting natural gas transmission to Poland and other countries which refuse to pay in roubles), or thanks to the REPowerEU Plan which, i.a. through regulatory measures, aims to end the EU's dependence on Russian fossil fuels (this plan is discussed in detail in National long-term strategies

[14] Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017, p. 2. This regulation was amended by the Commission Delegated Regulation of 18/11/2021, supplementing it with new legislative provisions to facilitate regional cooperation and joint risk assessments by establishing thirteen regional risk groups corresponding to the four main gas supply corridors (East, North Sea, North Africa and South-East). The risk groups will be responsible for carrying out analyses for the next four years (until 2026) and advising the Commission and EU countries on measures to properly manage these risks. Furthermore, the latest update discusses changes in the creation of new main gas infrastructures in 2017-2022 and the withdrawal of the UK from the EU.
[15] Based on the Proposal for a Directive of the European Parliament and of The Council on Common Rules for the Internal Markets in Renewable and Natural Gases and in Hydrogen of 15 December 2021.
[16] Based on Gas Infrastructure Europe.
[17] Zachmann G. et al. (2021). How serious is Europe's natural gas storage shortfall?

in the context of REPowerEU, where the validity of LTSs in view of the REPowerEU is also briefly assessed). Under the REPowerEU Plan, measures aimed at securing enough natural gas reserves in view of the expected natural gas supply shortages resulting from cutting of supplies from Russia were proposed by the European Commission as early as on 23 March 2022, and the relevant Regulation[18] has entered into force on 1 July 2022. It provides that underground gas storage on member states' territory must be filled to at least 80% of their capacity before the winter of 2022/2023 and to 90% before the following winter periods. Overall, the EU will attempt collectively to fill 85% of the total underground gas storage capacity in the EU in 2022.

In order to diversify gas supplies, the EU states have also been investing in new natural gas infrastructure: pipelines and LNG terminals, like Baltic Pipe which is to enable natural gas imports from Norway to the Danish, Polish and neighbouring markets, and the Transatlantic Gas Pipeline connecting Azerbaijan with Europe. As far as investments in LNG terminals are concerned, the Polish terminal located in Świnoujście is currently being expanded (which will result in an increase in the regasification capacity from 5 bcm per year to 8.3 bcm per year), as well as the French terminal located in Fos Cavaou and the British terminal in the Isle of Grain.[19] New terminals are also being built in Latvia, Ukraine, Romania and Estonia.[20]

[18] Regulation (EU) 2022/1032 of the European Parliament and of the Council of 29 June 2022 amending Regulations (EU) 2017/1938 and (EC) No 715/2009 with regard to gas storage.
[19] The National Law Review. (2021). LNG In Europe 2021: Current Trends, The European LNG Landscape And Country Focus.
[20] European Commission. (2022). EU-US LNG Trade.

4 Role of natural gas in national long-term strategies

4.1 National long-term strategies – the overall outlook

This analysis is based on the national long-term strategies available at the time of writing. As of 18 May 2022, 22 out of 27 EU Member States have submitted their LTSs. Missing at that point were **Bulgaria**, **Cyprus**, **Ireland**, **Poland** and **Romania**, even though the deadline for the submission of the strategies to the European Commission was 1 January 2020.

A general remark on the quality of the LTSs is that they do not provide comprehensive information on the low-carbon transition: The majority of the EU Member States have submitted a strategy which is underdeveloped in terms of climate targets tailored for particular sectors and fuels, e.g. natural gas. Hence, the LTSs are rather of low relevance for policymakers. Moreover, the LTSs differ very much from each other in terms of the structure which does not allow neither for an easy comparison of the paths taken by particular countries, nor for the identification of an EU-wide natural gas consumption patterns.

Due to the aspects related to the development of the strategies and the framework laid out in the Governance Regulation, which provided only general guidelines for the content, the natural gas consumption pathways presented in the LTSs are very diverse, often incomplete or incomprehensive. This results from several aspects which are specific to individual states:

(i) various levels of dependence on gas and other fossil fuels which are followed by various amounts of willingness to expand or reduce the level of its use;
(ii) varying views on the use and need to use gas as a transition fuel;
(iii) geographic, infrastructural, economic and political conditions;
(iv) the prospects for the use of alternative gaseous fuels and natural gas substitutes;

but also from aspects linked to the development and content of the strategy itself:

(i) the scope and level of the details provided in the document;
(ii) the use of different models and putting a range of scenarios into consideration;
(iii) the date of adoption of the document – affecting its topicality in terms of decision-making and policymaking;
(iv) different emission reduction scenarios have been put into consideration but no decision has been made yet as to which one will be followed.

It is important to highlight that LTSs, since they were adopted before Russia's invasion of Ukraine, do not take into account the problems with energy security which emerged in this context. In addition, due to the lack of a strict framework of the LTSs provided by the Governance Regulation, the outcomes of the so-called first wave of LTSs vary significantly in terms of structure, content and level of details. Among the issues with LTSs, there is also the time adequacy of the strategies: given the recent changes in the EU's climate and energy policy, and due to different dates of adoption of documents, which extend over a period of several years, some documents may present a vision which is not compatible with the current state.

4.2 Natural gas consumption pathways

The development of natural gas consumption patterns by 2050 in the EU Member States can be determined (at least to some extent) based on the decarbonisation pathways provided in the LTSs. Hence, three general approaches towards natural gas were identified: (i) natural gas treated as a transition fuel, i.e. a policy assuming a temporary rise in natural gas consumption (nominal, proportional or both) at the expense of other fossil fuels on the net-zero pathway; (ii) phase-down path, i.e. a gradual reduction of natural gas consumption which may (but does not have to) lead to the natural gas phase-out (iii) not negligible consumption (i.e. above 5% of PEC) of natural gas in 2050 and beyond. The role of natural gas in each of the LTSs was assessed in terms of these three possible developments below (for detailed methodology see: Annex I). The results are summarised in the Table 2. Countries whose share of natural gas in GIC in 2019 was above the EU average (23%) are highlighted in red to signal the importance of natural gas to the national economy.

Table 2. Member States' natural gas consumption pathways according to the LTSs

Country	Natural gas… …is barely mentioned	…is a transition fuel	…will be being phased down	…will be used in 2050 and beyond	The share (%) of NG in GIC in 2019
Austria			■	■	22%
Belgium		■	■		**27%**
Croatia		■	■	■	**27%**
Czechia		■	■	■	17%
Denmark	■				15%
Estonia	■				8%
Finland			■		6%
France			■		15%
Germany		■	■		**25%**
Greece		■	■	■	19%
Hungary		■	■	■	**32%**
Italy			■	■	**39%**
Latvia	■				**24%**
Lithuania	■				**24%**
Luxembourg			■		15%
Malta		■	■		**34%**
Netherlands	■				**42%**
Portugal		■	■	■	22%
Slovakia	■				**24%**
Slovenia			■		11%
Spain			■		**24%**
Sweden	■				2%
EU27					23%

Countries that did not submit the LTS

Bulgaria					13%
Cyprus					0%
Ireland					**30%**
Poland					15%
Romania					**28%**

Legend:

Not applicable
Depending on the scenario/to be considered yet
Adoption of a given pathway is already assumed/confirmed in the LTS

Source: WiseEuropa based on the LTSs and Eurostat data (Complete energy balances)

Out of 23 EU Member States, 8 countries seek to use natural gas as a transition fuel and one. The reason for a substantial increase in the consumption of natural gas in 2020-2040 in order to replace coal or oil is that more climate-friendly options are thought to be unviable given the current structure of the energy system of some states. Those highly dependent on solid fossil fuels (such as **Czechia**) might believe that a switch to natural gas will allow for a faster and less expensive emission reduction in the short term.

EU Member States assume that, in the 2030s and 2040s, RES and notably energy storage options will become economically feasible to the extent allowing for moving away from natural gas. As a result, all EU Member States might commence phasing natural gas down, but only a few of them (like **France**) declare that natural gas of fossil origin is to be entirely phased out by 2050. In the majority of countries, negligible natural gas residues will remain in hard-to-abate sectors in the long term, but 7 EU Member States still see the opportunity to use greater amounts of natural gas in their energy system even beyond 2050. The emissions from the combustion of natural gas in these residual GHG sources may be offset by CCS (like in **Greece** or **Italy**) or by the uptake of carbon in forests.

Several EU Member States have not covered the issue of natural gas in their LTSs to an extent allowing to assess the role of this fuel in their future energy system, namely Denmark, Estonia, Latvia, Lithuania, the Netherlands, Slovakia and Sweden. Although natural gas holds a negligible share in **Estonian** and **Swedish** energy systems (8% and 2%, respectively), it accounts for more than 20% of current gross inland energy consumption (as of data for 2019) in **Latvia**, **Lithuania**, **Slovakia** and especially the **Netherlands**, which should translate into more extended coverage of the role of natural gas in the decarbonisation process. Dutch LTS misses the cornerstone of the Dutch energy system since: As of 2019, the Netherlands' energy system was the most natural gas-dependent system in the EU (natural gas accounts for 42% of GIC).

As far as the countries that not submitted the LTSs are concerned, the role of natural gas should be thoroughly discussed by **Ireland** and **Romania**, as the natural gas consumption amounts to significant values (30% and 28% share in gross inland energy consumption, respectively) in these two states.

4.3 Sectoral approach

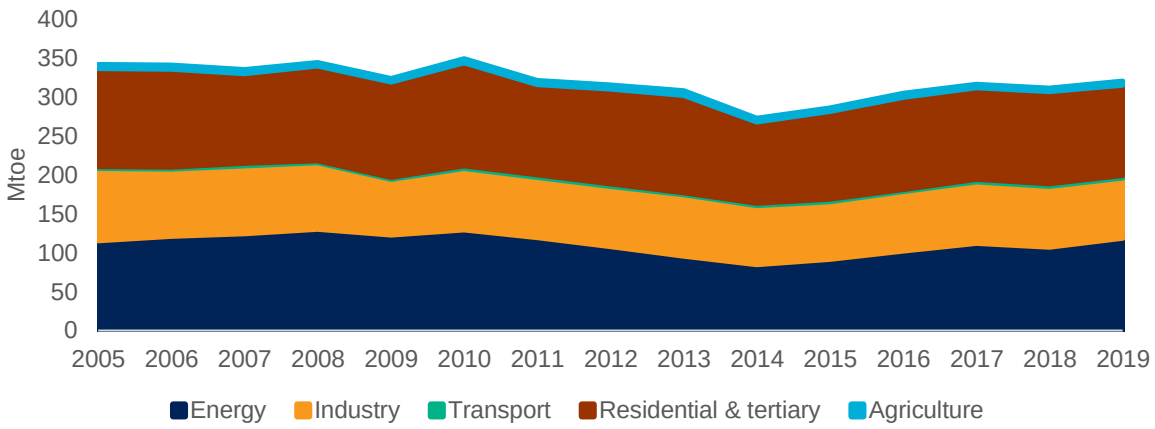
The significance of natural gas varies depending on the sector and hence the role of natural gas in the low-carbon transition of particular sectors will be different.

For the purpose of this document, sectors are understood as follows (this understanding is close to that outlined in Article 15 (4) (b) of the Governance Regulation):

(i) Energy sector which includes electricity generation and heat generation in district heating systems;
(ii) Industry which covers industrial processes in industrial plants;
(iii) Transport which encompasses all modes of transport, both of passengers and freight, i.e. passenger vehicles, heavy-duty vehicles, rail transport, maritime transport and aviation;
(iv) Residential & tertiary which stands for energy use in households (e.g. for individual heating and cooking) and commercial and public services: the heating and cooling and buildings sector;
(v) Agriculture which to a large extent refers to the powering of agricultural equipment.

The current importance of natural gas in these sectors in the EU is shown in Figure 6.

Figure 6. Natural gas consumption in particular sectors in the EU



Source: WiseEuropa based on the Eurostat data (Complete energy balances)

Energy, residential & tertiary and industry constitute the vast majority of the natural gas consumption. Due to the variety of uses and functions (e.g. gas burning in boilers for commercial or industrial power and heat generation, end-use for domestic heating or as feedstock for industrial installations) and the availability of different alternatives depending on the characteristics of a given country, different paths for natural gas use may emerge. The agriculture and transport sector consume the least amount of natural gas, which is used as a fuel for vehicles and agriculture machinery.

Accordingly with the framework set out in the Governance Regulation, Member States are required to include sector-specific related content in LTS. The table below (Table 3) summarises this sectoral approach in terms of natural gas, i.e. shows where natural gas is to play any role in particular countries according to the LTSs and demonstrates whether we know from the LTSs what is going to happen with natural gas in a given sector: if it will be substituted and with what fuel(s). The current share (as of 2019) of natural gas in these sectors has also been provided in the boxes to show the extent of the challenge faced by the EU Member States, i.e. whether natural gas is an issue which should be addressed when discussing a given sector. If this share exceeds the EU average, it is then highlighted in red. This allows to better assess if a given LTS fails to address an important area of natural gas consumption.

Table 3. Sectors covered in the LTSs of particular EU Member States in terms of natural gas

Country	Energy	Industry	Transport	Residential & tertiary	Agriculture
EU27	18%	28%	1%	31%	13%
Austria	**21%**	**32%**	**3%**	19%	5%
Belgium	**22%**	**29%**	1%	**41%**	**33%**
Croatia	**33%**	**47%**	0.2%	22%	9%
Czechia	7%	24%	1%	29%	10%
Denmark	16%	**28%**	0%	13%	5%
Estonia	6%	19%	1%	9%	4%
Finland	6%	5%	0.4%	1%	0.1%
France	6%	**29%**	0.4%	28%	4%
Germany	16%	**30%**	1%	**37%**	7%
Greece	**30%**	22%	0.3%	9%	1%
Hungary	**24%**	**29%**	**2%**	**50%**	**19%**
Italy	**44%**	**29%**	**3%**	**47%**	5%
Portugal	**35%**	22%	0.3%	10%	1%
Slovakia	12%	27%	**7%**	**39%**	**17%**
Slovenia	4%	**31%**	0.2%	9%	0%
Spain	**28%**	**35%**	1%	22%	7%
Sweden	0.4%	5%	0.1%	1%	1%
Latvia	**47%**	11%	0%	13%	2%
Lithuania	15%	**55%**	1%	11%	**18%**
Luxembourg	18%	**41%**	0%	**36%**	0%
Malta	**90%**	0%	0%	0%	0%
Netherlands	**48%**	**30%**	1%	**58%**	**52%**
Countries that did not submit the LTS					
Bulgaria	7%	**32%**	**4%**	5%	5%
Cyprus	0%	0%	0%	0%	0%
Ireland	**54%**	**39%**	0.4%	21%	0%
Poland	9%	27%	**2%**	17%	1%
Romania	**21%**	**33%**	0%	**34%**	**19%**
Legend:					
Sector not covered in the LTS in terms of natural gas					
Natural gas issue is addressed in the strategy outlined for a given sector					

Source: WiseEuropa based on the LTSs and Eurostat data (Complete energy balances)

As can be seen in Table 3, despite being a very important fuel in some sectors of the EU states, natural gas is sometimes overlooked in the LTSs when discussing these sectors.

If the benchmark of the EU average share of natural gas in a particular sector is taken as a reference point, then **9 countries** did not provide sufficient information on the role of natural gas in at least one sector:

(i) Austria, Spain, Latvia and the Netherlands as far as the energy sector is concerned;
(ii) Denmark, Germany, Spain and the Netherlands when it comes to industry;
(iii) Austria in the field of transport;
(iv) Germany, Slovakia, Luxembourg and the Netherlands in residential & tertiary;
(v) Agriculture: This sector was in general neglected by all EU Member States, whereas natural gas plays a substantial role (above EU average) in this sector in Belgium, Hungary, Slovakia, Lithuania and the Netherlands. The coverage of this sector is insufficient in all countries except for Greece and Slovenia.

Giving no attention to natural gas in the sectors where the gas share is above the EU average is a significant negligence, but the allegation of ignoring natural gas also applies (to a lesser extent) to countries where natural gas accounts for a minor, but still substantial share in a given sector, and is not referred to in the chapter on this sector, e.g. residential & tertiary in Czechia (29% natural gas share), energy sector in Denmark (16%) and industry in Slovakia (27%).

A general overview of the natural gas consumption pathways by 2050 and proposed natural gas-oriented measures in each sector is provided below. These measures (i.e. policies or quantitative targets) were included in the analysis below only if they were expressly stated for a given sector in the LTS. They are grouped according to three strategical approaches that might be taken towards natural gas: The one in which natural gas is considered transition fuel, being phased down and maintained in the energy system in 2050 and beyond.

4.3.1. Energy sector

With the increasing share of intermittent renewables in power generation, natural gas is considered as one of the technologies to balance the grid and provide a reserve, at least in the short and medium term (as a transition fuel). The available low and zero carbon alternatives to natural gas mainly include hydroelectric power stations (which, however, have a limited deployment potential depending on the hydrological and geographical conditions of a given country), geothermal (depending on geological conditions), nuclear power plants (with limited flexibility), waste incineration plants or biomass/biogas plants. Alternative technologies are also emerging: large-scale or decentralised energy storage systems or alternative fuel-fired thermal plants. Energy can also be stored in synthetic, carbon neutral, gaseous and liquid fuels: H_2, CH_4, NH_3, methanol, etc. are also known as electrofuels (abbreviated as “e-fuels”) since they are produced with the use of surplus electricity generated from RES.

Natural gas can also provide a rapid drop of emissions from district heating systems – especially in countries dependent on solid fossil fuels in this sector. Available alternative low-emission solutions include the integration of distributed low and zero carbon heat sources (heat pumps, biomass/biogas plants) or central heating boilers fired with bio- or alternative fuels, and heat storage. The advantage of natural gas is, however, its feasibility and immediate availability (thanks to the fast start-up time).

Therefore, prospects for natural gas use in the energy sector amid the transition to a low-carbon economy include:

(i) operating reserve in the electricity system (possibly with CCS applied), given the intermittent nature of renewables;
(ii) power generation and grid balancing (especially with CCS applied);
(iii) heat source in district heating systems (especially CHP with CCS applied).

Table 4 elaborates how these possible applications of natural gas translate into particular policies by EU Member States identified in their LTSs. These policies are sometimes accompanied by quantitative targets and milestones, which are outlined in Table 5.

Table 4. Qualitative policies regarding natural gas use in the energy sector identified in the LTSs of EU Member States

NG consumption pathway	Policy	Country
Natural gas is a transition fuel	Commissioning of new natural gas power plants (with CCS applied)	Belgium *Czechia* *Greece*
	Commissioning of new natural gas power plants (without CCS applied)	Greece
	Natural gas-based CHP production "will continue to play an important role[21]" until 2030	Germany
	Partial shift to natural gas in district heating systems	Czechia Slovakia
	Rise in electricity generation in existing natural gas power plants	Malta
Natural gas will be being phased down	Gradual decommissioning of natural gas capacities while maintaining some as an operating reserve in the transition period (until 2040)	Portugal
	"It will gradually become possible to completely phase out fossil fuels[22]" in CHP generation	Germany
	Natural gas phase-out	Malta Portugal
Natural gas will be used in 2050 and beyond	Electricity generation (with CCS applied)	Italy Netherlands
	Electricity generation (not necessarily with CCS applied)	Greece

Italics – depending on the scenario; Source: National long-term strategies submitted by EU Member States

[21] Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. (2016). Climate Action Plan 2050. Principles and goals of the German government's climate policy. p. 37.
[22] Ibidem.

Table 5. Quantitative targets and milestones regarding natural gas use in the energy sector identified in the LTSs of EU Member States

Country	Year	Target/milestone
Czechia	2050	*Total capacity of natural gas power plants (integrated with CCS) will be 3334 MW*
Italy	2050	7% share of natural gas in electricity generation (with CCS applied)*
Malta	2030	CCGT power plant will remain a leading electricity supplier until this date
	2050	Natural gas phase-out
Portugal	2040	Natural gas phase-out in electricity production

Italics – depending on the scenario; * modelled outcome of climate policies, not an assumed target; Source: National long-term strategies submitted by selected EU Member States

A switch to natural gas in the energy sector, which is visible in the policies and targets adopted by some countries, might result from high reliance on coal (e.g. in **Czechia**), nuclear phase-out and the need to offset nuclear power reduction (e.g. in **Belgium**, where nuclear phase-out was to happen by 2025[23]) or the availability of already existing infrastructure (e.g. in **Malta**). In the case of **Greece**, it is particularly difficult to unequivocally assess to what extent the shift to natural gas is really about to happen, since the Greek LTS uses the term "gas" in the energy sector for both natural and renewable gas. Therefore, although detailed projections on "gas" use are provided, one cannot always evaluate the extent of natural (fossil) gas consumption in the energy sector.

4.3.2. Industry

Industry, often presented as an aggregate in the context of high-level strategies, is in fact a highly diverse sector, requiring individual approaches to the decarbonisation depending on the sub-sector and products. It is thought that it will be very difficult to fully decarbonise some industrial branches, e.g. sectors producing basic materials such as cement, steel and chemicals. They either have a high proportion of process emissions i.e. not coming from fuel combustion (cement), require high temperatures for a high quality product that cannot be provided with the use of electricity only (steel), or use fossil fuels as feedstock, e.g. natural gas for ammonia production (fertilisers, chemicals).

Therefore, prospects for natural gas as a low-carbon fuel emerge. Natural gas can replace coal and other solid fossil fuels in high-temperature industrial processes, at least until alternative fuels will become more feasible. Table 6 shows how the EU Member States incorporate this issue in their policy frameworks as they are presented in the LTSs.

Table 6. Qualitative policies regarding natural gas use in the industrial sector identified in the LTSs of EU Member States

NG consumption pathway	Policy	Country
Natural gas is a transition fuel	Natural gas as an alternative to other fossil fuels in high-temperature industrial processes (which cannot be electrified)	e.g. Belgium, Portugal
	Phasing down natural gas as feedstock in fertiliser production	Belgium

[23] Le Gouvernement fédéral de Belgique. (2020). Stratégie à long terme de la Belgique, p. 75. Nuclear phase-out is, however, postponed until 2035 due to the Russian invasion of Ukraine.

Natural gas will be being phased down	Natural gas phase-out	Lithuania Slovenia
Natural gas will be used in 2050 and beyond	Natural gas residues	Greece Hungary Italy Portugal

Source: National long-term strategies submitted by EU Member States

As can be seen, not all the countries pledged the complete phase-out of natural gas from the industrial sector. Some natural gas residues are expected in the industrial sector, which is shown in Table 7 for those countries that delivered exact numerical projections on fuel consumption in the industry. None of the countries, however, except for Belgium, referred to the future of natural gas in the role of feedstock for industrial production.

Table 7. Quantitative targets and milestones regarding natural gas use in the industrial sector identified in the LTSs of EU Member States

Country	Year	Target/milestone
Greece	2030	12% of industry energy consumption is satisfied by natural gas*
	2050	2-18% of industry energy consumption is satisfied by natural gas*
Hungary	2020	Beginning of natural gas phase-down
	2030	26% of industry energy consumption is satisfied by natural gas*
	2040	23% of industry energy consumption is satisfied by natural gas*
	2050	15% of industry energy consumption is satisfied by natural gas*
Italy	2050	14% of industry energy consumption is satisfied by natural gas*
Lithuania	2045	Natural gas phase-out
Slovenia	2030	Natural gas phase-out
Portugal	2050	13-15% of industry energy consumption is satisfied by natural gas
		Industry-based natural gas consumption will amount to 90% of the total natural gas consumption of the country

* modelled outcome of climate policies, not an assumed target; Source: National long-term strategies submitted by EU Member States

4.3.3. Transport

Natural gas in the transport sector is consumed in the form of CNG and LNG. Member States recognise them as an alternative to oil-based fuels for freight transport (light- and heavy-duty trucks and ships) and maritime transport, in general. However, none of the countries that submitted LTSs put an emphasis on these fuels in the long term – an overarching goal in the 2050 perspective is to switch to electricity and hydrogen in the transport sector, although in the forthcoming years, the share of natural gas-fired vehicles might slightly increase (for example in **Czechia**). Anyway, LNG and CNG, if used in the transport sector, seem to be transition fuels by definition (especially in **Germany**) which are to be phased out by 2050. Some negligible natural gas residues of a few per cent share in energy consumed by the transport sector are, however, foreseen in 2050 in **Greece**

(2%), **Hungary** (2%) and **Portugal** (3%). In contrast, **Belgium** already declares that the decarbonisation of the transport sector is not to be conducted with the use of natural gas at all.

4.3.4. Residential & tertiary

The residential and tertiary sectors, which consume about 40% of final energy consumption in the EU (36% in 2019)[24], are key sectors in the decarbonisation process. They consume natural gas mainly for space heating, but also for water heating and cooking (gas stoves). Decarbonisation of these sectors is driven by energy efficiency improvements (mostly buildings renovation) and heat source retrofit. For the latter, there are already available low/zero carbon solutions like heat pumps, biomass (especially in rural areas), solar collectors and energy efficiency measures, but natural gas remains an economically viable option, which is to be adopted by some EU Member States, as Table 8 and Table 9 show.

Table 8. Qualitative policies regarding natural gas use in residential & tertiary identified in the LTSs of EU Member States

NG consumption pathway	Policy	Country
Natural gas is a transition fuel	Rise in natural gas consumption for individual heating	Croatia Hungary Latvia
Natural gas will be being phased down	Gradual phase-down after 2030	Portugal
	Switch to alternative fuels	Belgium
	Natural gas phase-out in households (including cooking)	Hungary Italy
	Natural gas phase-out in individual heating and water heating	Austria
Natural gas will be used in 2050 and beyond	Natural gas residues	Greece Italy Portugal
	Significant share of natural gas in the energy consumed by households for heating is to persist	Croatia

Source: National long-term strategies submitted by EU Member States

[24] Eurostat. Complete energy balances.

Table 9. Quantitative targets and milestones regarding natural gas use in the industrial sector identified in the LTSs of EU Member States

Country	Year	Target/milestone
Austria	2050	Natural gas phase-out in individual heating
Hungary Italy	2050	Natural gas phase-out in households
Croatia	2050	Between 20% and 29% of households may be heated with natural gas
Greece	2050	17% share of natural gas in final energy consumption in households*
Portugal	2050	Remnants of below a 1% share of natural gas in energy consumption in buildings

* modelled outcome of climate policies, not an assumed target; Source: National long-term strategies submitted by EU Member States

4.3.5. Agriculture

Natural gas in agriculture can be used as a fuel for agricultural machinery. The extent to which natural gas can be referred to in this sector is, therefore, limited and this is probably why the LTSs have, in general, ignored this topic except for **Slovenia** which assumes that CNG will partially replace diesel as fuel for agricultural machinery – in 2050, the share of CNG consumption in this sector is to reach 6%, and **Greece**, where the use of natural gas is however denied.

4.4 Alternative fuels

Notwithstanding the path chosen by any EU country in any sector, the goal of climate neutrality requires them to reduce natural gas consumption anyway. However, high calorific, gaseous fuels, might still be needed, especially in industrial processes (both as a feedstock, like in the fertilizers production, and as an energy source in steel production).

The above analysis indicates that natural gas would generally be primarily a transition fuel in the future, with a limited capacity on a European scale in 2050 and beyond. At the same time, a modern economy dominated by renewable energy sources will continue to need a reliable source in the context of securing the supply and increasing system-wide resilience. Alternative fuels are part of the solution to closing this gap. Low-emission alternative fuels generally have all the characteristics of conventional fuels that have allowed us to reach the level of civilisation we have now, such as the ability to be easily stored, the availability, the ease of transformation with current technology and infrastructure, but are created in a low-carbon way.

Alternative fuels, as they are defined by the EU Directive 2014/94 on the deployment of alternative fuels infrastructure[25] (hereinafter referred to as the "**Alternative Fuels Directive**"), are "fuels or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector"[26]. However, they can also substitute fossil solid and gaseous sources (e.g. coal and natural gas), and their role as an alternative low/zero carbon energy carrier should not be limited to the transport sector alone. As a result, the scope of the below

[25] EU Directive 2014/94 on the deployment of alternative fuels infrastructure.
[26] Ibid. article 2 (1).

analysis has been extended to all sectors and all fossil fuels which might be replaced by any of the low/zero carbon substitutes.

According to the Directive, alternative fuels include, inter alia:

- electricity,
- hydrogen,
- biofuels,
- synthetic and paraffinic fuels,
- natural gas in gaseous form (compressed natural gas (CNG)) and liquefied form (liquefied natural gas (LNG)),
- biomethane and
- liquefied petroleum gas (LPG).

The meaning of alternative fuels in terms of the role of natural gas in the low-carbon transition is, therefore, that some of them, like CNG and LNG, are natural gas of changed physical properties, and some of them might be derived from natural gas, as it can be in the case of hydrogen ("blue" hydrogen produced from natural gas with a process of steam methane reforming) and electricity. Therefore, alternative fuels are another important field where natural gas can play a role during the transition.

Moreover, in the long term, alternative fuels of renewable origin such as biogas, biomethane, green hydrogen (i.e. renewable gases) or synthetic natural gas (which may be both of renewable and fossil origin if it is made from captured CO2 – then it is a climate-neutral fuel) may replace not only fossil oil and solid sources, but they can also support the natural gas phase-out in the process of achieving climate neutrality by 2050. The role of alternative fuels as substitutes for natural gas should also be discussed in the LTSs. One should bear in mind, however, that alternative fuels are not necessarily an immediately viable option in all sectors and their full-scale implementation still requires some research (which is stressed by Croatia, for example).

A comprehensive analysis and comparison of the approaches taken by EU Member States towards alternative fuels in their LTSs cannot be provided due to the varying methodology adopted by particular countries and different coverage of this issue. However, a few important observations arise from these strategies. **France** emerges as the forerunner in the pledges of deployment of the alternative fuels, as it declares that, by 2050, its energy system will be based on electricity and gas which will be 100% renewable by then. In this section, we provide a general assessment of the role of the alternative fuels as they are defined in the Alternative Fuels Directive in the LTSs to the extent possible, with reference to natural gas and including different decarbonisation scenarios being under consideration in the EU Member States.

4.4.1. Electricity

As a result of the technical and economic opportunities for decarbonisation offered by electricity, the buildings and transport sectors are to be almost entirely electrified, while in the industrial sector, electricity is to replace other fuels where possible. Electrification will require a large amount of power generation, which will increase its share of final energy consumption. A surge in the electricity consumption may be also caused by the production of hydrogen, which is another fuel important for the transition, which can be obtained by electrolysis. This issue is covered by **Italy**, which envisages that a significant share of electricity produced, at least 25-30%, will be used for the production of hydrogen, particularly in the overgeneration phase. Table 10 presents expected change in the share of electricity in FEC in these EU countries, which provided the relevant data.

Table 10. Expected change in the share of electricity in FEC in selected EU Member States between 2019 and 2050

Country	Share of electricity in FEC		
	2019	2030	2050
Croatia	19%	22-24%	36-47%
Greece	26%	32%	45-58%
Hungary	17%	22-24%	48-54%
Italy	21%	ND	55%
Portugal	23%	33%	67%

Source: National long-term strategies submitted by selected EU Member States

All of this can translate into the increased consumption of natural gas, in particular in those countries, which aim for using natural gas in the electricity generation, even in the short term only, like Malta or Czechia.

4.4.2. Hydrogen

Hydrogen is set to replace natural gas in high process temperature applications, powering vehicles and as a back-up source for electricity generation or to store charge over longer periods of time to compensate seasonal fluctuations of energy generations from RES (like in **Malta**, the **Netherlands** or, in particular, in **Portugal**, where hydrogen can be considered as an independent electricity source given the expected share of hydrogen installed capacity of up to 28% in the total installed capacity of power generation in 2050) – hydrogen could, therefore, replace natural gas in this role in future energy systems.

As far as the natural gas issue is concerned, “blue” hydrogen should be taken into particular consideration, since it is derived from the methane in natural gas (via steam reforming) with the use of CCU/CCS. However, although the origin of hydrogen is often not specified in the LTSs, “green” hydrogen of renewable origin seems to be prioritised. “Blue” hydrogen is expressly considered as a valid option only by **Austria**, where it is to play a role as a bridging technology until “green” hydrogen can be used over the medium and long term, in particular in industrial processes. In contrast, **Belgium** and **Luxembourg** openly deny the use of “blue” hydrogen.

4.4.3. CNG and LNG

Natural gas itself is also an alternative fuel, but only upon a change of its physical properties via compression or liquefication, which leads to the creation of CNG and LNG, respectively. These fuels can then be used to operate combustion engines, especially in transport (see chapter 4.3.3)

However, LNG and CNG are not in general perceived as long-term alternative fuels, as the transport sector is to ultimately rely on electricity and hydrogen (in the case of passenger vehicles) or hydrogen and synthetic fuels (when it comes to modes of transports which are hard to electrify). However, some natural gas residues in transport are expected in **Hungary** and **Portugal**.

All in all, the role of LNG and CNG will be limited by 2050 – in the LTSs, CNG and LNG are alternative fuels which are considered for short-term use only.

4.4.4. Other alternative fuels

Natural gas in hard-to-abate sectors can also be replaced by a wide range of gaseous fuels other than hydrogen, e.g. synthetic zero carbon or carbon-neutral gases, including biomethane and synthetic natural gas, electrofuels, biogas, biomass, etc. Electrofuels, when produced from surplus electricity generated from RES, can also store surplus energy (which is to be pursued by **Slovenia**).

The most prospective sector in terms of other alternative fuels, as they are discussed in the LTSs, is aviation and maritime transport, where they can be a substitute for heavy fuel oil and kerosene: in **Belgium** and **Lithuania**, in particular, when it comes to aviation, and in **Greece** as far as ships are concerned. Greece underlines that only carbon-neutral fuels, such as biomethane and synthetic methane, can be used in the maritime transport in the long term.

Slovenia, however, puts the greatest emphasis on synthetic natural gas as a viable solution for all sectors of the energy systems, since one of the two decarbonisation scenarios presented by this country is based on synthetic natural gas and the commissioning of a few power plants fired with carbon neutral synthetic gases. Moreover, a gradual entire substitution of natural gas with synthetic gas is anticipated there by 2050. Over the coming decades, including in **Germany**, natural gas shall be replaced with carbon neutral gas from renewable sources.

Moving away from natural gas on the path to climate neutrality might result in the necessity of decommissioning the natural gas infrastructure, as it will become redundant. However, the emergence of alternative fuels can "save" the natural gas infrastructure, because it can be adapted or repurposed for alternative fuels, either with or without retrofitting, depending on the fuel injected into the natural gas facility – the chemical composition of some of the alternative fuels is very similar to that of natural gas, if not identical (e.g. biomethane), and they can be blended with natural gas or entirely substitute this fuel at once (for this reason they are called "drop-in fuels"). However, in the case of hydrogen a prior conversion of e.g. natural gas pipelines might be required[27]. Therefore, in order to avoid the so-called stranded assets, the issue of adapting natural gas infrastructure to the transmission, storage, etc. of the alternative fuels should be taken into consideration in advance when developing climate policies and strategies.

Although the issue of the future of the natural gas infrastructure has not been broadly discussed in the LTSs, the strategies unveil some measures in this field, which apply to four segments of the natural gas infrastructure: natural gas grid (i.e. transmission pipelines and distribution grids), natural gas fired power and heating plants (such as CCGT plants), filling stations (for vehicles) and storage sites (usually located underground).

4.5.1. Natural gas grid

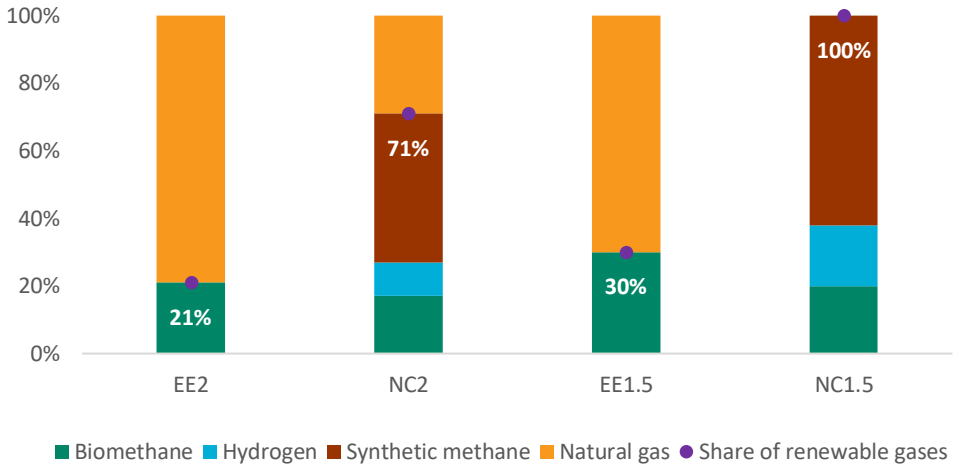
One of the most frequently mentioned measures is feeding renewable gases into the already existing transmission pipelines and distribution grids. These gases may completely replace natural gas in the long term, but an initial step is to blend hydrogen, biomethane and synthetic methane with natural gas. However, the natural gas grid might require some retrofits before being suitable for hydrogen.[28] Therefore, an upgrade of the gas network is being considered, for example in **Italy**. On the other hand, new natural gas pipelines can be built hydrogen-ready, as it is assumed by

[27] ACER. op. cit.
[28] ACER. (2021). Transporting Pure Hydrogen by Repurposing Existing Gas Infrastructure: Overview of existing studies and reflections on the conditions for repurposing. "Hydrogen can accelerate pipeline steel degradation, which occurs primarily in the form of embrittlement which causes cracks and may eventually result in pipeline failure. However, technical remedies to prevent embrittlement are readily available (…)"

Malta. Another option is to build pipelines dedicated solely to hydrogen, which is being planned by **Malta** (as an alternative to hydrogen-ready natural gas pipeline) and **Hungary**.

An approach that emerges from the LTSs is, therefore, that EU Member States will increasingly substitute natural gas with renewable gases through blending. Nevertheless, very rarely the strategy of replacing natural gas with renewable substitutes is outlined in detail, as is done by **Greece**.

Figure 7. Renewable gases in the Greek gas grid in 2050 according to different transition scenarios



Source: WiseEuropa based on the national long-term strategy submitted by Greece

Rough estimations/targets of blending rate are also provided by **Hungary** (50% in 2050) and **Slovenia** (10% in 2030).

In order to increase the share of renewables in the gas grid, EU Member States (such as **Luxembourg**) usually plan to give priority to the injection of renewable gaseous fuels. In addition, incentive effects are considered (by **Austria**) to encourage the local feed of renewable gases into the domestic gas grid, probably by agricultural biogas plants.

Nevertheless, one should not assume that these measures will solve the problem of the operationality of the natural gas grid in the age of climate neutrality. Natural gas phase-out will anyway force the states to rethink the role of gas networks which might require reconfiguration: some segments should be dedicated to hydrogen only and some peripheral sections of the distribution grid should be disconnected from the national grid, since they may be operated by local independent systems of biogas plants, for example. This issue is tackled by **Italy**. The existing natural gas grid can also be used for seasonal energy storage thanks to the power-to-gas technology, as **Austria** claims.

4.5.2. Power and heating plants

Some countries are to grasp the opportunity that natural gas fired power, heating and CHP plants can be converted to renewable gases. **Slovenia**, for example, aims to use synthetic natural gas in

the existing natural gas power plants, and in **Malta** the hydrogen power station might be based upon retrofit of the current CCGT power station. Natural gas fired power stations can also remain in the energy system as a backup electricity supplier in case weather conditions do not allow RES, such as wind turbines or photovoltaics, to operate – this option is not excluded by **Malta**.

4.5.3. Filling stations

When it comes to the natural gas infrastructure in the transport sector, a first remark which must be made is that it is not well developed yet, as natural gas still plays a minor role as a fuel for vehicles (in 2019, the share of natural gas in the energy consumed by transport sector in the EU was 1.3%[29]). However, in the long term, renewable gases can be supplied in former CNG and LNG filling stations (according to **Slovenia** and **Latvia**, which sees the opportunity of introducing biomethane into the CNG infrastructure).

4.5.4. Storage sites

Although rarely mentioned in the LTSs, natural gas underground reservoirs appear to be suitable for renewable gas storage, as **Slovakia** has noticed. **Austria** takes a further step and considers geological formations which are currently used to store energy in the form of natural gas as potential hydrogen storage locations.

4.5.5. LNG terminals

Although many EU Member States (i.e. 18) either already operate LNG terminals (13) or are still developing infrastructure for LNG imports by sea (5)[30], none of the submitted LTSs refers to the future of LNG terminals in a climate-neutral Europe, where the consumption of natural gas will be limited. As a result, it is not known what will happen with LNG terminals, whether they will be operational or not, whereas, for example, they could be switched to hydrogen imports (both raw, liquefied hydrogen and hydrogen in the form of ammonia)[31]. The LTSs should, therefore, take this issue into consideration.

Increasing share of renewable energy in the EU's energy consumption will greatly contribute to a decrease in fossil fuel imports, thus contributing to an increase in energy sovereignty. However, the LTSs show that, in some countries and sectors, natural gas might play a significant role in the transition process (which might however not happen eventually, given the Russian invasion on Ukraine and, consequently, expected faster shift from natural gas to RES). Given low indigenous production of natural gas in the EU (in 2019 it constituted of 16% of gross inland consumption[32]), the Europe will continue to depend on imports from outside the European Union. From the energy security perspective, both the time range and volumes of these imports should be limited to a reasonable minimum and the directions diversified. Therefore, when developing strategy for the natural gas use, the security of natural gas supply should be taken into account, especially if natural gas is a transition fuel and, therefore, plays a major role in the low-carbon transition. Subsequently, the focus of the strategy should also be put on the infrastructure and its possible development, as natural gas is a fuel which cannot be supplied without specialised facilities like pipelines and LNG terminals. However, this issue is not discussed much in the LTSs. LNG terminals are not discussed

[29] Eurostat. Complete energy balances.
[30] European Commission. (2022). EU-US LNG Trade.
[31] ACER. (2021). Transporting Pure Hydrogen by Repurposing Existing Gas Infrastructure: Overview of existing studies and reflections on the conditions for repurposing. ENTSOG, Gas Infrastructure Europe and Hydrogen Europe. (2021). How to transport and store hydrogen – facts and figures.
[32] Eurostat. Complete energy balances.

(for details see: LNG terminals), and in terms of pipeline projects only **Malta**, which expects the temporal rise in natural gas consumption until 2030, mentions the construction of a natural gas pipeline (in the 2020s to secure natural gas supply from Sicily).[33] The most comprehensive approach in terms of policies was presented by **Denmark**, which, however, has its own natural gas reservoirs: in 2019, indigenous natural gas production was nominally enough to satisfy the inland demand[34], but it is to decrease as one of the facilities will be shut down. The high level of energy security is, however, to be maintained thanks to the increase in renewable energy share and interconnections with neighbouring countries.

A key action to maintain resilience to disruptions in natural gas supply is maintaining appropriate gas storage capacity with a corresponding withdrawal capacity – this was assessed and ensured by **Austria**. Minor measures include those proposed by **Belgium**, i.e. to conduct a switch from coal to natural gas in hard-to-abate industrial branches with gas of regional origin.

Security of supply, however, refers to alternative fuels as well. This issue is described to an even lesser extent in the LTSs, whereas the supply of renewable gases, for example, should be secured given the switch to alternative fuels and provided that the national production of renewable hydrogen, for example, might not satisfy the national demand.

When it comes to hydrogen imports, **Malta** is considering to either build a separate hydrogen pipeline or have the proposed natural gas pipeline hydrogen-ready "to enable the switch from gas to hydrogen at the time any EU hydrogen supply network is commissioned"[35] and to secure hydrogen imports. **Austria**, which is aware that the international hydrogen market will allow for substantial imports of hydrogen and synthetic fuels, assumes, however, distributed national hydrogen production and consumption, such as in energy collectives, which will allow for an efficient integration and use of locally generated renewable energy and will bolster local supply security. The local feed of renewable gases into the domestic gas grid is also to be promoted there. On the other hand, **Slovenia** is to exploit the opportunity of energy storage offered by electrofuels, which will contribute significantly to the stable functioning of the electricity system and hence to the national energy security. Measures addressing the security of supply of natural gas provided in LTSs are summarised in Table 11.

Table 11. Measures addressing the security of supply of natural gas

	Measure	Country
Natural gas supply	New natural gas pipeline to be built	Malta
	Use of domestic natural gas only	Belgium
	Increase in RES share	Denmark
	Interconnections with neighbouring countries	Denmark
	Maintaining appropriate gas storage capacity with a corresponding withdrawal capacity	Austria
Alternative fuels supply	Hydrogen pipeline	Malta
	Distributed national hydrogen production and consumption	Austria
	Local feed of renewable gases into the domestic gas grid	Belgium

[33] Natural gas pipelines are also being built by, for example, Poland (Baltic Pipe), which did not provide the LTS; also Italy has already commissioned a new natural gas pipeline – Trans Adriatic Pipeline.
[34] Eurostat. (Complete energy balances).
[35] Ministry for the Environment, Climate Change and Planning. (2021). Malta Low Carbon Development Strategy. p. 41.

	Energy storage in electrofuels	Slovenia

The security of supply of both natural gas and alternative fuels must be better addressed, especially by countries whose low-carbon transition is to be based upon natural gas, as to avoid excessive reliance on imports of these strategic resources which results in overexposure to the risk of disruptions in supply – for example on grounds related to politics.

4.6.1. National long-term strategies in the context of REPowerEU

Upon the Russian invasion of Ukraine, the EU's dependence on natural gas supplies from Russia has been put in question. On 8 March 2022, the European Commission presented the REPowerEU, "a plan to make Europe independent from Russian fossil fuels well before 2030, starting with [natural] gas".[36] The plan, laid out in the Commission's communication from 18 May 2022, is accompanied by policies which are to reinforce efforts to achieve this target. With the measures in the REPowerEU plan, at least 155 bcm of natural gas could be removed, which is equivalent to the volume imported from Russia in 2021. According to the Commission, "nearly two thirds of that reduction can be achieved within a year, ending the EU's overdependence on a single supplier."[37]

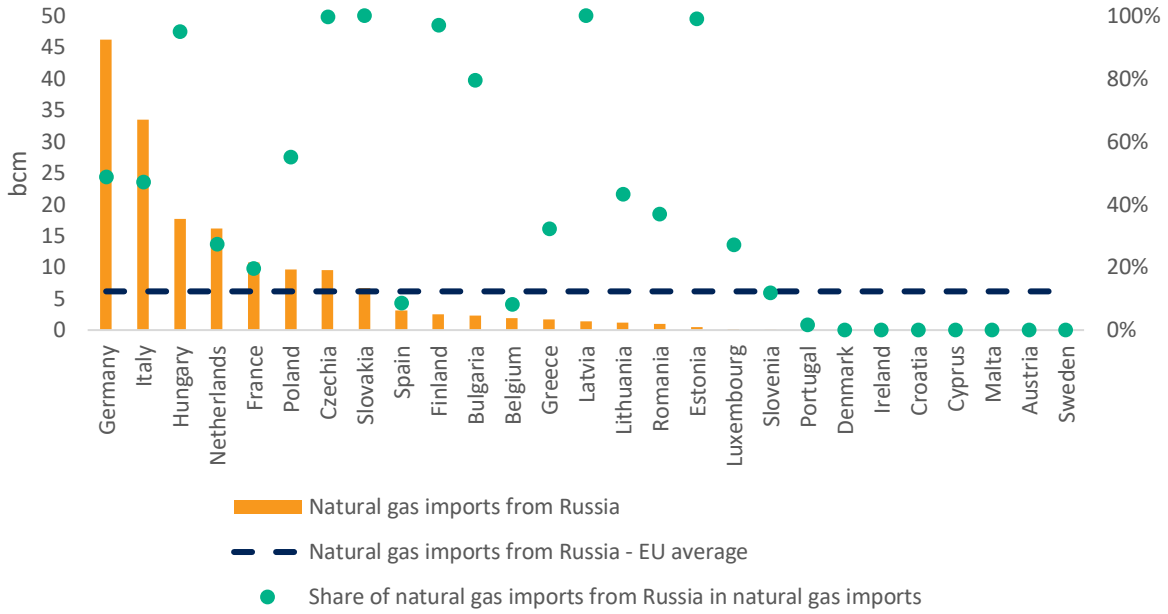
REPowerEU – key proposals

- Law requiring underground gas storage across the EU to be filled up to at least 90% of its capacity by 1 November each year (already adopted and in force since 1 July 2022)
- Diversifying gas supply via imports from non-Russian suppliers and securing purchases and prices through common purchases
- Increasing the ambition on energy savings: the EU-wide energy efficiency target for 2030 is to be raised from 9% to 13%
- Accelerating the rollout of renewables: the European RES share target for 2030 is to be increased from 40% to 45%
- Doubling the EU ambition for biomethane to produce 35 bcm per year by 2030, in particular from agricultural waste and residues
- Setting a target of 10 million tonnes of domestic renewable hydrogen production and 10 million tonnes of imports by 2030, to replace natural gas, coal and oil in hard-to-decarbonise industries and transport sectors

Juxtaposing the strategy presented in REPowerEU with the plans of the Member States presented in the LTSs, one should expect significant changes in the decarbonisation strategies of the states, especially those which planned to adopt natural gas as a transition fuel (see: Table 2). This is now the date by which they should move away from European countries, wishing to move away from Russian gas imports, will be forced to reduce their gas consumption and look for other supply routes and alternatives. Figure 8 shows the volumes of imported natural gas from Russia of each country and their share in the country's total imports.

[36] European Commission. (2022). REPowerEU: Joint European action for more affordable, secure and sustainable energy
[37] Ibidem.

Figure 8. Natural gas imports from Russia in the EU in 2019



Source: WiseEuropa based on Eurostat data (Imports of natural gas by partner country)

Therefore, the revision of the LTSs in terms of natural gas and compliance with the REPowerEU plan is urgently needed. In the first place, the role of natural gas as a transition fuel should be reconsidered. The update should also cover the issue of the security of supply to a sufficient extent. A development of the strategy of a faster switch to alternative fuels might also be advised.

Although climate neutrality or significant emission reduction by 2050 is pursued by all EU Member States which submitted LTSs, 2050 does not have to be the date of natural gas phase-out. Nearly all countries recognise that in hard-to-abate industrial branches, natural gas can be an only viable option to reduce emissions (unless the development of low-carbon technologies will solve this problem) and, therefore, natural gas residues in the industrial sector, for example, can be a common phenomenon in 2050. The summary of policies under which natural gas will persist in some EU countries' energy systems is provided in Table 12.

Table 12. Natural gas in Member States beyond 2050

Sector	Measure	Country adopting
Energy sector	Natural gas-fired power plants as operating reserve	Malta Portugal
	Natural gas-fired power plants fully operational, but integrated with CCS installations	*Czechia* *Greece* Italy
Industry	Significant amounts of natural gas to satisfying energy needs	Greece Hungary Italy Portugal
Transport	Negligible residues	Greece Hungary Portugal

Residential & tertiary	Natural gas remains important fuel in individual heating	Croatia
Agriculture	Natural gas to fuel a minor part of agricultural machinery	Slovenia

Italics – depending on the scenario; Source: National long-term strategies submitted by EU Member States

Given the intermittent nature of RES such as wind and solar, natural gas fired plants can remain operational in 2050 and beyond as operating reserves, especially since it is technically feasible to start up and shut them down quickly. This solution has been put into consideration by **Malta** and **Portugal**.

However, besides the above applications, natural gas offers a low-carbon opportunity in the long term for the energy and industrial sector under the condition that it is used in plants with CCS installations. This option is being considered by countries which are currently highly dependent on natural gas and lag behind in the development of RES or perceive natural gas as the most feasible low-carbon solution, or both. These countries are, for example, **Czechia**, **Greece** and **Italy**.

Natural gas can persist particularly in the heating sector (both heating plants with district heating networks and individual heating). **Croatia** expects the share of natural gas in households heating to be 20%-29% in 2050.

A proportional high share of natural gas can be met in 2050 in the industrial sector. In **Greece**, **Italy**, **Hungary** and **Portugal** natural gas is to satisfy 10%-20% of industry energy consumption. In **Portugal**, this would translate into 90% of the total natural gas consumption of the country.

The role if natural gas in transport in 2050 is to be very limited and when it comes to agriculture, only **Slovenia** expects that, in 2050, the share of CNG consumption in this sector will be 6%.

5 Conclusions and recommendations

The European Union's economy and its energy system rely on natural gas, as it constitutes over 20% of annual gross inland energy consumption. Due to the lack of sufficient domestic resources, around 80% imported into Europe from third countries[38]. Depending on the country, natural gas is particularly important for individual heating, power and heat generation and as a feedstock for industrial processes.

An analysis of the long-term strategies confirmed the circulating belief that many EU countries consider, to a greater or lesser extent, to use natural gas as a transition fuel. Moreover, some countries plan to continue the use of natural gas beyond 2050. The natural gas contribution, evolution and alternatives towards a net-zero economy should, therefore, be one of the key challenges. Nonetheless, the assessment showed that, in large part the issues of the share of natural gas in particular sectors, its infrastructure and the security of its supply were insufficiently covered by the current version of the strategies. The strategies also generally lack information on alternative fuels as a direct replacement for fossil natural gas. Part of the strategy does not specify natural gas targets, and does not provide projections of gas use, making it difficult to understand its role in the process. A lack of transparency and lack of clearly defined goals is a persistent problem in the strategies, which is particularly evident in attempts at cross-national assessment. Russia's aggression against Ukraine has highlighted the need for a strategy that takes into account the geopolitical aspects as well as the security of imported fuel supplies.

The strategies provide us with information on what role natural gas has been envisioned to play by countries in the decarbonisation process. However, given the war in Ukraine and the need to move away from fuels imported from Russia, some countries are already declaring significant changes in their approach to this fuel. This will be an opportunity to take better account of these aspects in updated strategies. Despite significant gaps in the current strategies, the analysis provides information on good practices developed in the strategies that can serve as a point of reference for future updates.

1. **LTSs would benefit from more detailed natural gas consumption pathways**

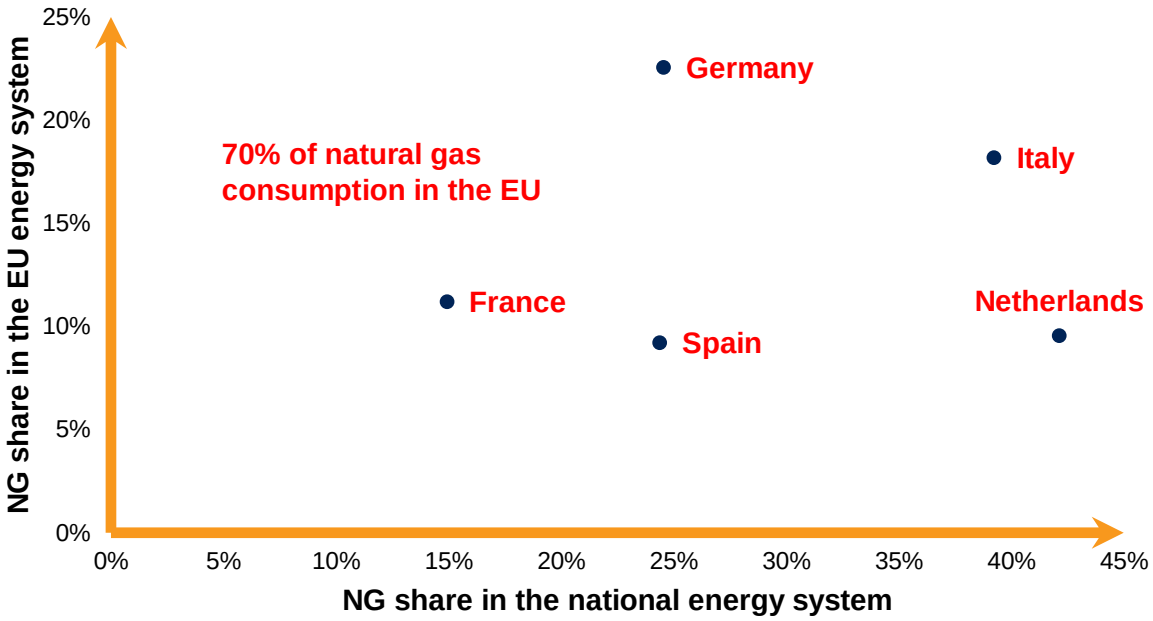
The problem with the majority of the LTSs is that they do not give an exact insight into the future fuel mix of the economy as a whole and of particular sectors. As for now only for a few countries the exact share of natural gas in the energy mix as a whole and in particular sectors, projected for, 2050 can be provided (**Greece**, **Hungary**, **Portugal**). Moreover, even if such projection is delivered, it is sometimes ambiguous, especially when it comes to gaseous fuels. Therefore, natural gas and synthetic (renewable) gases should be clearly distinguished, as the measures applying to them should be disaggregated. Furthermore, different scenarios are often put into consideration, without specifying which one will be ultimately followed.

2. **Top European natural gas consumers should lead the way**

As for now, the coverage of the natural gas issue by top natural gas consumers in the EU, i.e. **Germany**, **Spain** and notably the **Netherlands** is unsatisfactory. These three states account for 40% of natural gas consumption in the EU and effective natural gas phase-down will not happen without the well-designed actions taken by them.

[38] Eurostat. Natural gas supply statistics.

Figure 9. Top European natural gas (NG) consumers



Source: Wise Europa based on the Eurostat data (Complete energy balances)

3. Role of natural gas should be revised in the view of the REPowerEU Plan

Since the EU's dependence on Russian natural gas is coming to an end, EU Member States should reconsider whether they should adopt natural gas as a transition fuel (especially as a substitute for nuclear power in Belgium) and should promote a faster switch to alternative fuels or other alternatives.

4. The security of supply should be discussed in more detail

Although not required by the framework provided in the Governance Regulation, the current geopolitical situation has shown that the issue of securing energy carriers supply is a key element of the energy transition. The updates of the LTSs should take into account the new Commission's policy orientation and cover this issue, including diversification plans, LNG terminals and gas storage.

5. More efforts in governance from the EU level

Although the Governance Regulation provides for a structure of the LTS and outlines necessary elements of this document, the LTSs submitted to the Commission differ very much in terms of the level of details, which translates into problems with making an effective comparison and coordinating climate policy from the EU level. The Commission could, therefore, elaborate more detailed guidelines on the content of the LTSs to ensure the structural cohesion of their updates.

6 Annex I: Methodology of the assessment

Methodology of the analysis of the natural gas consumption pathways

The assessment was made on the basis of the following assumptions:

- scenarios that reach net zero or intended emission reductions in the long-term were only taken into consideration; provided by the LTSs
- when the issue of natural gas is covered in a given LTS to the extent which does not allow to assess the role of this fuel in the country's energy system until 2050, then it was assumed that natural gas is "**barely mentioned**" in this LTS; this applies to the greatest extent to the countries which are highly dependent on natural gas, but do not propose any specific measures applying to natural gas in their LTSs - this is the case of the Netherlands;
- if the share of natural gas in the gross inland energy consumption is to grow in the coming decades until 2050 at the expense of other fossil fuels (e.g. coal and oil), then the role of natural gas in a given LTS is described as a "**seen as a transition fuel**";
- if the share of natural gas in the gross inland energy consumption is to start declining before 2050, then it was assumed that natural gas in a given country is "**going to be phased down**";
- if natural gas is known to remain a non-residual quantity (i.e. the share of natural gas in PEC is to exceed 5%) in the energy system of a given country in 2050 (also with the use of CCU/CCS), then the box in the column entitled "**to be used after 2050**" is checked.

The majority of the LTSs lack in numerical projections, or objectives mentioned there are defined vaguely. Hence, the assessment made in Table 2 is sometimes based on conclusions drawn from the general picture presented in a given LTS and not on precise data.

7 Annex II: Natural gas in the energy systems of the EU countries and summaries of the LTSs submitted to the European Commission

The tables provided below include detailed information on:

(i) the structure of natural gas consumption and supply in 2019 in all EU countries;

(ii) the natural gas-related content of the LTSs submitted to the European Commission.

Data on the structure of natural gas consumption has been uploaded from the Eurostat database *Complete energy balances*.

Data on natural gas supply have been uploaded from the Eurostat databases: *Supply, transformation and consumption of gas* and *Imports of natural gas by partner country*. Natural gas supply charts based on these databases and provided in the tables below do not include, however, *change in stock* and *international maritime bunkers*. Moreover, data on imports is broken down between *imports from Russia* and total imports from other countries (described as simply *Imports*).

When it comes to the content of the LTSs, the tables are based on the documents shared on the dedicated website by the European Commission, *National long-term strategies*. Alternatively, if the documents published on that webpage were available only in the original language version, the English language versions of the LTSs submitted to the United Nations[39] were referred to (only if these submissions were identical with those made to the European Commission): this was the case of Austria and Finland.

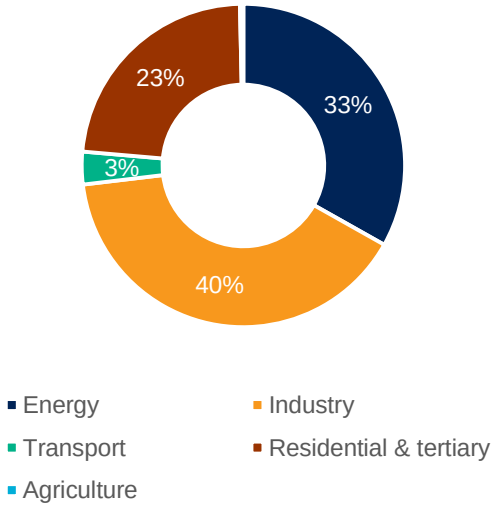
[39] United Nations Framework Convention on Climate Change. Communication of long-term strategies.

7.1. Austria

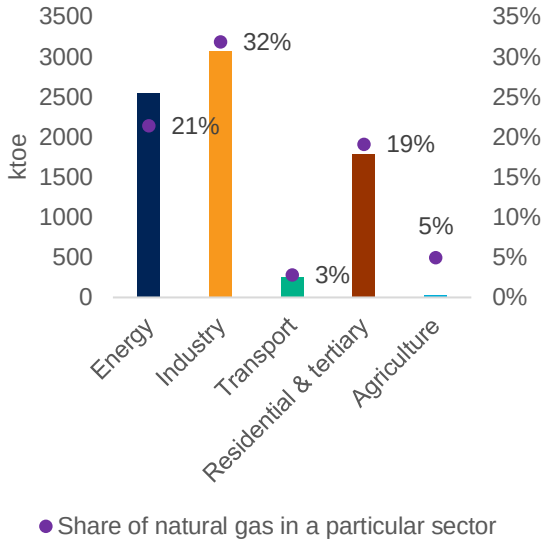
Natural gas in Austria in 2019

Gross inland natural gas consumption	**7 676.6 ktoe**
Share of natural gas in gross inland energy consumption	**22%**

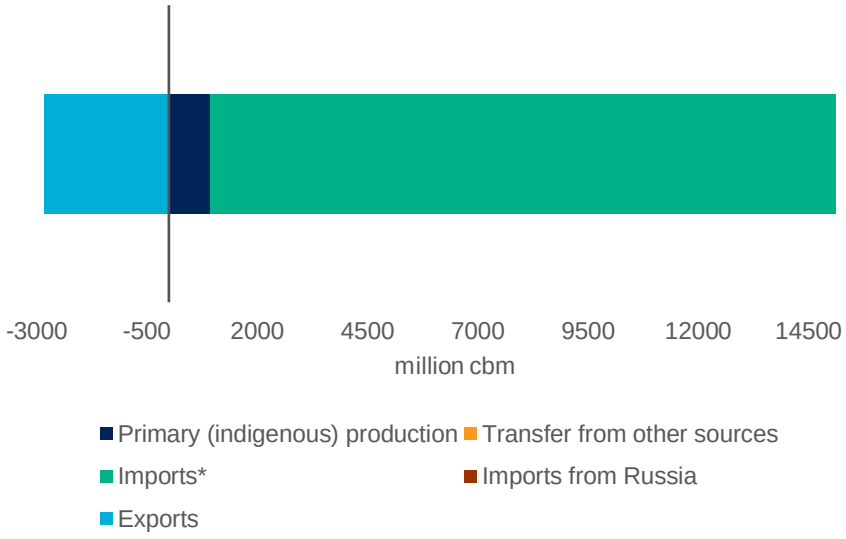
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



**Austria did not report on countries of origin of imported natural gas*

Austrian LTS[40]

General measures pertaining to natural gas	Consumption of fossil fuels and heating oil will fall to virtually zero by 2050.
	Gas consumption will be reduced by at least 40% by 2050.

[40] Federal Ministry for Sustainability and Tourism of the Republic of Austria. (2019). Long-Term Strategy 2050 – Austria. Period through to 2050.

	Gas consumption should be CO_2 neutral in net terms by 2050 while still accounting for Austria's role as a gas hub in a tightly integrated European internal market.	
Sectoral approach		
Energy sector	*NI*	
Industry	In the industrial sector "blue" hydrogen derived from natural gas (with the use of CCU/CCS) is to play the role as a bridging technology until "green" hydrogen can be used.	
Transport	*NI*	
Residential & tertiary	The target vision for buildings is that in 2050 they are heated and cooled virtually free of CO_2 emissions, and that they are also supplied with hot water exclusively via renewable energy sources.	
Agriculture	*NI*	
Alternative fuels		
General measures	The use of hydrogen, synthetic fuels and renewable gases will massively increase by 2050.	
	Large electrolysis systems for converting electricity into hydrogen and synthetic gas.	
	"Blue" hydrogen will play the role as a bridging technology for a certain time, and "green" hydrogen will be used over the medium and long term.	
Sector	*Fuels to be used*	*Measures*
Energy sector	*NI*	
Industry	Electricity	The greatest national potential for the use of hydrogen has been identified in the steel, chemicals (ammonia and methanol production), mineral oil, and brick industries. Especially high-temperature processes will still depend on gaseous, molecular fuels for which there are not yet any alternatives in many areas. In a first wave, coal and other particularly harmful fossil fuels (including natural gas) will likely be replaced, and industrial processes will then be powered by electricity and green gas/hydrogen in a second wave. Renewable hydrogen will play a central role in the decarbonisation of industry, especially in energy-intensive sectors. Hydrogen is used not only as a raw material in industrial processes, but can also
	Renewable gas	

	Renewable hydrogen	replace natural gas as a source of energy if the production process cannot be electrified. Steel production will shift from the traditional blast furnace process to electricity- and hydrogen-based production over the long term. Existing refinery capacities will be converted to the use and production of non-fossil fuels (hydrogen, renewable gas).
Transport	*NI*	
Residential & tertiary	Renewable gas	Fossil gas will be increasingly replaced with renewable and synthetic gas in order to ensure a CO2-neutral gas supply by 2050. Fossil gas shall no longer be used in new residential and services buildings starting in 2021. Exceptions should only be granted in justified cases which require effective compensation measures in the form of the generation of renewable energy or energy savings. When gas heating systems are replaced, fossil gas is only to be used again if there is no technically or economically feasible option for the use of renewable energy sources or if the use of a heating system powered by renewable energy sources would not be economical, with the economic costs and benefits being taken into account in determining the economic efficiency. Incentives in the form of funding for renewable heating systems are envisaged, which shall also mitigate social impacts, fiscal measures, and especially requirements and funding for the replacement of fossil gas with renewable gas.
	Synthetic gas	
Agriculture	*NI*	
Natural gas infrastructure		
Natural gas grid	The natural gas grid for space and water heating purposes shall not be expanded any further if possible. The addition of new connections for space and water heating is still possible in exceptions if justified by the unavailability of district heating.	
	The existing natural gas grid can be used for seasonal energy storage thanks to the power-to-gas technology.	
	Decarbonisation of the gas grid by increasingly substituting natural gas with renewable gases is planned.	
	Incentive effects to promote the local feed of renewable gases into the domestic gas grid are envisaged.	
Power and heating plants	*NI*	
Filling stations	Conversion of the compressor stations to electric drives.	

Storage sites	In future, other media besides natural gas can be injected into the geological formations to contribute to the storage of energy generated from volatile sources (e.g. hydrogen).
LNG terminals	*NA*
Security of supply	
Natural gas	*NI*
Alternative fuels	Decentralised hydrogen production and consumption, such as in energy collectives, will allow for an efficient integration and use of locally generated renewable energy and will bolster local supply security.
	A hydrogen storage capacity of around 3.0 to 3.5 billion Nm3 with corresponding withdrawal capacity should be available by 2050.
Natural gas beyond 2050	
NI	

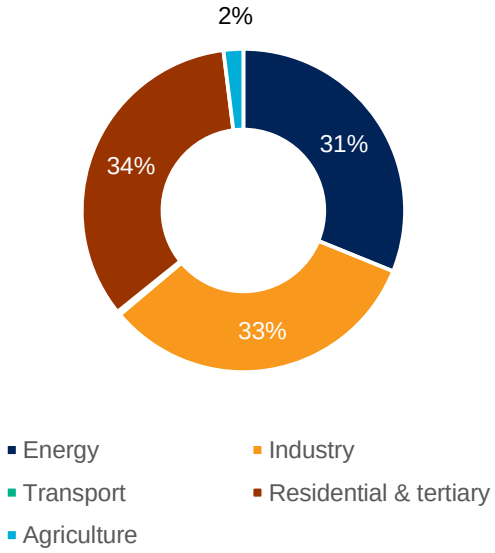
NI – no information
NA – not applicable

7.2. Belgium

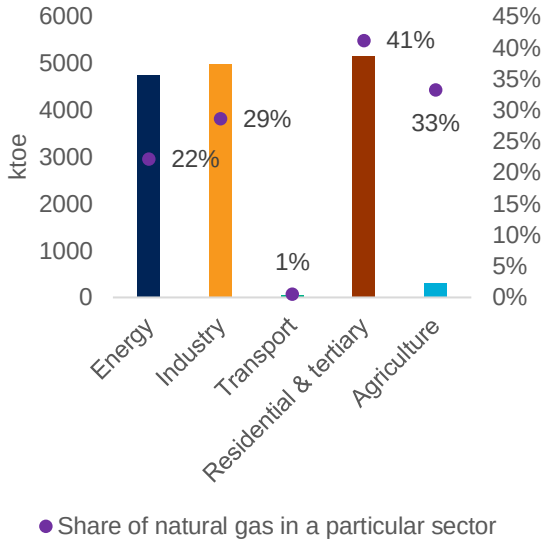
Natural gas in Belgium in 2019

Gross inland natural gas consumption	**15 246 ktoe**
Share of natural gas in gross inland energy consumption	**27%**

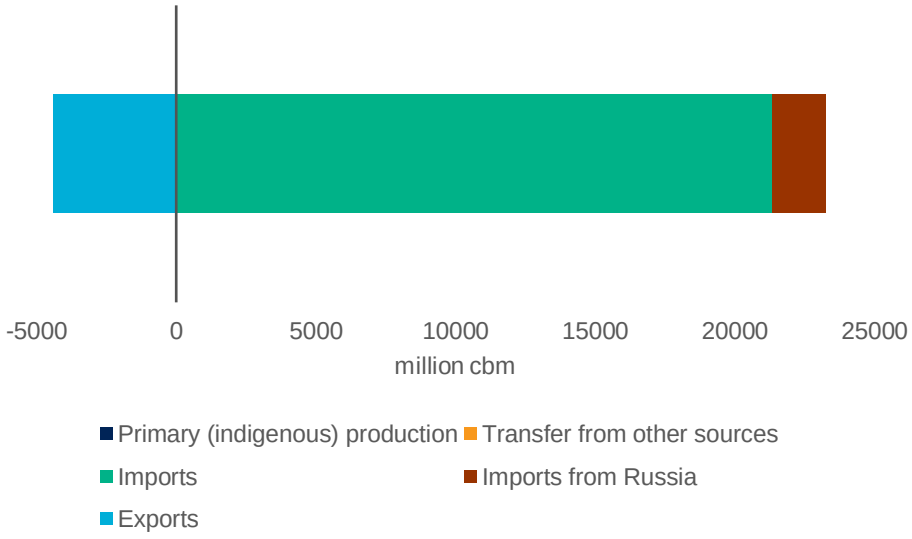
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Belgian LTS[41]

General measures pertaining to natural gas	In 2050 all fuels will be of renewable origin (electricity, gas, hydrogen, biofuels and synthetic fuels).
	In the long term the emissions from the combustion of fossil fuels will systematically decrease and disappear completely in 2050, when the energy system will rely on sustainable electricity only.

[41] Le Gouvernement fédéral de Belgique. (2020). Stratégie à long terme de la Belgique.

	Electricity production will be completely free of emissions in 2050.	
Sectoral approach		
Energy sector	Given the nuclear phase-out planned for 2025, electricity production in natural-gas fired power plants will temporarily increase.	
Industry	Industry has already significantly lowered emissions by 59% between 1990 and 2017, i.a. thanks to the transition to natural gas.	
	In industry further replacement of coal with biomass, biogas and natural gas will take place in the branches which cannot be electrified.	
Transport	Low-carbon transition in the transport sector is not to be conducted with the use of natural gas.	
Residential & tertiary	*NI*	
Agriculture		
Alternative fuels		
General measures	Electrification seems to be the main focus of the strategy. Renewable electricity is to decarbonize the energy consumption in industry, residential sector and, to a large extent, transport.	
	In residential heating, industry and transport a switch from coal, oil and natural gas to green electricity and carbon neutral fossil fuels (biomass, renewable methane, green hydrogen, synthetic gases, renewable gas) will take place.	
	All alternative fuels using carbon should be applied during the transition process only in the sectors which cannot be directly electrified. The development of synthetic fuels (gaseous and liquids) will have to decrease in 2030; in 2050 they will only be used as a substitute for heavy fuel oil and kerosene (aviation fuels).	
Sector	*Fuels to be used*	*Measures*
Energy sector	*NI*	
Industry	Green hydrogen	In industrial branches, where electrification is not viable, green hydrogen will be used (certainly not low-carbon hydrogen).
		The hydrogen for the production of fertilizers could be obtained through the electrolysis with the use of renewable energy, not through the steam methane reforming, as it is now.
	Electricity	Research is being conducted on how to replace natural gas with electricity.
Transport	Electricity	In the transport sector, a switch to electricity, biofuels, sustainable biogas or electrofuels (in the aviation and maritime transport) will happen. When it comes to heavy-duty vehicle transport, an equilibrated mix of renewable gas, electricity and biofuels is being researched. Electrification of these vehicles will be less rapid than that of the private vehicles.
	Biofuels	
	Sustainable biogas	
	Electrofuels	
	Renewable gas	

Residential & tertiary	Renewable hydrogen	Heating in the residential sector will rely on renewable hydrogen.
Agriculture	*NI*	
Natural gas infrastructure		
Natural gas grid	The gas network is to be extended in order to transport greater volumes of hydrogen.	
	In the first stage of the transition in the heating sector, some amounts of hydrogen could be injected into the gas grid and blended with natural gas.	
Power and heating plants	*NI*	
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	Resources (including natural gas, but also biomass and biogas) which will be used to replace coal in the industrial sector are to be of regional origin.	
Alternative fuels		
Natural gas beyond 2050		
NA		

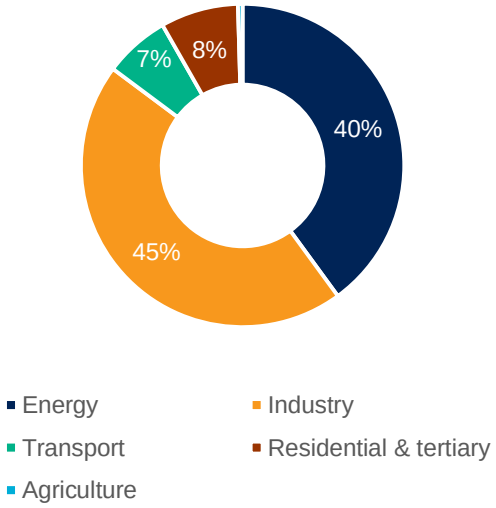
NI – no information
NA – not applicable

7.3. Bulgaria

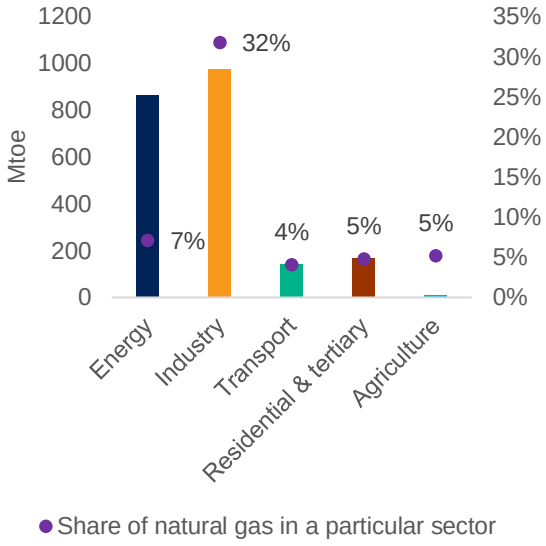
Natural gas in Bulgaria in 2019

Gross inland natural gas consumption	**2 441.8 ktoe**
Share of natural gas in gross inland energy consumption	**13%**

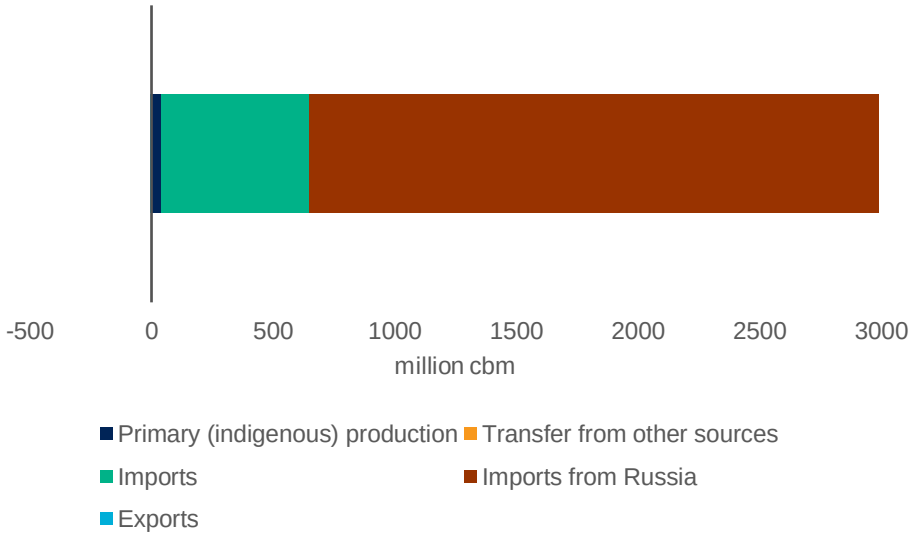
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply

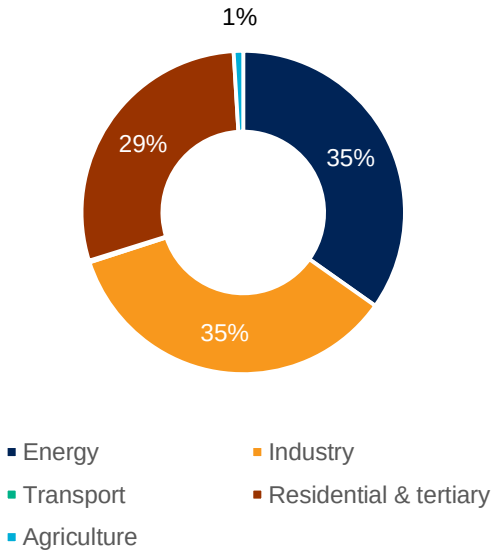


7.4. Croatia

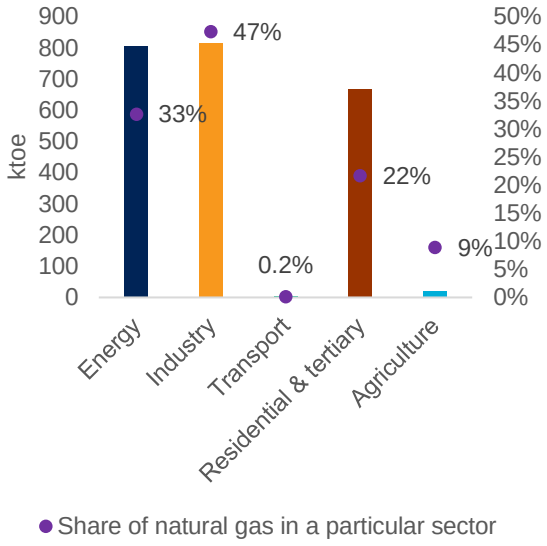
Natural gas in Croatia in 2019

Gross inland natural gas consumption	**2 406 ktoe**
Share of natural gas in gross inland energy consumption	**27%**

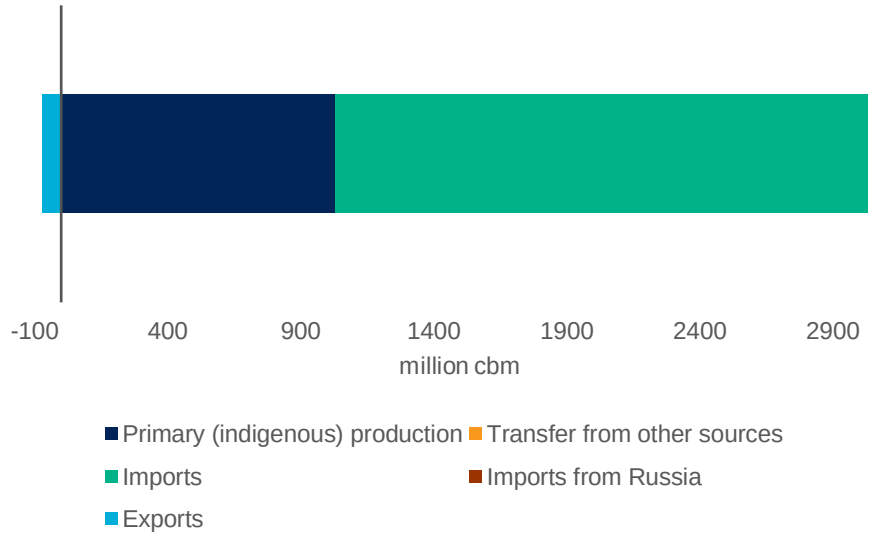
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



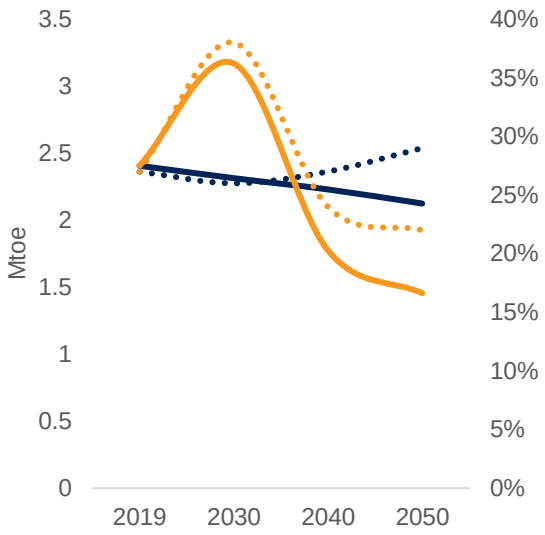
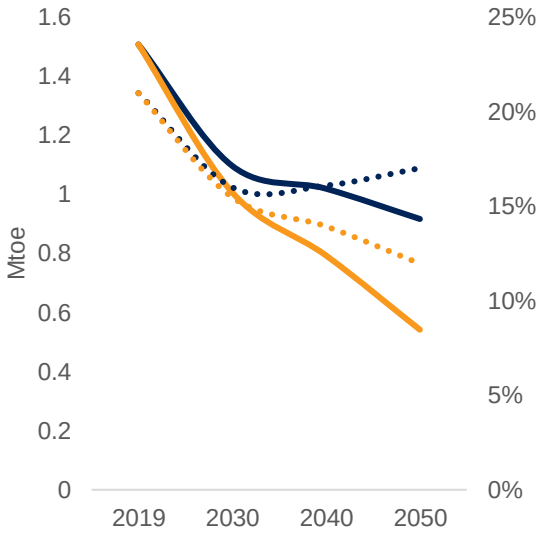
Natural gas supply



Croatian LTS[42]

General measures pertaining to natural gas	Croatian LTS provides a projection of the use of different fuels, including natural gas, in 2030, 2040 and 2050 under two transition scenarios: gradual transition scenario and strong transition scenario.

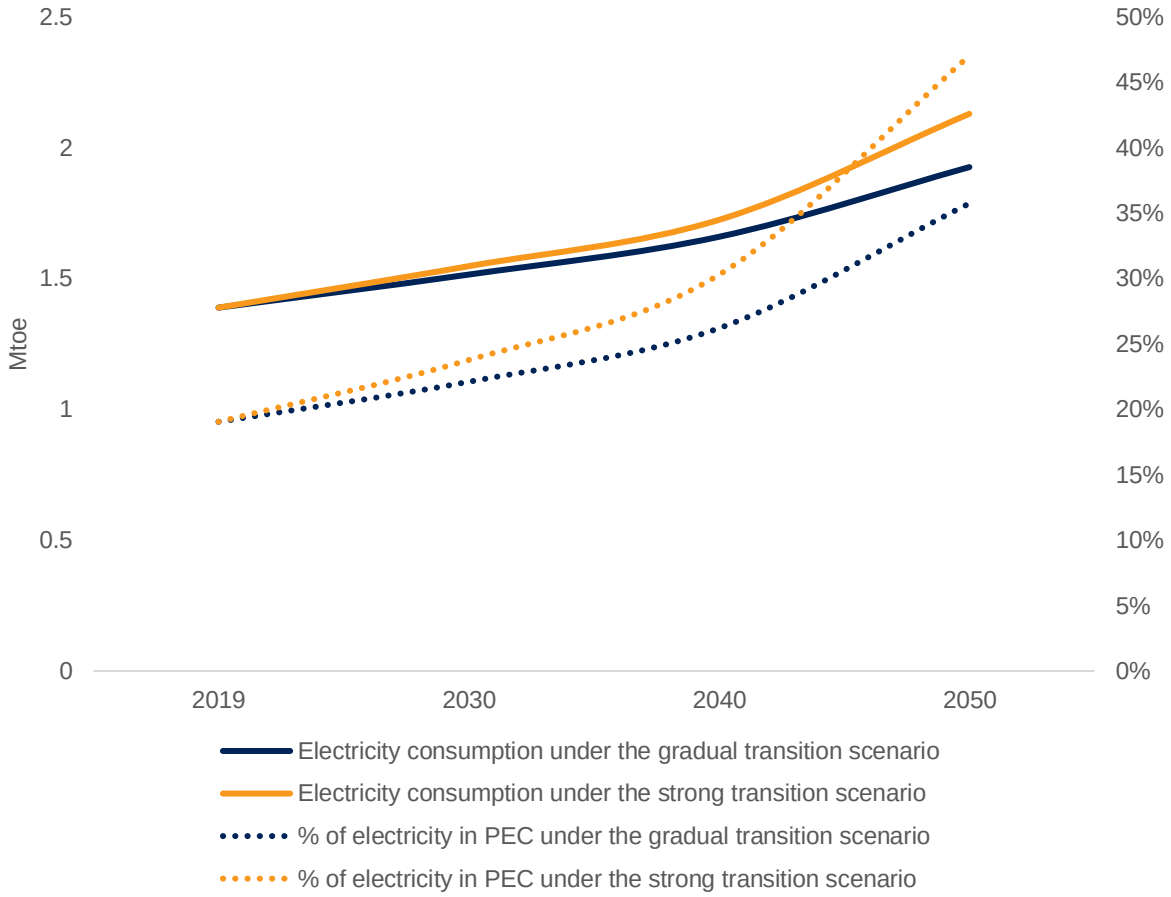
[42] Ministarstvo Gospodarstva i Održivog Razvoja. (2021). Strategija Niskougljičnog Razvoja Republike Hrvatske do 2030. s pogledom na 2050. godinu.

Total natural gas consumption[43] in Croatia until 2050	Direct natural gas consumption[44] in Croatia until 2050
	

Source: WiseEuropa based on the Croatian LTS[45]

Sectoral approach	
Energy sector	The gradual transition scenario does not assume the deployment of CCS, whereas under the strong transition scenario CCS will be needed in gas power plants and in the cement industry after 2040.
Industry	*NI*
Transport	Applicable for both transition scenarios: increase in the consumption of natural gas by buses, light and heavy goods vehicles, rail and maritime transport; the emphasis is however on other alternative fuels; only for ships LNG is considered as being important in the transition process.
Residential & tertiary	In 2050 the share of households heated with the use of natural gas will be 20% or 29% depending on the scenario (the former figure is for the gradual transition scenario and the latter one for the strong transition scenario).
Agriculture	*NI*
Alternative fuels	
General measures	Limited role of hydrogen (less than 1% in PEC and FEC projections).
Electricity consumption in Croatia until 2050 under the transition scenarios	

[43] *Ukupna potrošnja energije po gorivima* (Total energy consumption by fuel, probably PEC).
[44] *Neposredna potrošnja energije po gorivima* (Direct energy consumption by fuel, probably FEC).
[45] Ibid. p. 86 and 91-92.



Source: WiseEuropa based on the Croatian LTS[46]

Sector	*Fuels to be used*	*Measures*
Energy sector	Biogas	One of the envisaged measures is the construction of facilities that use renewable energy sources to produce electricity and/or heat, such as biogas power plants. Power plants/cogeneration plants that use biogas, hydrogen, synthetic gas and other fuels obtained through the chemical recycling of waste can become competitive by 2030.
	Hydrogen	
	Synthetic gas	
Industry	Electricity	The use of electricity or climate-neutral energy carriers (hydrogen, synthetic fuels), biofuels if the use of electricity or climate-neutral energy carriers will not be possible (the measure outlined in the perspective of 2050).
	Hydrogen	
	Synthetic fuels	
	Biofuels	
Transport	Synthetic gas	Growing consumption of synthetic gas and biogas by buses, light and heavy goods vehicles, rail and maritime transport.
	Biogas	

[46] Ibid. p. 86 and 91.

	Hydrogen	The most promising fuels in the freight transport (which is expected to increase) are hydrogen, synthetic methane and synthetic liquid fuel. Smaller trucks will be powered by electricity. Ships will be ultimately fuelled by hydrogen and synthetic fuels.
	Electricity	
	Synthetic liquid fuel	
Residential & tertiary	Electricity	An increase in the share of electricity for thermal purposes will occur. In 2050 the share of households heated by electric heat pumps will be 19% or 45% (the former figure is for the gradual transition scenario, the latter one for the strong transition scenario).
Agriculture	*NI*	
Natural gas infrastructure		
Natural gas grid	The development of the gas system is conditioned by the development of the gas market and the need to ensure an adequate level of security of gas supply.	
	An increase in the efficiency of the gas grid is assumed.	
Power and heating plants	The decommissioned units of existing natural gas power plants can be used for the construction of new units, given that they already have certain infrastructure prerequisites. Croatia considers to use synthetic gas in existing natural gas power plants.	
Filling stations	*NI*	
Storage sites		
LNG terminals		
Security of supply		
The Croatian LTS provides for the projections on the amount of domestic and imported energy in 2030, 2040 and 2050 under both transition scenarios. However, these projections are not broken down between particular fuels.		
Natural gas	*NI*	
Alternative fuels		
Natural gas beyond 2050		
NI		

NI – no information

7.5. Cyprus

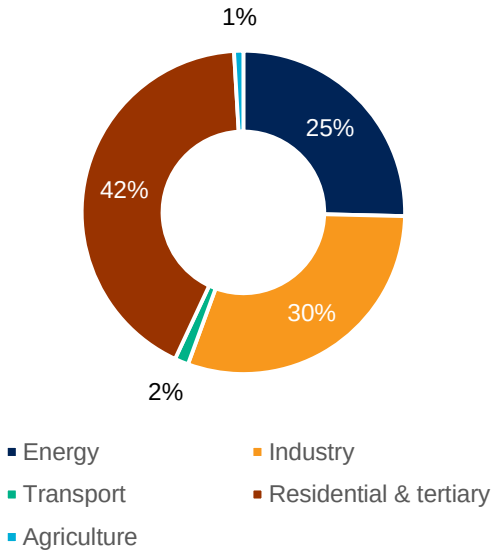
Cyprus did not submit the LTS to the European Commission. Cyprus, however, does not use natural gas.

7.6. Czechia

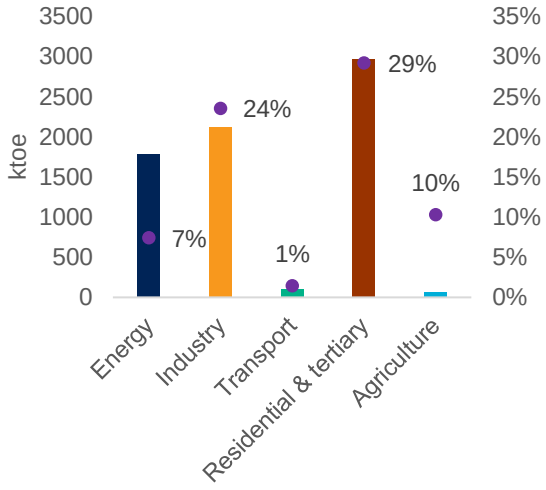
Natural gas in Czechia in 2019

Gross inland natural gas consumption	**7 158.2 ktoe**
Share of natural gas in gross inland energy consumption	**17%**

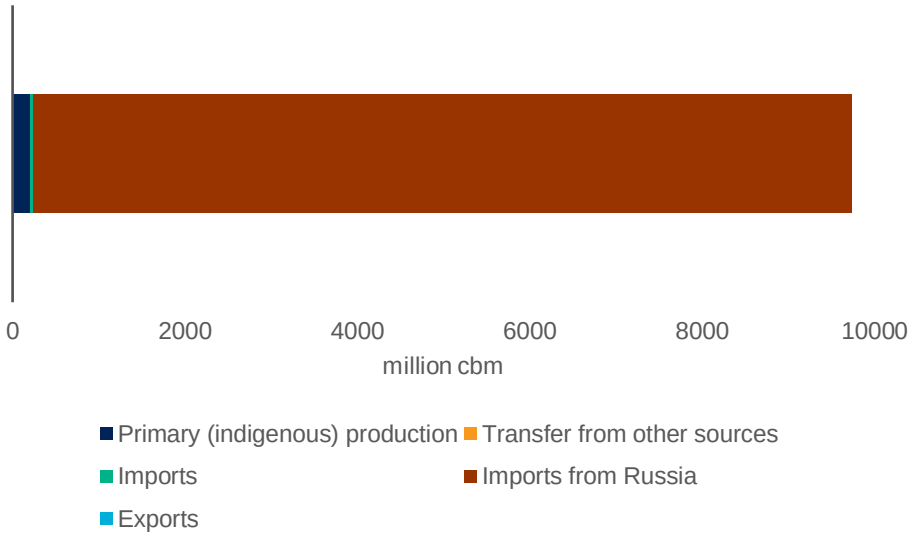
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



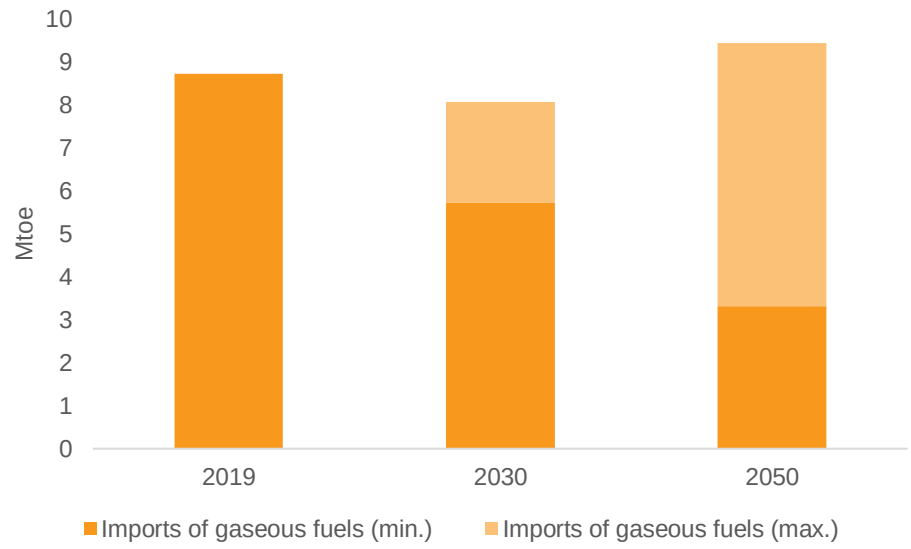
Natural gas supply



Czechian LTS[47]

[47] Ministerstvo Životního Prostředí České Republiky. (2017). Politika ochrany klimatu v České republice.

General measures pertaining to natural gas	Dependence on gaseous fuels is not to come to an end until 2050 under any scenario.	
Sectoral approach		
Energy sector	In 2050, according to the scenario with expansion of CCS, the installed capacity of electricity generation from natural gas will be 3334 MWe.	
	Consumption of natural gas for heating purposes is to increase, especially in small and medium-sized district heating systems.	
Industry	*NI*	
Transport	The Czechian national vehicle fleet is to be renewed. In the first stage transport sector is to partially switch to natural gas: in 2025 10% of the fuel consumption in the transport sector will be attributed to natural gas (which translates into 600 million m^3 and 250 thousand CNG vehicles).	
Residential & tertiary	*NI*	
Agriculture		
Alternative fuels		
General measures	*NI*	
Sector	*Fuels to be used*	*Measures*
Energy sector	*NI*	
Industry		
Transport	Hydrogen	Although the decarbonization of transport is to be initially conducted with the use of natural gas, the renewal of the Czechian national vehicle fleet is to ultimately rely on alternative fuels (hydrogen).
Residential & tertiary	*NI*	
Agriculture	*NI*	
Natural gas infrastructure		
Natural gas grid	*NI*	
Power and heating plants		
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas		
Natural gas imports under three low-carbon transition scenarios		



Source: WiseEuropa based on the Czechian LTS[48]

Alternative fuels	*NI*
Natural gas beyond 2050	
Depending on the scenario, natural gas power plants will be accompanied by CCS installations.	

NI – no information

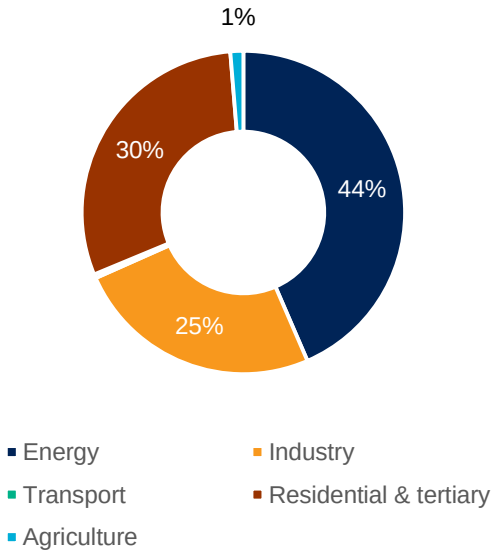
[48] Ibid. p. 122-123.

7.7. Denmark

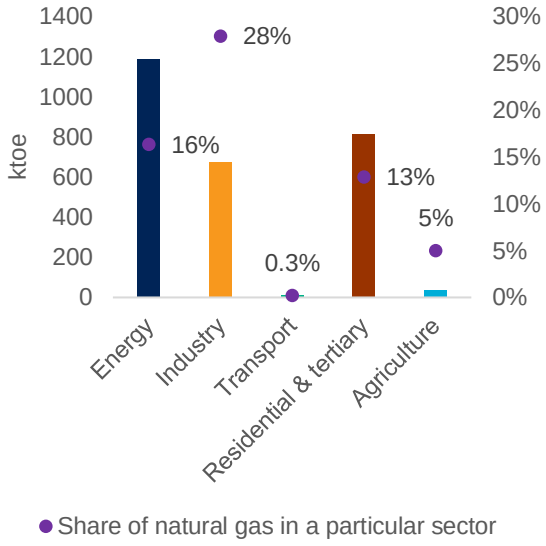
Natural gas in Denmark in 2019

Gross inland natural gas consumption	**2 529.2 ktoe**
Share of natural gas in gross inland energy consumption	**15%**

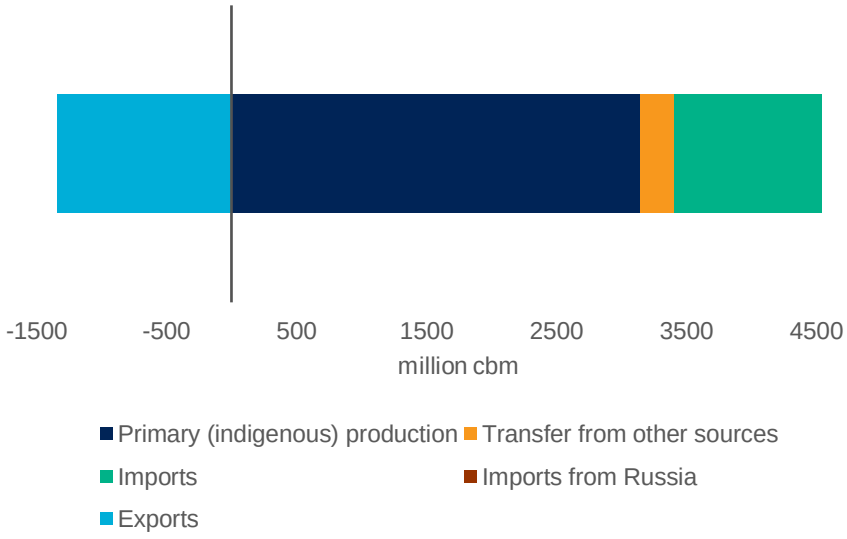
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Danish LTS[49]

General measures pertaining to natural gas	The Danish gas production will decrease during the next three years (until 2022) as the Tyra facility will be shut down, but the overall energy mix in Denmark is expected to keep a relatively stable trend in its transition towards a green energy system.

Sectoral approach

[49] Government of the Kingdom of Denmark. (2019). Denmark's Long-term Strategy.

Energy sector	*NI*	
Industry		
Transport		
Residential & tertiary	At least 90% of district heating consumption is based on energy sources other than coal, oil or gas by 2030.	
Agriculture	*NI*	
Alternative fuels		
General measures	*NI*	
Sector	*Fuels to be used*	*Measures*
Energy sector	*NI*	
Industry		
Transport		
Residential & tertiary		
Agriculture		
Natural gas infrastructure		
Natural gas grid	*NI*	
Power and heating plants		
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	The high level of energy security is ensured through decreased dependency on import from third countries through: Denmark's increase in its renewable energy share largely; Denmark's domestic oil and gas production; Denmark's cooperation with neighbouring countries to keep the interconnectivity level high. It is also ensured through increased flexibility in the energy system, through systematized monitoring of adequacy of the supply in different sectors, through emergency plans and the historical development of a resilient energy system.	
Alternative fuels		
Natural gas beyond 2050		
NI		

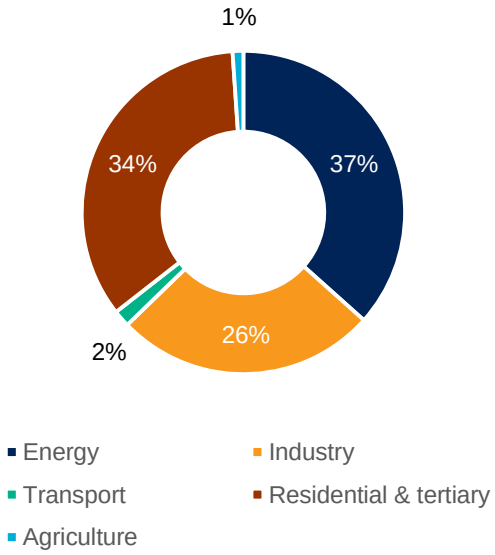
NI – no information

7.8. Estonia

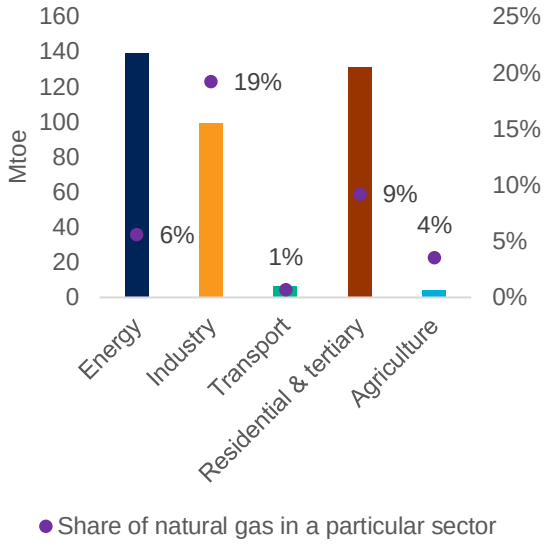
Natural gas in Estonia in 2019

Gross inland natural gas consumption	**380.2 ktoe**
Share of natural gas in gross inland energy consumption	**8%**

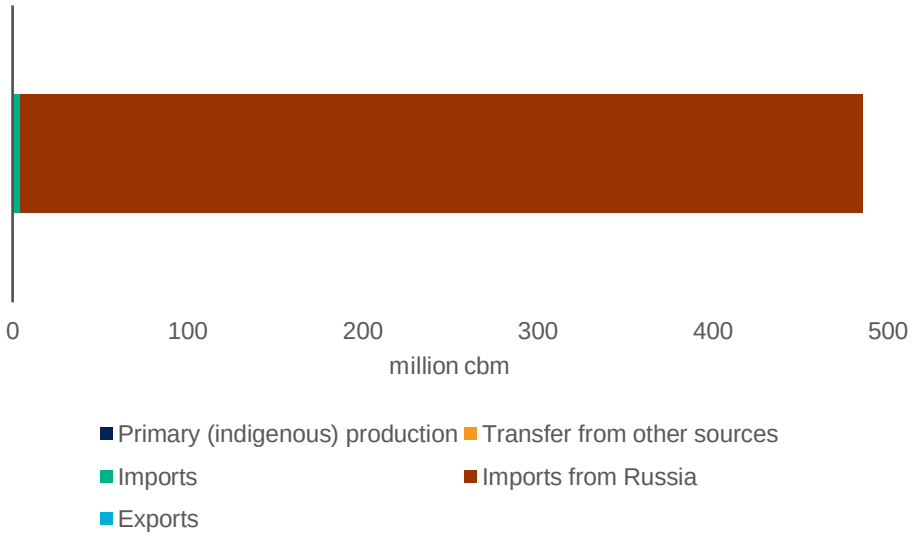
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Estonian LTS[50]

General measures pertaining to natural gas	Emission of GHG is to be reduced by 2050 by 80% in comparison with the emission levels of 1990. As the country moves towards this target, emissions will be reduced by about 70% by 2030 and by 72% by 2040 in comparison with the 1990 emission levels.

[50] Riigikogu. (2017). General Principles of Climate Policy until 2050.

Sectoral approach		
Energy sector	*NI*	
Industry		
Transport		
Residential & tertiary		
Agriculture		
Alternative fuels		
General measures	The retort gas produced as a by-product to shale oil production will be used to produce energy and heat, while in the longer perspective, the aim is to produce a maximum amount of replacement products for liquid fuels, natural gas, etc. from retort gas.	
Sector	*Fuels to be used*	*Measure*
Energy sector	*NI*	
Industry		
Transport		
Residential & tertiary		
Agriculture		
Natural gas infrastructure		
Natural gas grid	*NI*	
Power and heating plants		
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	*NI*	
Alternative fuels		
Natural gas beyond 2050		
NI		

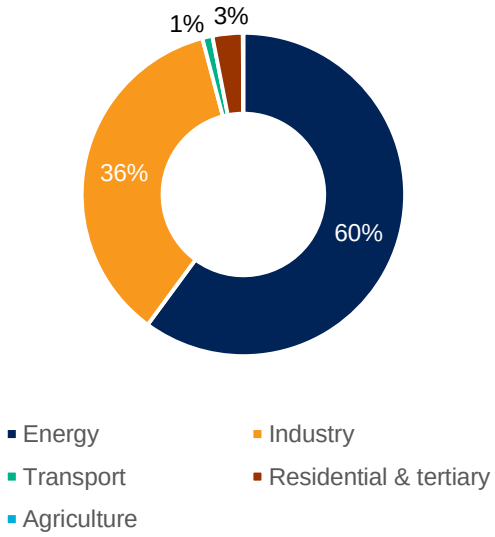
NI – no information

7.9. Finland

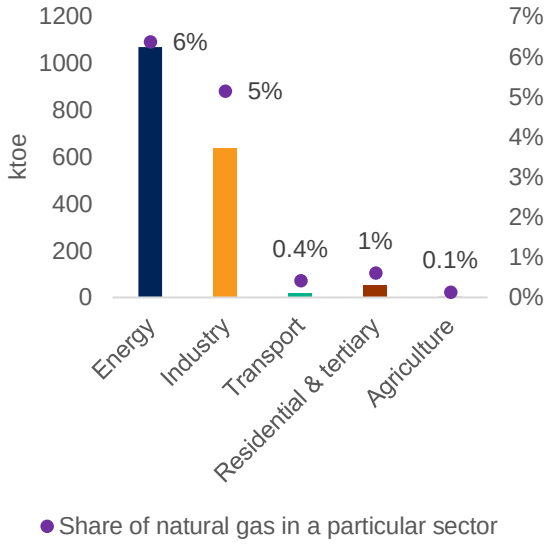
Natural gas in Finland in 2019

Gross inland natural gas consumption	**2 132 ktoe**
Share of natural gas in gross inland energy consumption	**6%**

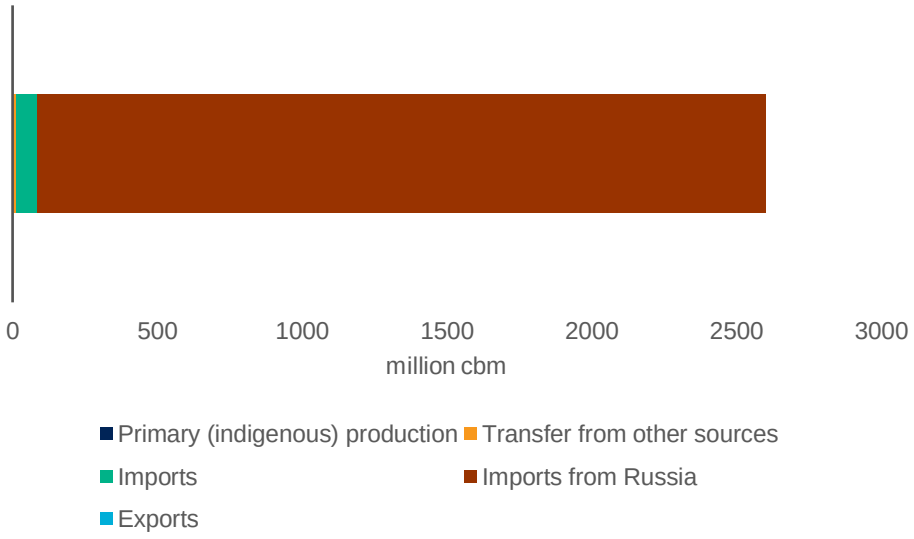
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Finnish LTS[51]

General measures pertaining to natural gas	Fossil fuel consumption will shrink significantly as early as by 2030 under both low-emission scenarios, under which climate neutrality will be achieved by 2035.
	Natural gas is to be completely phased-out by 2050 under the "Savings" scenarios; under the "Continuous Growth" scenario there will

[51] Ministry of Economic Affairs and Employment of the Republic of Finland. (2020). Finland's long-term low greenhouse gas emission development strategy.

	be some remnants of natural gas in 2050 (approx. 2% of PEC and FEC).	
Sectoral approach		
Energy sector	*NI*	
Industry		
Transport	At least 50 000 natural gas-powered vehicles by 2030.	
Residential & tertiary	*NI*	
Agriculture		
Alternative fuels		
General measures	*NI*	
Sector	*Fuels to be used*	*Measure*
Energy sector	*NI*	
Industry		
Transport	Biofuels	The share of biofuels in road transport energy consumption at 30% of the energy content part 2030 (linear growth); a 10% bioliquid blending obligation for light fuel oil used in building-specific heating and for diesel oil used in mobile machinery, with linear growth between 2020 and 2030.
	Electricity	The number of electric vehicles to be at least 250,000 (full electric vehicles, hydrogen-powered vehicles, plug-in hybrids) by 2030.
Residential & tertiary	*NI*	
Agriculture	*NI*	
Natural gas infrastructure		
Natural gas grid	*NI*	
Power and heating plants		
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	*NI*	
Alternative fuels		
Natural gas beyond 2050		
NI		

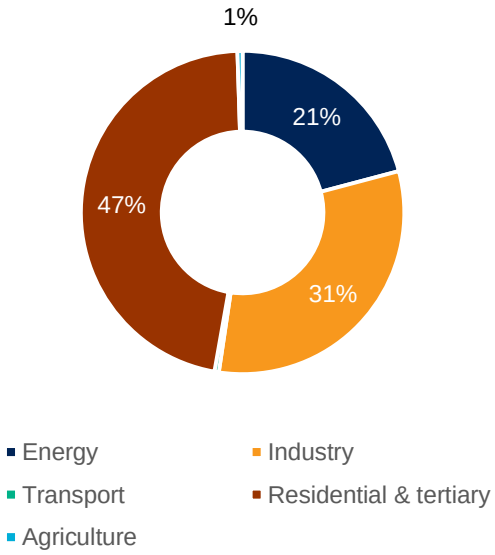
NI – no information

7.10. France

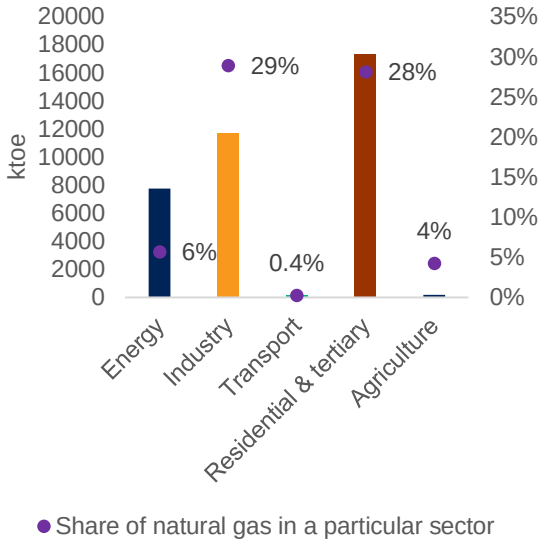
Natural gas in France in 2019

Gross inland natural gas consumption	**37 542.6 ktoe**
Share of natural gas in gross inland energy consumption	**15%**

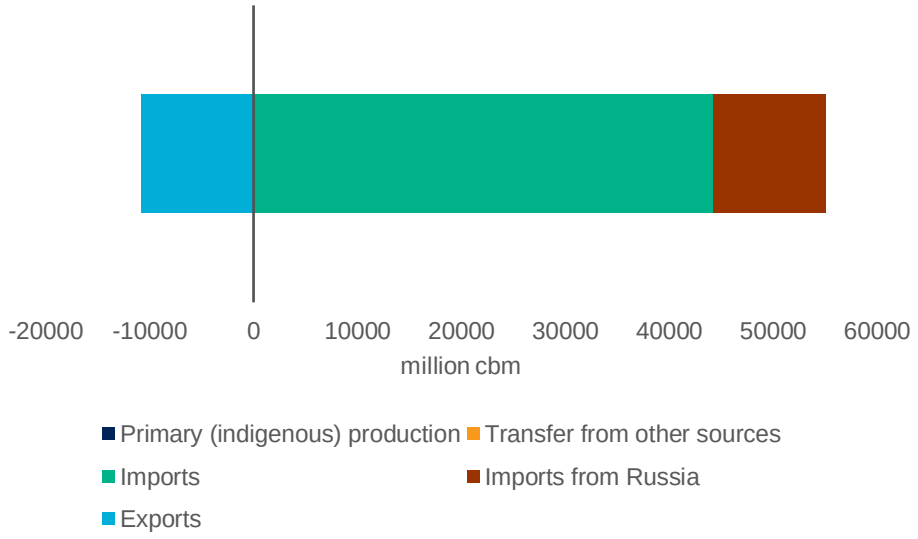
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



French LTS[52]

General measures pertaining to natural gas	Since 2018 the exploration of hydrocarbon reservoirs will be banned; hydrocarbon exploitation permits will not be prolonged beyond 2040 and all still valid concessions will expire on that date.
	In 2030 RES shall be responsible for at least 33% of FEC. This target is broken down between particular sectors and energy carriers (40%

[52] Ministère de la Transition écologique et solidaire. (2020). Stratégie nationale bas-carbone. La transition écologique et solidaire vers la neutralité carbone.

	share of RES in electricity generation, 38% in the final heat consumption, **10% in the final consumption of gas** and 15% in the final consumption of other fuels).	
Sectoral approach		
Energy sector	*NI*	
Industry	Replacing fossil fuels with lower emission energy sources via, for example, replacing coal with biomass, solid recovered fuels (SRF) or natural gas and biogas in industrial sectors that technically cannot do without fuels (industrial processes for which no electrical solution would be possible).	
Transport	In 2040 all new heavy-duty vehicles powered with natural gas will consume up to 15 kg of NG/100 km.	
	Facilitating connections to natural gas refuelling infrastructure.	
Residential & tertiary	*NI*	
Agriculture	*NI*	
Alternative fuels		
General measures	All gas consumed in 2050 and onwards will be carbon-free.	
	In 2050 renewable gas production will amount to between 195 and 295 TWh.	
	The energy system will be virtually carbon free: In 2050 the energy mix will be made up of renewable and recovered heat (90-100 TWh), biomass (400-450 TWh) and carbon-free electricity (600-650 TWh, some electricity will be used for conversions to other energy carriers: hydrogen, gas, etc.).	
Sector	*Fuels to be used*	*Measure*
Energy sector	*NI*	
Industry	Electricity	The electrification rate of the industrial sector will increase to 41% in 2030 and to more than 70% of the sector's final energy consumption by 2050.
	Biomass	Highly efficient use of biomass and RES, favouring local/regional/easily transportable resources.
	Renewable gas from waste	Heat and renewable gas production from waste and reusing it in industrial processes.
Transport	Electricity	The objective of neutrality by 2050 implies a near-total decarbonisation of the transport sector by switching to electric motors, biofuel and biogas depending on the mode of transport.
	Biofuels	A more balanced mix (renewable gas, electricity, biofuels) is sought for goods transport because of the greater constraints in the engines used in this type of transport. Electrification of these vehicles will be slower than in the case of passenger vehicles.

	Biogas	Total decarbonisation of the land, river and (domestic) maritime transport sectors, either by switching to low-emitting (in life cycle) electric engines or by switching to carbon-free alternative fuels (in life cycle analysis). A complete transformation of the vehicle fleet is therefore necessary, as is the development of electric charging and renewable gas distribution infrastructures (biogas, hydrogen etc.). Non-bio-based fuels are reserved in 2050 for air transport and international marine bunkers.
	Renewable gas	
Residential & tertiary	Electricity	The share of gas used in the residential and tertiary sector will decrease sharply. The number of renewable heating and cooling sources in heating networks will increase by a factor of 5 (compared to 2012) by 2030. Until carbon-free electricity and gas are available: High-efficiency heat pumps, and, depending on the geographical conditions, solar thermal collectors and geothermal energy will be prioritized in individual housing; as far as collective housing is concerned, connection to a heating network using both renewable and recovered energy, high-efficiency heat pumps and solar thermal collectors will be promoted (the latter one only if geographical conditions allow for an effective use of that source).
	Renewable gas	
Agriculture	*NI*	
Natural gas infrastructure		
Natural gas grid	*NI*	
Power and heating plants		
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	*NI*	
Alternative fuels		
Natural gas beyond 2050		
NA		

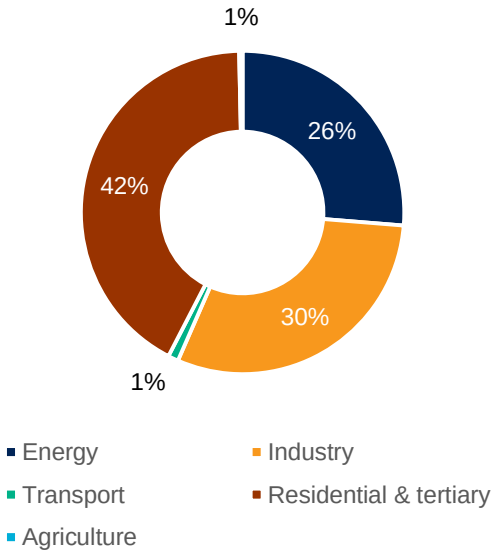
NI – no information
NA – not applicable

7.11. Germany

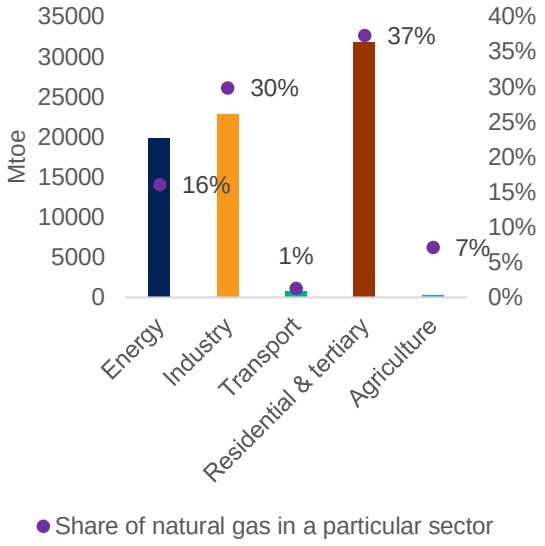
Natural gas in Germany in 2019

Gross inland natural gas consumption	**75 620.4 ktoe**
Share of natural gas in gross inland energy consumption	**25%**

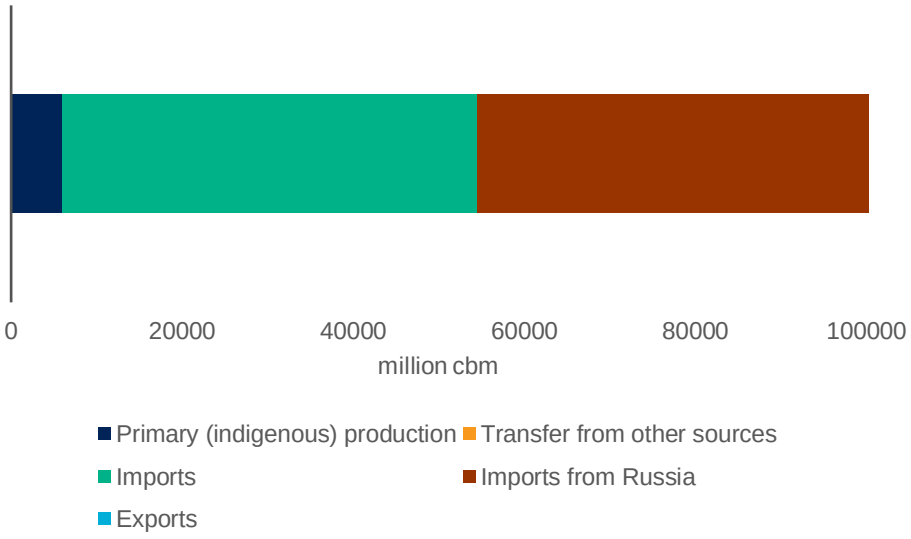
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



German LTS[53]

General measures pertaining to natural gas	Over the coming decades, natural gas shall be replaced with CO2-neutral gas from renewable sources.

Sectoral approach

[53] Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. (2016). Climate Action Plan 2050. Principles and goals of the German government's climate policy.

<table>
<tr><td>Energy sector</td><td colspan="2">Combined heat and power production, preferably based on natural gas, will continue to play an important role in 2030 and probably onwards.</td></tr>
<tr><td>Industry</td><td colspan="2">NI</td></tr>
<tr><td>Transport</td><td colspan="2">Natural gas to play a key role in the gradual transition to mainly electricity-based mobility and in reducing emissions of GHG and other pollutants.
The potential for reducing GHG emissions per vehicle kilometre from heavy goods vehicles is around 30 per cent by 2030 as a result of the use of, i.a., LNG.</td></tr>
<tr><td>Residential & tertiary</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Agriculture</td></tr>
<tr><td colspan="3">Alternative fuels</td></tr>
<tr><td>General measures</td><td colspan="2">NI</td></tr>
<tr><td>Sector</td><td>Fuels to be used</td><td>Measure</td></tr>
<tr><td>Energy sector</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Industry</td></tr>
<tr><td rowspan="3">Transport</td><td>Electricity</td><td rowspan="3">The vehicle fleet is to be powered mainly with electricity.
The potential for reducing GHG emissions per vehicle kilometre from heavy goods vehicles is around 30 per cent by 2030 as a result of the use of, i.a., hydrogen and renewable methane in optimised gas engines.</td></tr>
<tr><td>Hydrogen</td></tr>
<tr><td>Renewable methane</td></tr>
<tr><td>Residential & tertiary</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Agriculture</td></tr>
<tr><td colspan="3">Natural gas infrastructure</td></tr>
<tr><td>Natural gas grid</td><td colspan="2" rowspan="5">New investments in fossil energy infrastructure and the resulting lock-in effects are to be avoided.</td></tr>
<tr><td>Power and heating plants</td></tr>
<tr><td>Filling stations</td></tr>
<tr><td>Storage sites</td></tr>
<tr><td>LNG terminals</td></tr>
<tr><td colspan="3">Security of supply</td></tr>
<tr><td>Natural gas</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Alternative fuels</td></tr>
<tr><td colspan="3">Natural gas beyond 2050</td></tr>
<tr><td colspan="3">NI</td></tr>
</table>

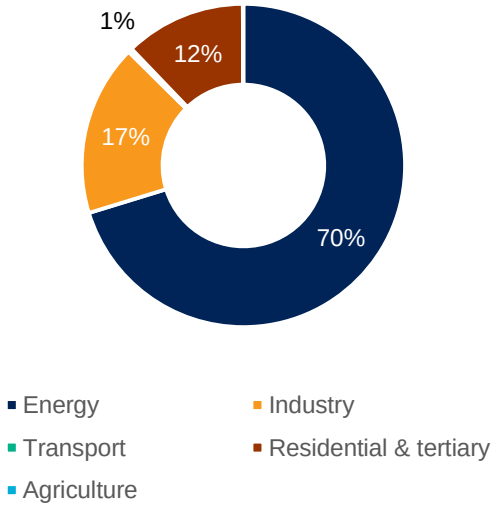
NI – no information

7.12. Greece

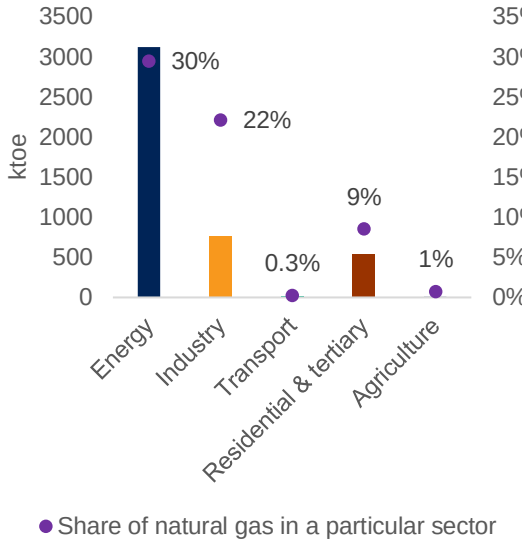
Natural gas in Greece in 2019

Gross inland natural gas consumption	**4 489.3 ktoe**
Share of natural gas in gross inland energy consumption	**19%**

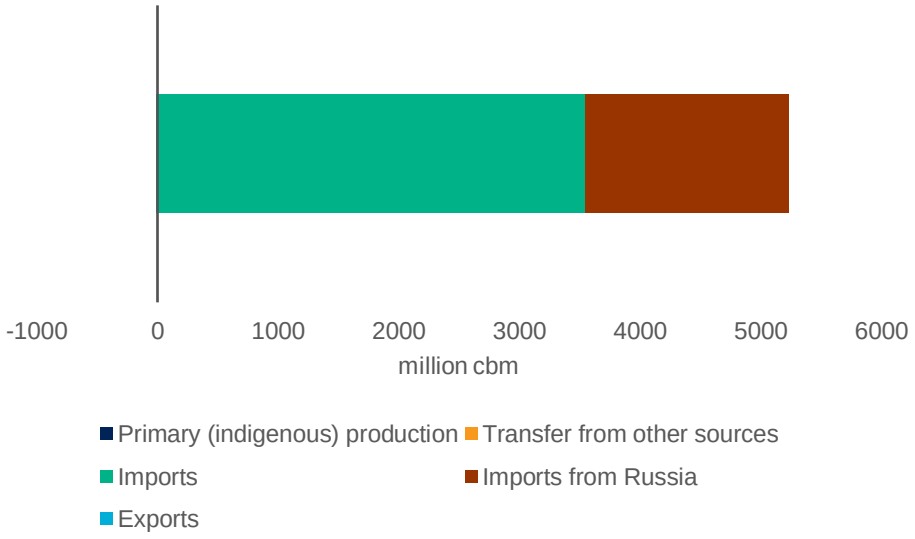
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



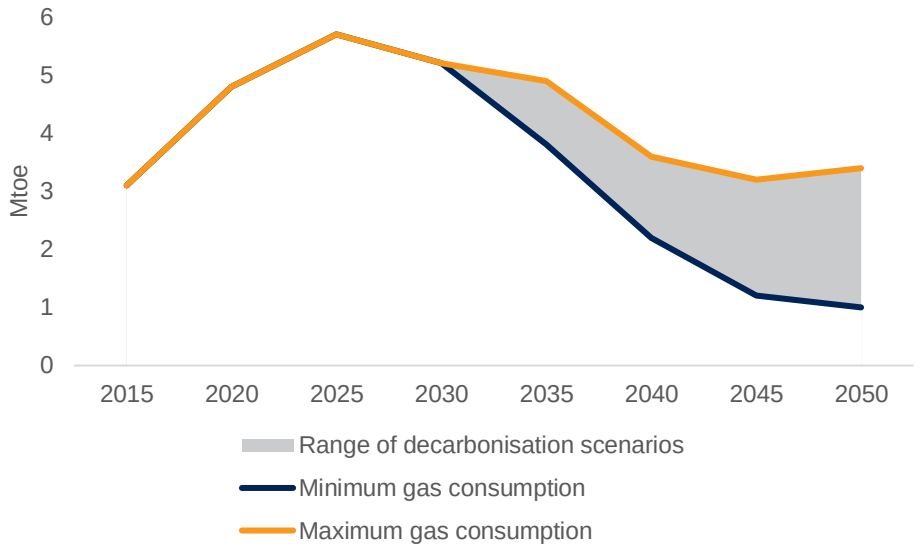
Greek LTS[54]

General measures pertaining to natural gas	The LTS presents four low-carbon scenarios up to 2050, two of which correspond to strategies to achieve the 2°C climate target and two scenarios compatible with the 1.5°C climate target: **Energy Efficiency and Electrification for 2°C** (**EE2**): 'very ambitious' measures for the electrification of energy uses in all sectors and the improvement of energy efficiency;

[54] Government of the Hellenic Republic. (2019). The Long-term Strategy for the year 2050.

	New Energy Carriers for 2°C (**NC2**): energy efficiency and electrification measures (at a lower level than EE2), complemented by 'very ambitious' EU policies to boost hydrogen, biogas, and synthetic methane; **Energy Efficiency and Electrification for 1.5°C** (**EE1.5**); as for EE2, but at 'maximum ambition' level; **New Energy Carriers for 1.5°C** (**NC1.5**): as for NC2, but at 'maximum ambition' level[55].
	In the period up to 2030 the role of natural gas as a transition fuel is confirmed. But the use of natural gas in the long term is inconsistent with climate neutrality unless carbon capture and storage is implemented on a large scale.

Evolution of the primary gas* consumption until 2050 under the low-carbon scenarios

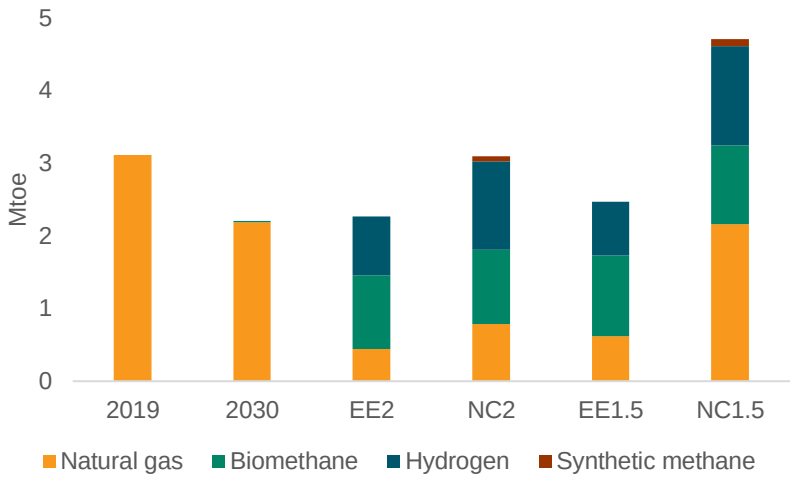
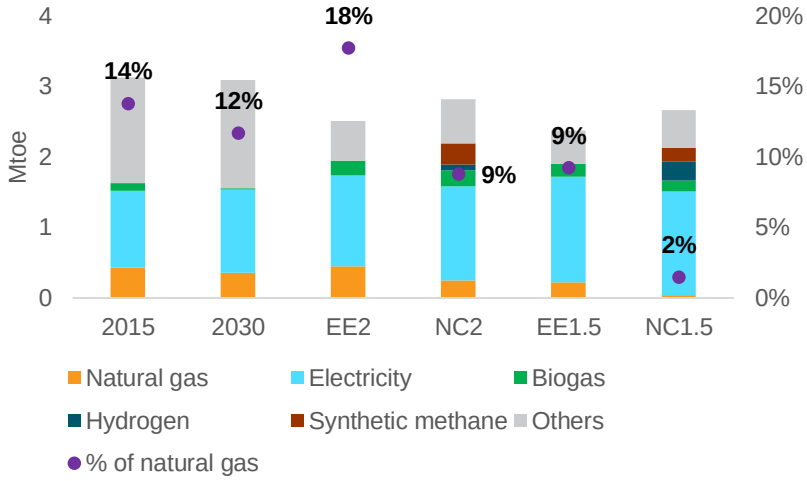


**The Greek LTS does not always distinguish between natural gas and renewable gas; natural and synthetic gas (excluding hydrogen) are meant here*

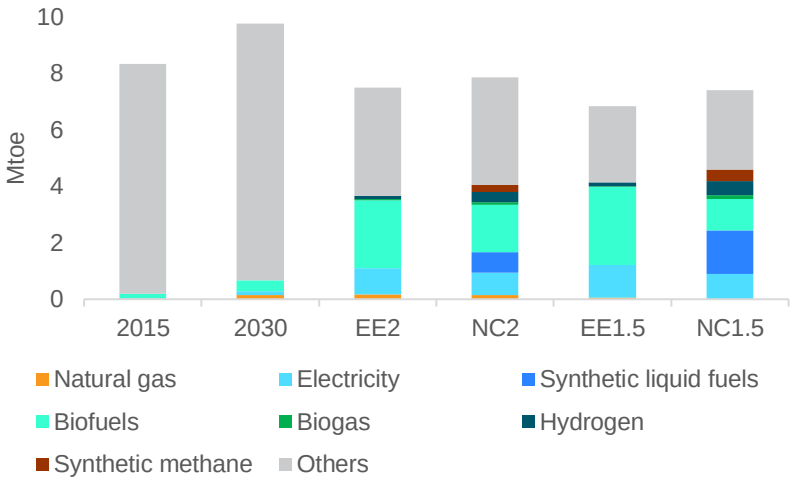
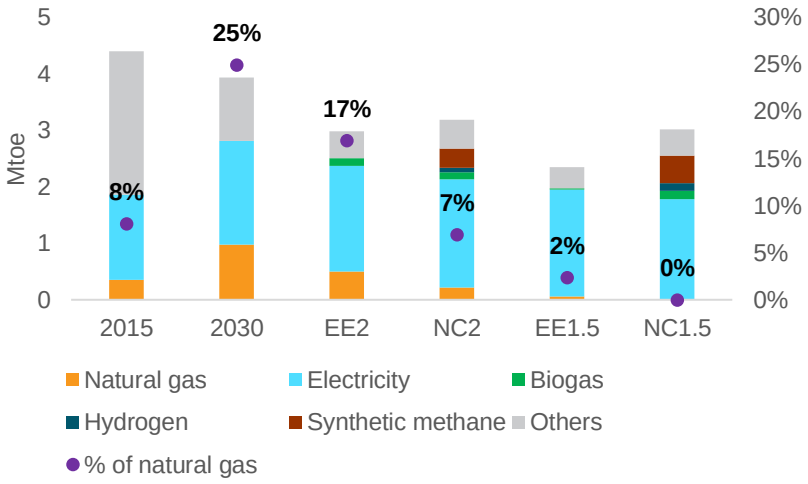
Source: WiseEuropa based on the Greek LTS[56]

Sectoral approach	
Energy sector	In 2050, the carbon footprint of electricity generation results only from the burning of small amounts of gas for the long-term balancing and reserve purposes under the 2°C scenarios, while in the 1.5°C scenarios it becomes negative through the application of carbon dioxide capture and storage installations which are applied to gas units but also to biomass units (CCS is not developed in the case of the 1.5°C scenarios).
	The fuel of the thermal units must be climate neutral (e.g. biogas, hydrogen or synthetic methane) or the carbon dioxide capture and storage technique must be applied (in natural gas units). The use of fossil fuels (mainly natural gas) as an operating reserve has the effect of continuing to emit carbon dioxide by the power generation sector.

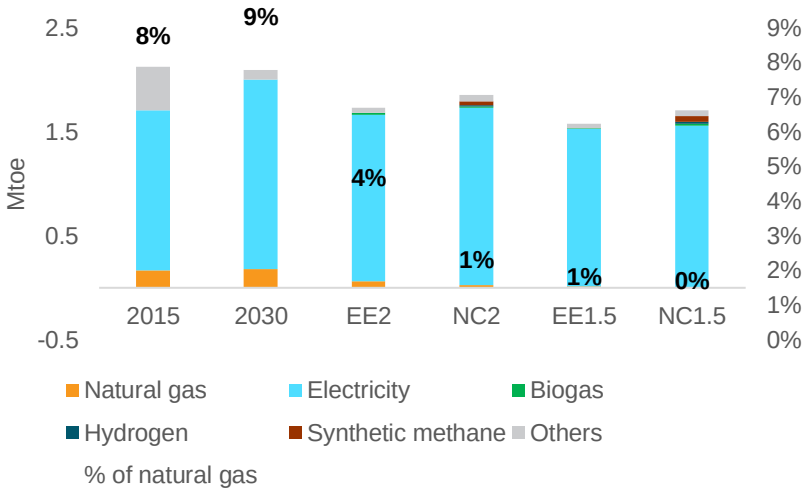
[55] Country table for Greece prepared by a team led by the consultancy Ricardo, as part of a contract to support DG CLIMA with the assessment of the Long-Term Strategies of EU Member States.
[56] Ibid. p. 25.

	In the EE1.5 and NC1.5 scenarios the combustion of natural gas is not allowed unless CCS is present.
	Evolution of the gas consumption in the energy sector until 2050 under the low-carbon scenarios
	
	Source: WiseEuropa based on the Greek LTS[57]
Industry	A switch to natural gas from petroleum products and solid fuels. The use of solid fuels is quite limited in Greece, mainly because there are no blast furnaces in Greece and there is no organized supply system for hard coal and coke. The use of oil is quite widespread and its substitution with natural gas will have a small but still positive impact on carbon dioxide emissions. This substitution is already taking place and is expected to be continued during the first decade, i.e. until 2030. There is a little potential to further reduce emissions through an increase in the natural gas use in industry after 2030.
	Evolution of the structure of the final energy consumption in the industrial sector until 2050 under the low-carbon scenarios
	
	Source: WiseEuropa based on the Greek LTS[58]

[57] Ibid. p. 55.
[58] Ibid. p. 37.

Transport	The use of LNG is expected in a maritime transport, also in the long term, but only if this fuel will become climate neutral in the future (i.e. it is biomethane or synthetic climate neutral methane).
	Evolution of the structure of the final energy consumption in the transport sector until 2050 under the low-carbon scenarios
	 *Source: WiseEuropa based on the Greek LTS*[59]
Residential & tertiary	**Evolution of the structure of the final energy consumption in households until 2050 under the low-carbon scenarios**
	 *Source: WiseEuropa based on the Greek LTS*[60]
	Evolution of the structure of the final energy consumption in services until 2050 under the low-carbon scenarios

[59] Ibid. p. 42.
[60] Ibid. p. 29.



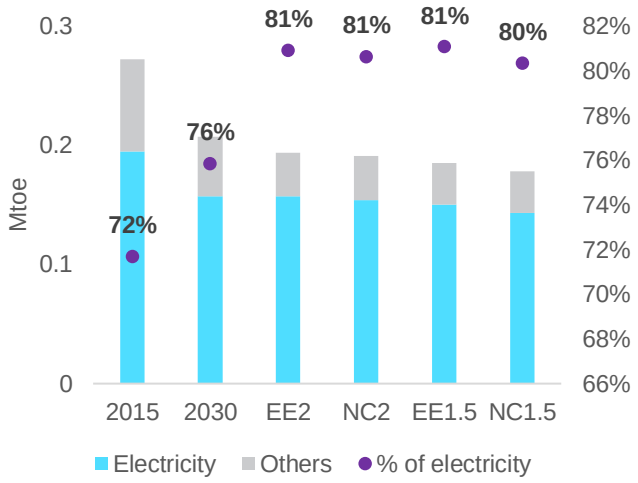
Source: WiseEuropa based on the Greek LTS[61]

Agriculture	For details on the fuel composition of the energy consumption in the agricultural sector see: *Alternative fuels*.

Alternative fuels

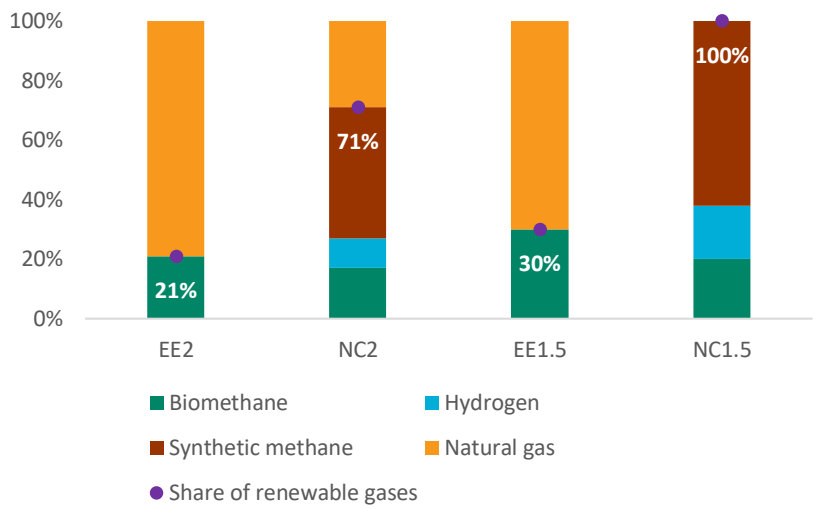
General measures	Since the available CO_2 storage potential is limited, it is necessary to gradually change the composition of the gas consumption in the direction of climate neutrality. Climate neutral gases are biogas, hydrogen and synthetic methane.	
Sector	*Fuels to be used*	*Measures*
Energy sector	Biomethane	Biogas offers a relatively cheap low-emissions solution to power generation, as well as an opportunity to form negative (by contract) emissions if used by CCS plants. Hydrogen and synthetic methane are used to a lesser extent, but their presence is valuable as they constitute a key chemical energy storage mechanism. These synthetic fuels are produced in periods where there is a surplus of RES and are consumed by generating stations in periods of deficit of RES production in relation to the electrical load of the system. For details on the fuel composition of the energy consumption in the energy sector see: *Sectoral approach*.
	Hydrogen	
	Synthetic methane	
Industry	Electricity	The complete electrification of industrial processes is not feasible and the use of fuels in high-temperature furnaces, glass manufacturing and elsewhere will remain. For details on the fuel composition of the energy consumption in the industrial sector see: *Sectoral approach*.
	Biogas	
	Hydrogen	
	Synthetic methane	

[61] Ibid. p. 30.

<table>
<tr><td rowspan="6">Transport</td><td>Electricity</td><td rowspan="6">Lignocellulosic biomass is suitable for the production of new generation biofuels with the lowest possible carbon footprint that will replace fossil fuels in transport, without affecting the food and feed market.
For details on the fuel composition of the energy consumption in the transport sector see: Sectoral approach.</td></tr>
<tr><td>Synthetic liquid fuels</td></tr>
<tr><td>Biofuels</td></tr>
<tr><td>Biogas</td></tr>
<tr><td>Hydrogen</td></tr>
<tr><td>Synthetic methane</td></tr>
<tr><td rowspan="4">Residential & tertiary</td><td>Electricity</td><td rowspan="4">For details on the fuel composition of the energy consumption in the residential & tertiary sectors see: Sectoral approach.</td></tr>
<tr><td>Biogas</td></tr>
<tr><td>Hydrogen</td></tr>
<tr><td>Synthetic methane</td></tr>
<tr><td>Agriculture</td><td>Electricity</td><td>Evolution of the structure of the final energy consumption in agriculture until 2050 under the low-carbon scenarios
 

Source: WiseEuropa based on the Greek LTS[62]</td></tr>
<tr><td colspan="3">Natural gas infrastructure</td></tr>
<tr><td colspan="3">The maturation of natural gas liquefaction and regasification technologies (as well as hydrogen to a lesser extent) will enable the distribution and use of gaseous fuels in areas not covered by the natural gas transmission and distribution system. Such examples are refuelling stations.</td></tr>
<tr><td rowspan="2">Natural gas grid</td><td colspan="2">Natural gas will not be the main component of the distribution system and gas market in the future. Gas networks will progressively integrate mixtures of other gases with a smaller (or even zero) carbon footprint such as biomethane, hydrogen and synthetic methane.</td></tr>
<tr><td colspan="2">Renewable gases in the Greek gas grid in 2050 under the low-carbon scenarios</td></tr>
</table>

[62] Ibid. p. 31.



Source: WiseEuropa based on the Greek LTS[63]

Power and heating plants	*NI*
Filling stations	
Storage sites	
LNG terminals	
Security of supply	
Natural gas	It is possible to develop decentralized hydrogen and biomethane production and distribution units depending on the geographical distribution of resources. Consequently, the mixing of the gases will be done at various points in the network and not at high pressure, as natural gas is injected today. The conventional gas import model with few import points (connections through pipelines, a few LNG regasification terminals) is being replaced by a system in which there is an injection of domestic quantities of gas into the transmission or distribution system. Relevant regulations need to be completely revised to make such a zero carbon footprint gas market model work.
Alternative fuels	
Natural gas beyond 2050	
Power generation is the only sector that still uses significant amounts of natural gas, but mainly in plants equipped with CCS technologies, thereby minimizing the carbon footprint of their plants.	

NI – no information

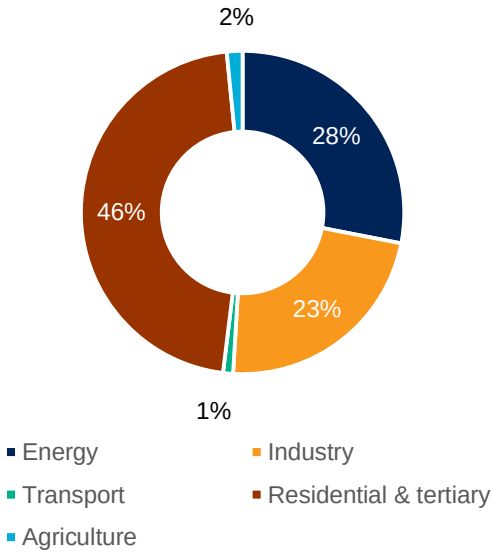
[63] Ibid. p. 54.

7.13. Hungary

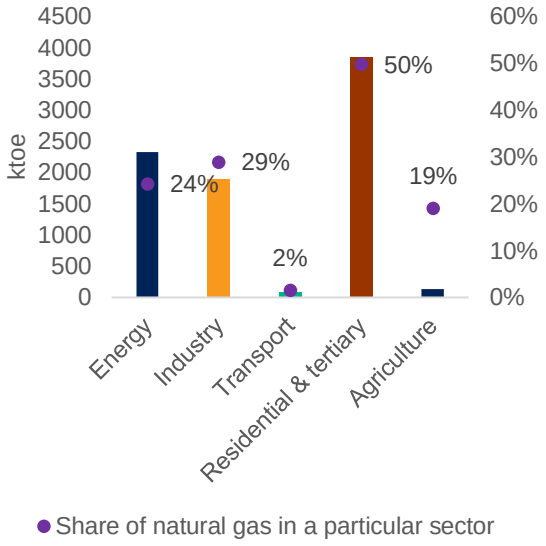
Natural gas in Hungary in 2019

Gross inland natural gas consumption	**8 464.3 ktoe**
Share of natural gas in gross inland energy consumption	**32%**

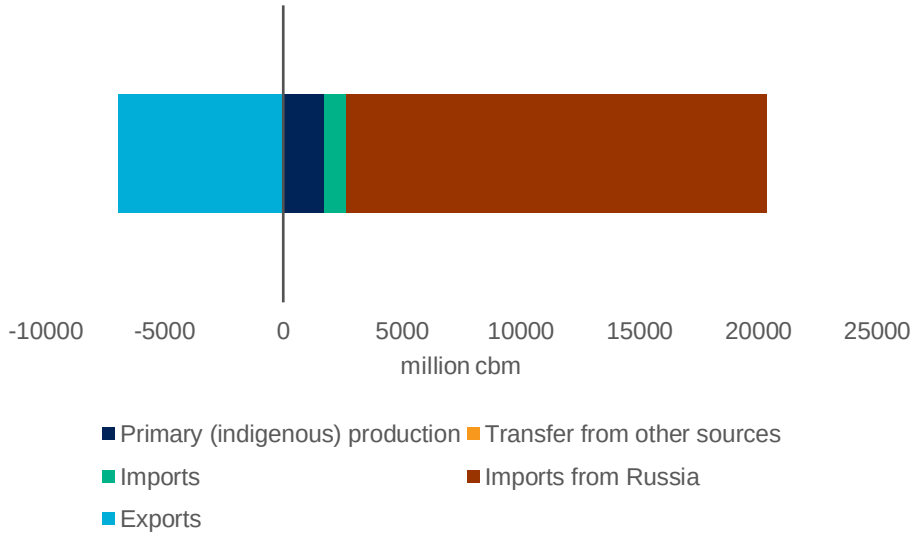
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply

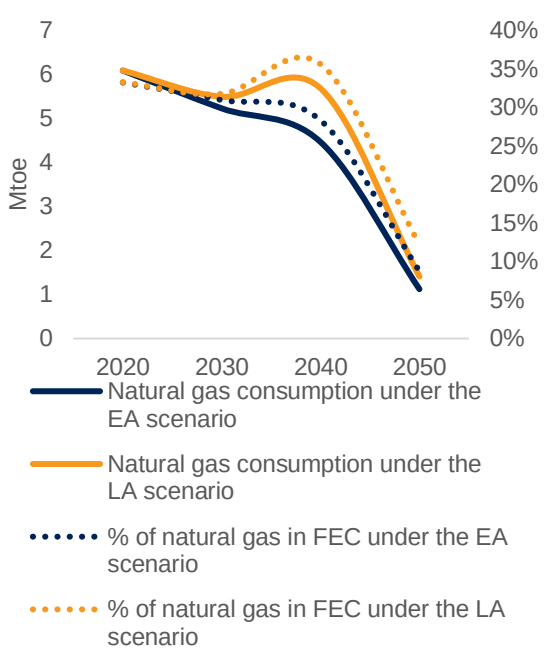
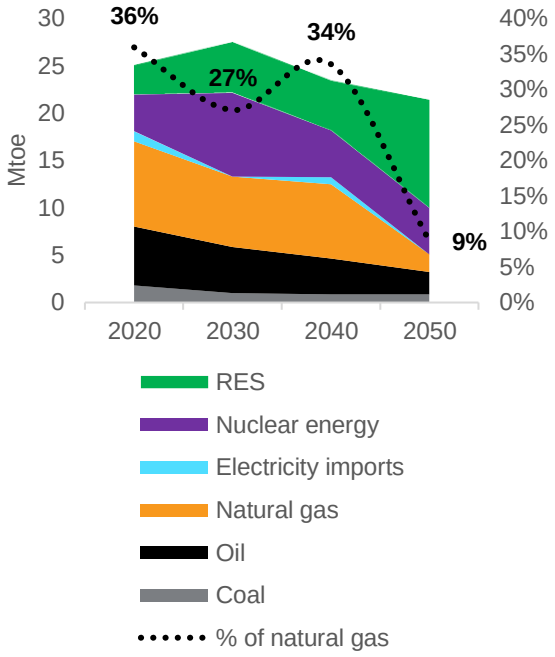


Hungarian LTS[64]

General measures pertaining to natural gas	Hungarian LTS envisages two decarbonisation scenarios: **Late action** (**LA**) climate neutrality scenario: This scenario aims to reduce emissions in the energy sector at a delayed and slower pace until 2045, and then with an increased effort until 2050; **Early action** (**EA**) climate neutrality scenario: The EA approach envisages achieving climate neutrality by 2050 while considering the

[64] Ministry for Innovation and Technology. (2021). National Clean Development Strategy 2020-2050.

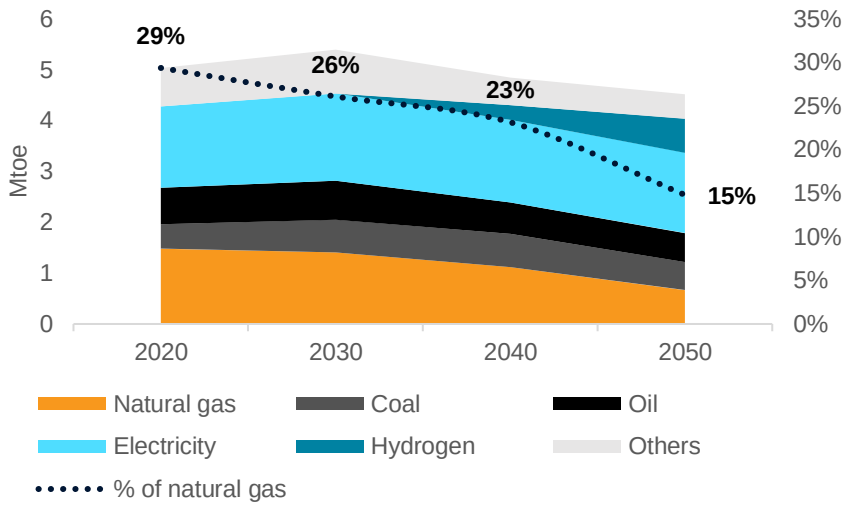
	short- and medium-term benefits of job creation and a reduction of environmental externalities, the economic potential of the first mover, improved productivity, and higher GDP growth.

Natural gas in FEC under the EA and LA scenarios until 2050	**Fuel composition of PEC under the EA scenario until 2050**
	
Source: WiseEuropa based on the Hungarian LTS[65]	*Source: WiseEuropa based on the Hungarian LTS*[66]

Sectoral approach

Energy sector	Under the EA scenario (*NI* for the LA scenario) the installed electricity capacities based on natural gas will not be developed and will be decommissioned in 2040s, as fossil fuels are being phased out of the electricity mix.
Industry	**Distribution of energy consumption in the industrial sector in the EA scenario**

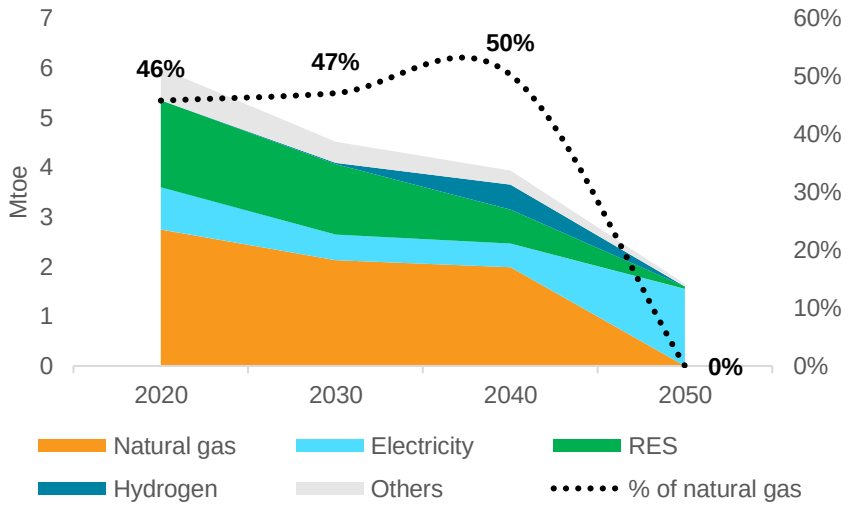
[65] Ibid. p. 12.
[66] Ibid. p. 43.



Source: WiseEuropa based on the Hungarian LTS[67]

Transport	Very limited role of natural gas in the transport sector under the EA scenario (*NI* for the LA scenario): negligible amounts of LNG and some quantities of CNG (3-4% share in total energy consumption in the transport sector, and only until 2030s) are forecasted. Raw natural gas is however planned to power some vehicles in the longer perspective, as its share in total energy consumption in the transport sector is to be 2%.
Residential & tertiary	Natural gas phase-out in households in the 2040s.

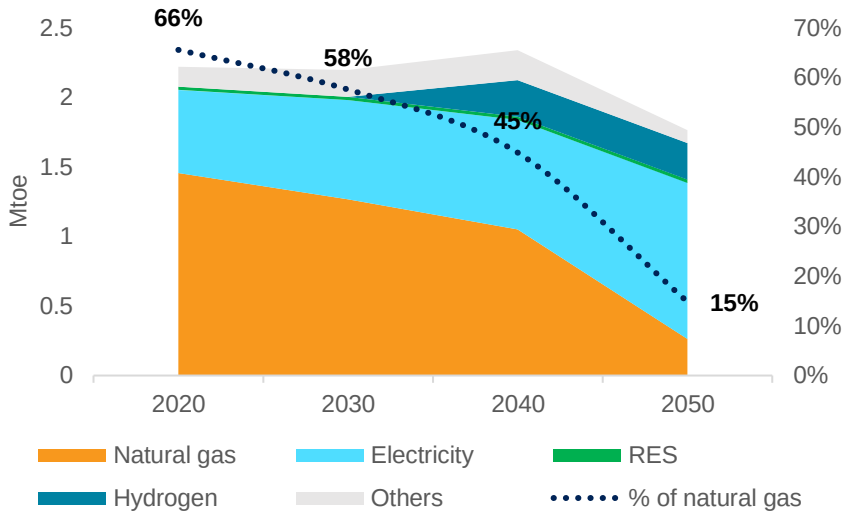
Distribution of energy consumption of the household sector in the EA scenario



Source: WiseEuropa based on the Hungarian LTS[68]

Distribution of energy consumption in the service sector in the EA scenario

[67] Ibid. p. 49.
[68] Ibid. p. 48.

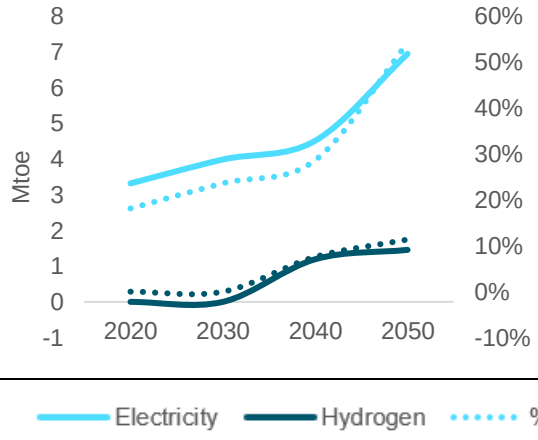
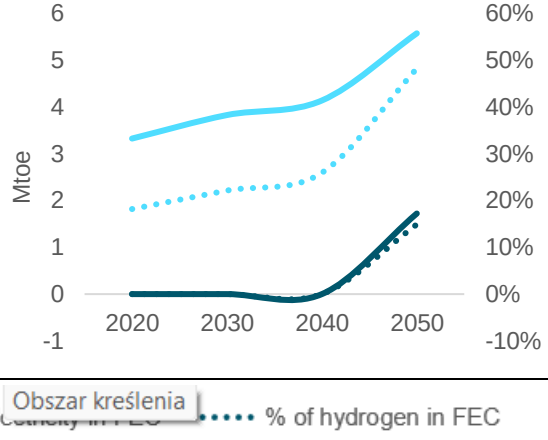


Source: WiseEuropa based on the Hungarian LTS[69]

Agriculture	*NI*

Alternative fuels

General measures	A significant change, which will start in the 2040s according to both EA and LA scenarios, is the decline in natural gas consumption and the complete disappearance thereof in some sectors. Natural gas is partly replaced by hydrogen, mainly in the transport and industrial sectors. By 2040, hydrogen will already play an important role in both climate neutrality scenarios. By 2050, hydrogen will account for 11% and 15% of final energy consumption in the EA and LA scenarios, respectively.
	High degree of electrification.

Electricity and hydrogen in FEC under the EA scenario	**Electricity and hydrogen in FEC under the LA scenario**
	

Source: WiseEuropa based on the Hungarian LTS[70]

Sector	*Fuels to be used*	*Measures*

[69] Ibid.
[70] Ibid. p. 12.

Energy sector	Hydrogen	The EA scenario will integrate earlier CCUS technologies and hydrogen use into the power generation.
Industry	Hydrogen	The consumption of electricity in the industry in 2050 (under the EA scenario, *NI* for the LA scenario) does not diverge from the level of consumption in 2016 (57 PJ in 2016 vs. 66 PJ in 2050, which in both cases translates into over 30% of total energy consumption in the industrial sector). Under the EA scenario (*NI* for the LA scenario) hydrogen is to account for 6% and 15% of total energy consumption in the industrial sector in 2040 and 2050, respectively. For details on the fuel composition of the energy consumption in the industrial sector under the EA scenario see: *Sectoral approach*.
	Electricity	
Transport	Electricity	The transport sector is to be highly electrified: in 2050 the share of electricity in the energy consumption in the transport sector is to be 59%. Hydrogen will appear to a greater extent in the 2040s, and by 2050 its share will be significant (7%). The biofuel share will be twice as much (15%)*, with the rise of second-generation biofuels, and the relegation of first-generation biofuels to the background. *these estimates are for the EA scenario (*NI* for the LA scenario).
	Biofuels	
	Hydrogen	
Residential & tertiary	Electricity	In the EA scenario (*NI* for the LA scenario) in 2040, hydrogen will appear as energy blended into the natural gas grid, but this is more of a temporary solution as electricity will remain the only widely available, zero emission fuel in the long run. For details on the fuel composition of the energy consumption in the residential & tertiary under the EA scenario see: *Sectoral approach*.
	Hydrogen	
Agriculture	*NI*	
Natural gas infrastructure		
Natural gas grid	Hydrogen will be partly blended into the natural gas grid. The maximum blending rate in 2050 is 50%. This is a theoretical average value, which shows that half of the domestic gas consumption (theoretical mixture of hydrogen and natural gas) will consist of half natural gas and half hydrogen. There will be dedicated hydrogen pipelines that will supply 100% pure hydrogen as well as sectors and activities where pure hydrogen will be needed (e.g., transport, industrial raw materials). The 50% of hydrogen will not be fed into the natural gas network.	
Power and heating plants	*NI*	

Filling stations	
Storage sites	
LNG terminals	
Security of supply	
Natural gas	An increase in the use of renewable energy will greatly contribute to a large decrease in energy imports, thus contributing to an increase in energy security. This affects all areas of the energy sector: the electricity sector, oil consumption, and the reduction of natural gas import demand through the reduction of natural gas consumption.
Alternative fuels	*NI*
Natural gas beyond 2050	
Although some quantities of natural gas are to remain in 2050 (e.g. in the industrial and tertiary sector) no particular details are provided in the Hungarian LTS on how they will be approached, for example whether CCUS technologies will be applied to them.	

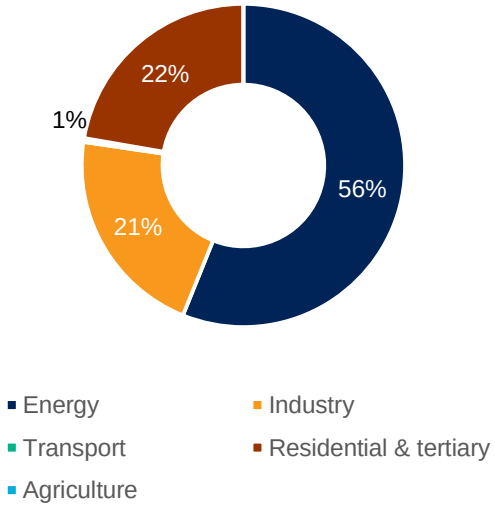
NI – no information

7.14. Ireland

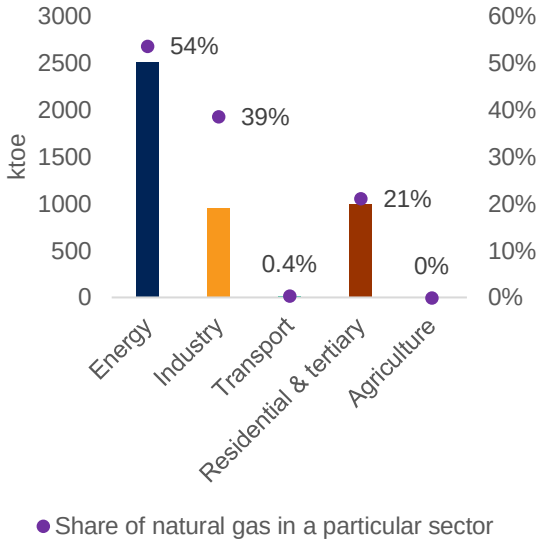
Natural gas in Ireland in 2019

Gross inland natural gas consumption	**4 560.1 ktoe**
Share of natural gas in gross inland energy consumption	**30%**

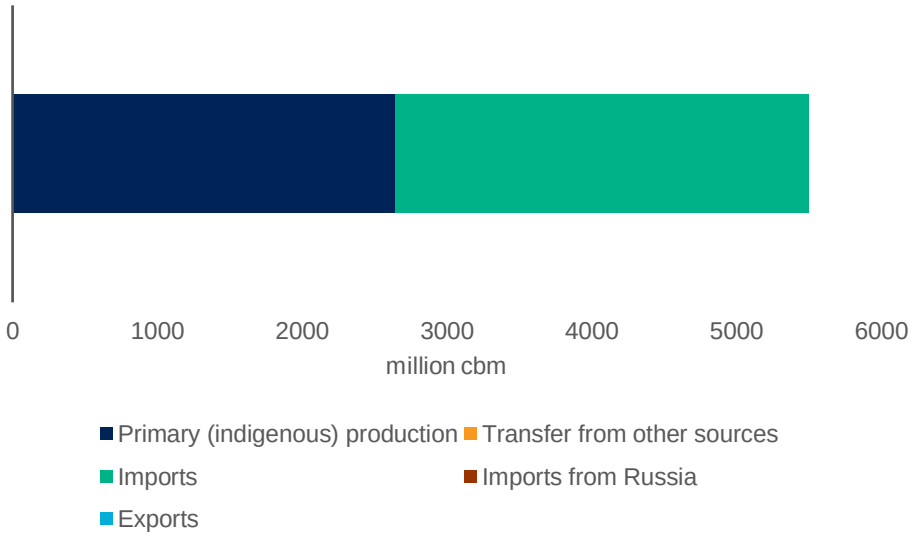
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply

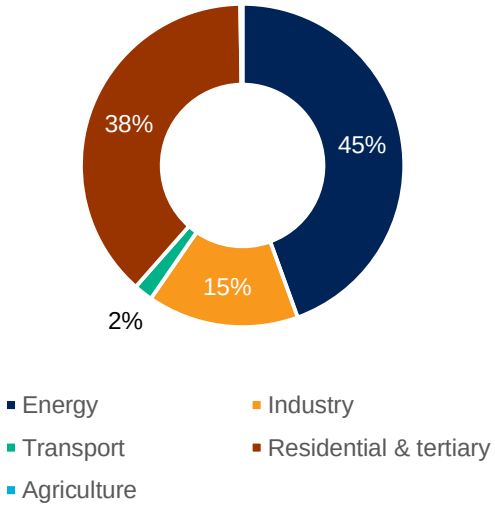


7.15. Italy

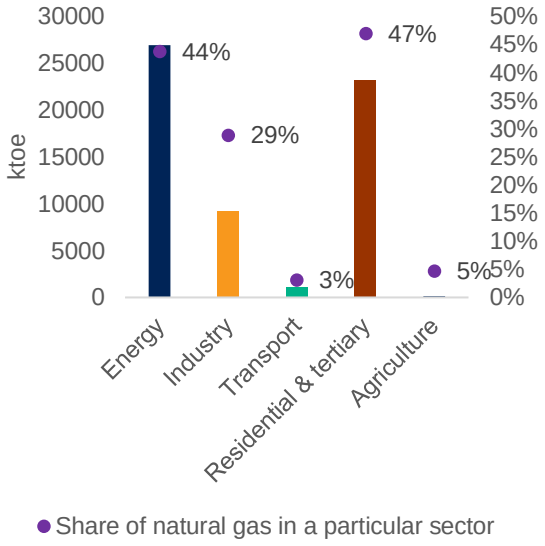
Natural gas in Italy in 2019

Gross inland natural gas consumption	**60 949 ktoe**
Share of natural gas in gross inland energy consumption	**39%**

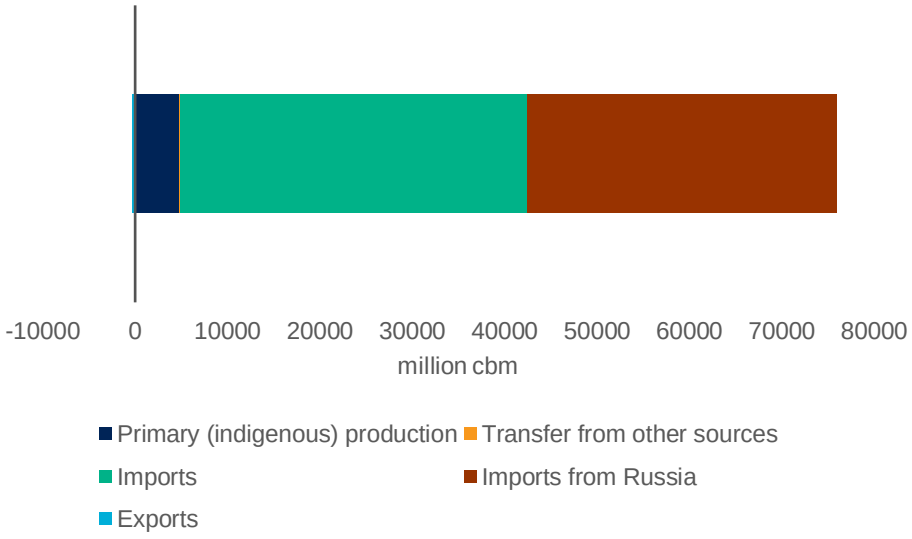
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Italian LTS[71]

General measures pertaining to natural gas	In 2050 the share of natural gas in FEC will be 3% (which is 3 Mtoe).

Sectoral approach

[71] (2021). Strategia Italiana di lungo termine sulla riduzione delle emissioni dei gas a effetto serra.

Energy sector	Natural gas is to be responsible for approx. 7% energy generated in Italy in 2050.	
Industry	In the long term, i.e. until 2050, the share of natural gas in the industrial sector will shrink to 14%, which is 3 Mtoe. Therefore, the industrial sector will be responsible for the entire final consumption of natural gas in 2050.	
Transport	Natural gas vehicles will play a limited role in the transition process of the transport sector, as in 2050 the number of natural gas vehicles is expected to be negligible.	
Residential & tertiary	Natural gas is to be phased out in residential heating and cooking by 2050, and replaced by electricity.	
Agriculture	*NI*	
Alternative fuels		
General measures	A significant share of electricity, at least 25- 30%, is to be used for the production of hydrogen (particularly in the overgeneration phase).	
Sector	*Fuels to be used*	*Measure*
Energy sector	*NI*	
Industry	Hydrogen	Hydrogen is a valid option for replacing natural gas in all high process temperature applications.
Transport	Electricity	In 2050 approx. 80% of vehicles will be powered by electricity, approx. 17% will be hydrogen-fuelled and approx. 4% will be powered by green synthetic fuels.
	Hydrogen	
	Green synthetic fuels	
Residential & tertiary	Electricity	Heat sources powered by fossil fuels are to be replaced by electric reversible heat pumps. It is estimated that in the residential sector approx. 70% of buildings can use an electric heat pump as their main heating system. Electricity will also replace natural gas in cooking systems.
Agriculture	Electricity	Small electric agricultural machinery will be introduced by 2050.
Natural gas infrastructure		
Natural gas grid	The substitution of natural gas with hydrogen will require an upgrade and an overall reconfiguration of the gas grid: some segments will be dedicated exclusively to the transport of hydrogen; peripheral sections of the distribution grid, where local communities will be served by independent local systems, could be closed; an appropriate coupling of the electricity and gas sectors will take place.	
Power and heating plants	*NI*	
Filling stations		
Storage sites		

LNG terminals	
Security of supply	
Natural gas	*NI*
Alternative fuels	
Natural gas beyond 2050	
Remaining natural gas capacities and industrial plants using natural gas will be integrated with carbon capture and storage system.	

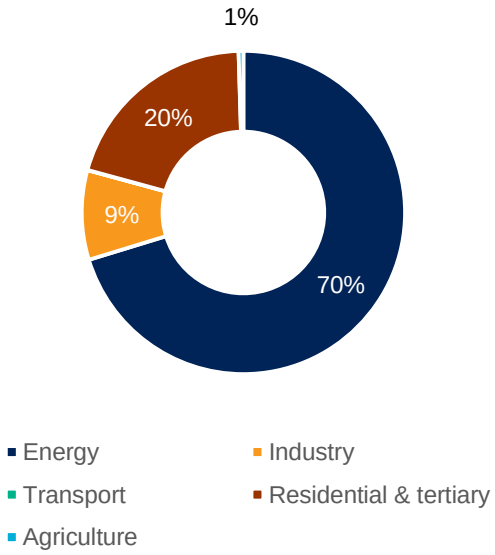
NI – no information

7.16. Latvia

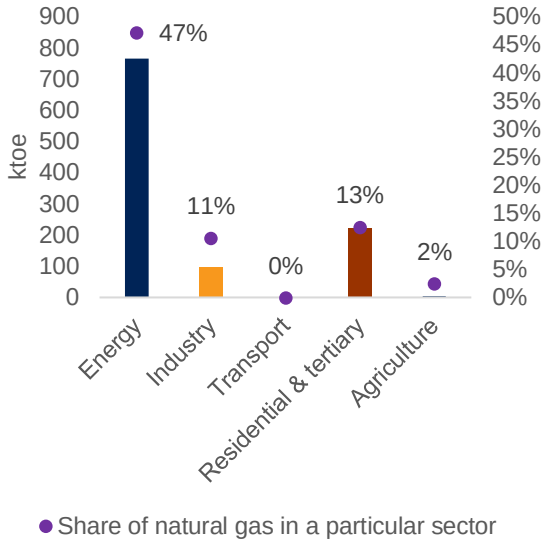
Natural gas in Latvia in 2019

Gross inland natural gas consumption	**1 103.3 ktoe**
Share of natural gas in gross inland energy consumption	**24%**

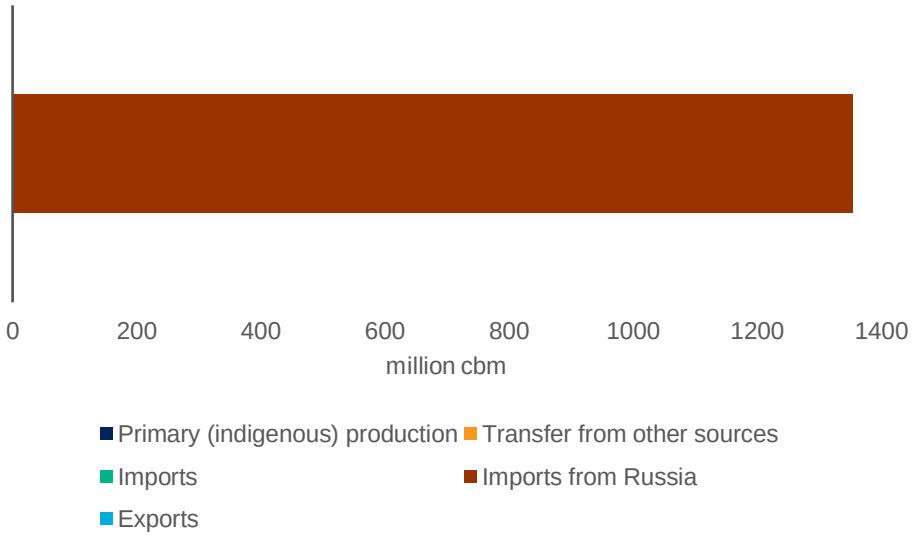
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Latvian LTS[72]

General measures pertaining to natural gas	The State will not subsidise the use of fossil energy sources.

Sectoral approach

[72] Ministry of Environmental Protection and Regional Development of the Republic of Latvia. (2019). Strategy of Latvia for the Achievement of Climate Neutrality by 2050.

<table>
<tr><td>Energy sector</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Industry</td></tr>
<tr><td>Transport</td><td colspan="2">Two CNG filling stations are planned to be opened in Riga.</td></tr>
<tr><td>Residential & tertiary</td><td colspan="2">Switching of the heating fuel from liquid and solid fuels to natural gas.</td></tr>
<tr><td>Agriculture</td><td colspan="2">NI</td></tr>
<tr><td colspan="3">Alternative fuels</td></tr>
<tr><td>General measures</td><td colspan="2">One of the essential factors for the reduction of GHG emissions from the energy sector in the total balance sheet is the replacement of fossil energy sources with biomass and other types of RES.</td></tr>
<tr><td>Sector</td><td>Fuels to be used</td><td>Measure</td></tr>
<tr><td>Energy sector</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Industry</td></tr>
<tr><td rowspan="5">Transport</td><td>Electricity</td><td rowspan="5">Transition of the private road transport to electric drive, the use of synthetic fuel, biofuel (not first-generation biofuel), biomethane, hydrogen, and other non-fossil fuels is to take place.</td></tr>
<tr><td>Synthetic fuels</td></tr>
<tr><td>Biofuels</td></tr>
<tr><td>Biomethane</td></tr>
<tr><td>Hydrogen</td></tr>
<tr><td>Residential & tertiary</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Agriculture</td></tr>
<tr><td colspan="3">Natural gas infrastructure</td></tr>
<tr><td>Natural gas grid</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Power and heating plants</td></tr>
<tr><td>Filling stations</td><td colspan="2">Biomethane can be introduced into the CNG infrastructure instead of natural gas.</td></tr>
<tr><td>Storage sites</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>LNG terminals</td></tr>
<tr><td colspan="3">Security of supply</td></tr>
<tr><td>Natural gas</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Alternative fuels</td></tr>
<tr><td colspan="3">Natural gas beyond 2050</td></tr>
<tr><td colspan="3">NI</td></tr>
</table>

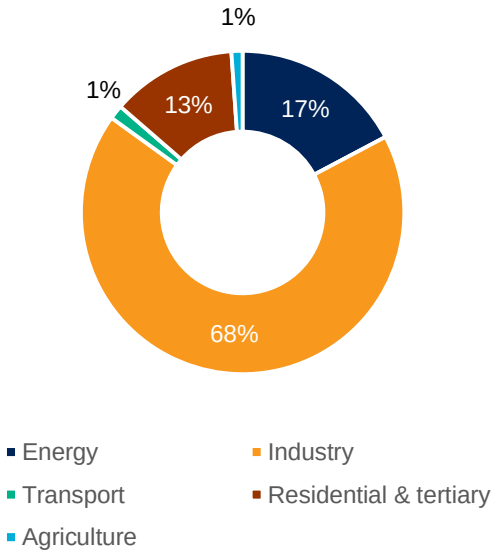
NI – no information

7.17. Lithuania

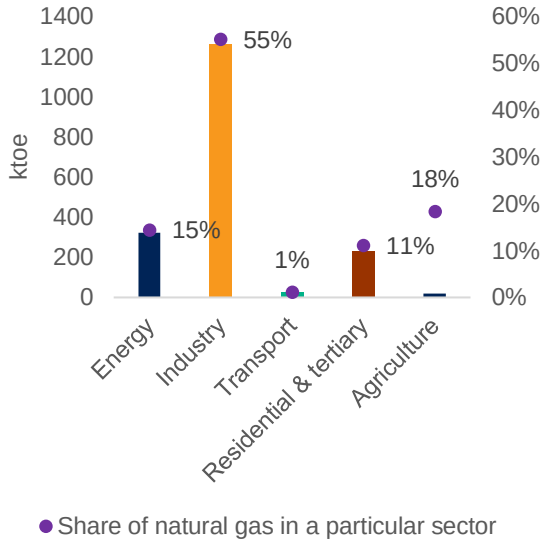
Natural gas in Lithuania in 2019

Gross inland natural gas consumption	**1 864.4 ktoe**
Share of natural gas in gross inland energy consumption	**24%**

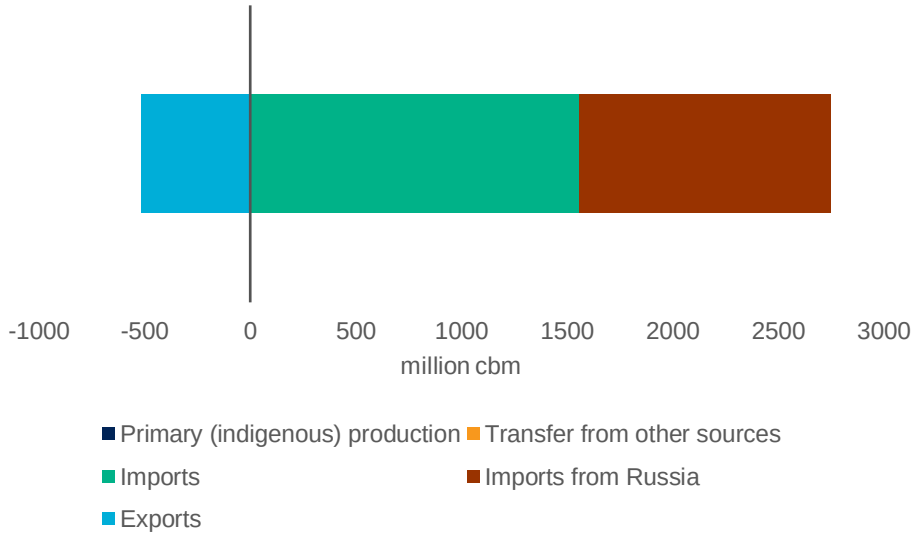
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Lithuanian LTS[73]

General measures pertaining to natural gas	The number of households connected to district heating systems will double and the share of energy from RES will be at least 95% in the district heating sector by 2040.
	Fossil fuels in industries covered by the EU ETS will be phased out by 2045.

[73] Lietuvos Respublikos Seimas. (2020). Dėl Nacionalinės klimato kaitos valdymo politikos strategijos patvirtinimo.

	A 70% share of electric cars and low-emission vehicles in the national fleet is to be achieved.	
	CO2 emissions from the maritime transport sector will be reduced by at least 50% compared to 2008.	
	100% reduction in industrial emissions, compared to 2005, through applying environmentally friendly carbon capture and use technologies.	
Sectoral approach		
Energy sector	*NI*	
Industry		
Transport		
Residential & tertiary		
Agriculture		
Alternative fuels		
General measures	Fossil fuels will be phased out by 2045 in the industries covered by the EU ETS and replaced by RES (green hydrogen, sustainable biomass, secondary raw materials and other high-quality climate-neutral raw materials) or other non-fossil resources.	
Sector	*Fuels to be used*	*Measure*
Energy sector	*NI*	
Industry		
Transport		
Residential & tertiary		
Agriculture		
Natural gas infrastructure		
Natural gas grid	The existing Lithuanian natural gas grid is to be adapted for the transmission of hydrogen and biogas by 2024; gaseous fuels from RES will be prioritised.	
Power and heating plants	*NI*	
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	*NI*	
Alternative fuels		
Natural gas beyond 2050		
NI		

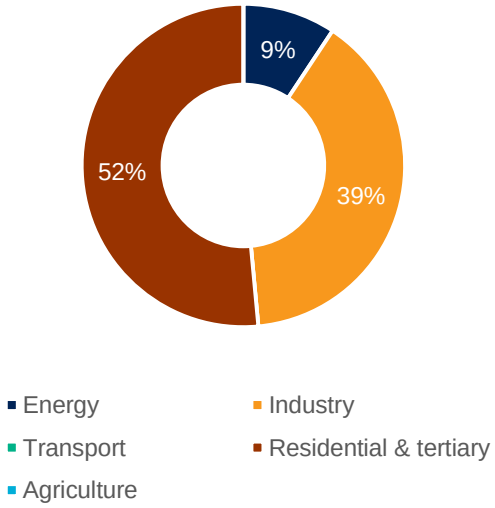
NI – no information

7.18. Luxembourg

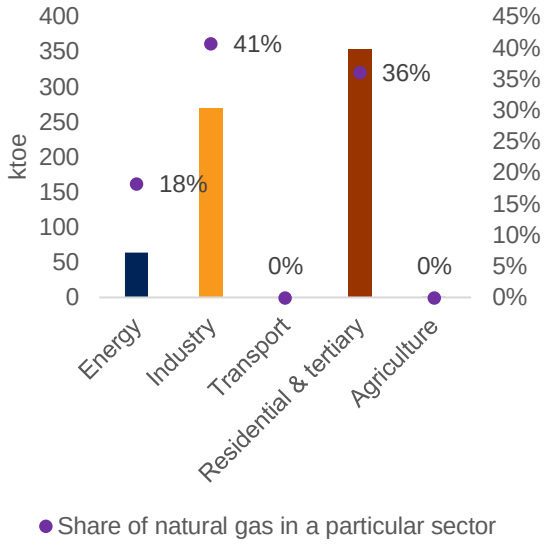
Natural gas in Luxembourg in 2019

Gross inland natural gas consumption	**684.1 ktoe**
Share of natural gas in gross inland energy consumption	**15%**

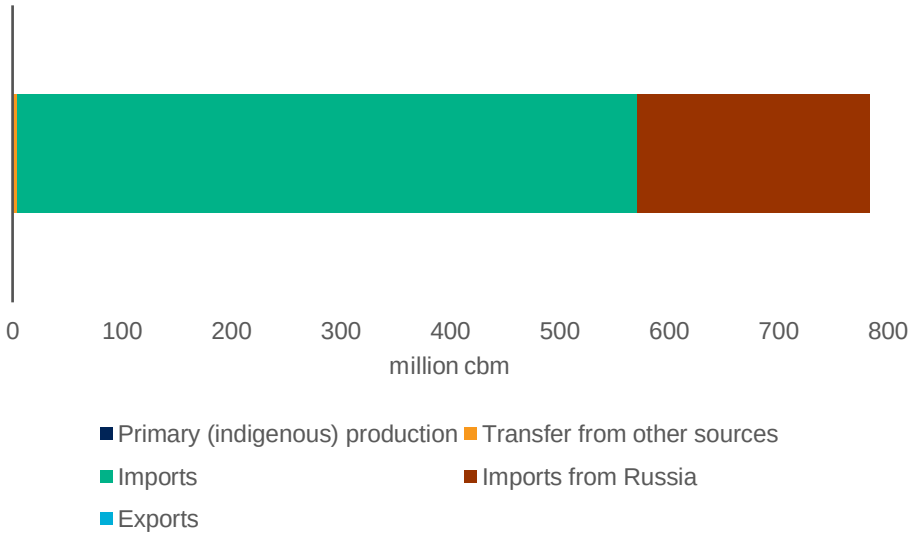
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Luxembourgish LTS[74]

General measures pertaining to natural gas	One of the general measures to promote energy efficiency efforts in buildings/households and, as a result, accelerate fossil fuel phase-out, is the taxation of fossil fuels, in particular heating oil and natural gas. A first step has been already made with the introduction of a CO_2 tax set

[74] Le Gouvernement du Grand-Duché de Luxembourg, Ministère de l'Environnement, du Climat et du Développement durable. (2021). Stratégie nationale à long terme en matière d'action climat *Vers la neutralité climatique en 2050*.

	at 20 euros per tonne of CO_2, which came into force in 2021.The gradual and predictable increase in the tax is envisaged: an annual increase by 5 euros per tonne of CO_2 is planned for 2022 and 2023.	
Sectoral approach		
Energy sector	*NI*	
Industry	Unless adequate technologies are available, certain emissions inherent to industrial production processes (including natural gas-fired processes, probably) will be difficult to eliminate. In these cases, carbon capture and use can potentially be a last climate-neutral option.	
Transport	Regarding heavy-duty vehicles, where the use of fuels derived from natural gas (i.e. LNG and CNG) is the most convenient, Luxembourg plans to implement lower carbon options.	
Residential & tertiary	*NI*	
Agriculture		
Alternative fuels		
General measures	The share of electricity in final energy consumption in Luxembourg will be increasing beyond 2030. As a result, the energy system is to be highly electrified.	
	In Luxembourg only hydrogen of renewable origin is being considered as an energy source; hydrogen is not to be derived from natural gas.	
	The rate of biofuels blended with fossil fuels has increased in Luxembourg over the last years and reached 7.7% in 2020. The biofuel blending rate of 10% is expected in 2030.	
	Biomethanation will be further promoted. Given that in 2018 only a little more than a tenth of manure was used in biomethanation, a substantial potential remains to be developed. In order to encourage the production of biogas, the regulatory and policy conditions will be improved.	
Sector	*Fuels to be used*	*Measure*
Energy sector	*NI*	
Industry	Electricity	No more details are provided on the use of electricity. Luxembourg recognizes the role that hydrogen can play in the indirect electrification of processes that are difficult to decarbonize in the medium and long term. Process gases, including natural gas, are to be substituted with hydrogen produced with the use of renewable electricity, especially in the steel industry.
	Hydrogen	
Transport	Electricity	Nearly half (49%) of the vehicle fleet is to be electrified by 2050. Hydrogen is to power heavy-duty trucks and airplanes.

	Hydrogen	The installation of at least one hydrogen supply station for vehicles is planned in Luxembourg in the short term. A complete decarbonization of the national vehicle fleet is also to be achieved by 2050.
Residential & tertiary	*NI*	
Agriculture		
Natural gas infrastructure		
Natural gas grid	The injection of biomethane into the natural gas grid will be preferred.	
Power and heating plants	*NI*	
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	*NI*	
Alternative fuels		
Natural gas beyond 2050		
Carbon capture and use installations applied to hard-to-abate industrial plants (maybe also those reliant on natural gas) might be operational in 2050 and beyond.		

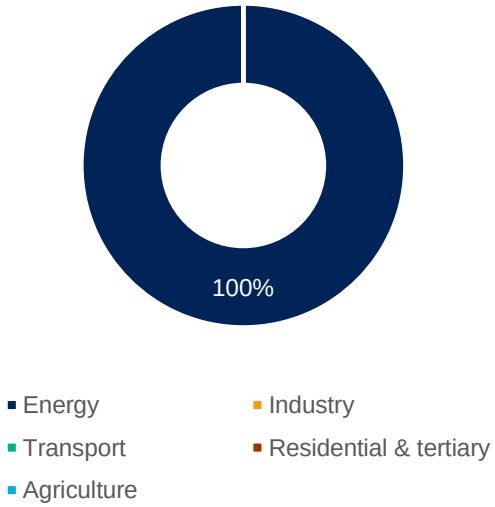
NI – no information

7.19. Malta

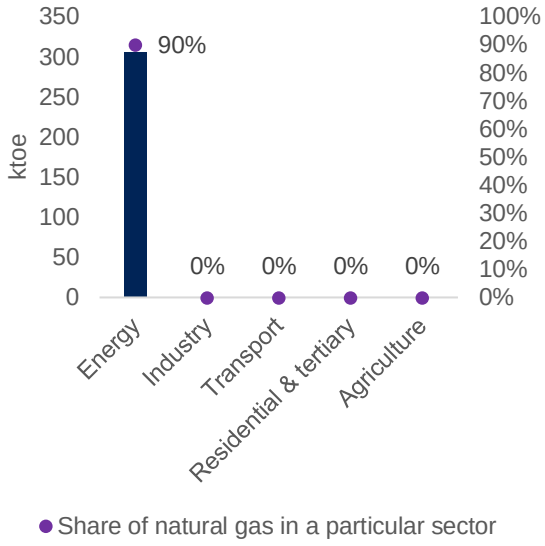
Natural gas in Malta in 2019

Gross inland natural gas consumption	**306.2 ktoe**
Share of natural gas in gross inland energy consumption	**34%**

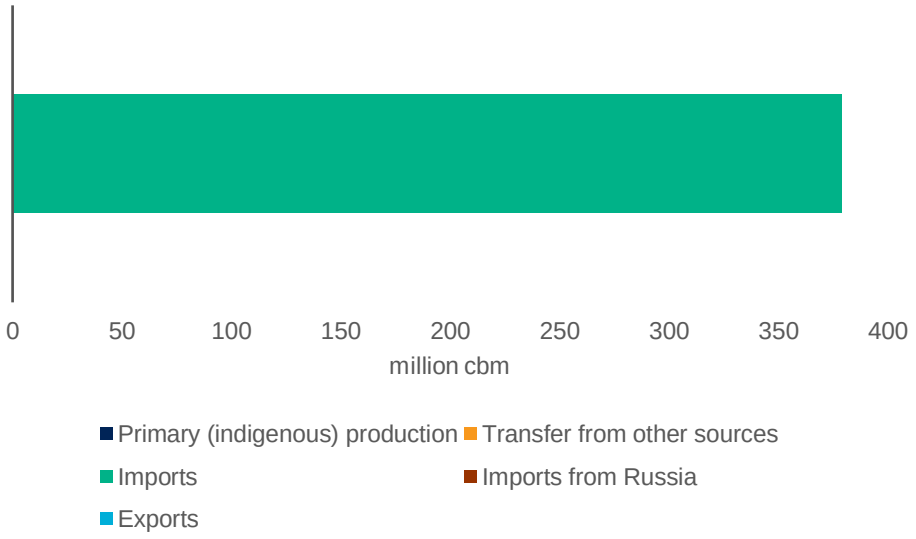
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Maltese LTS[75]

General measures pertaining to natural gas	Natural gas consumption is to increase slightly in the short term, i.e. until 2030.
	Until 2050 all power generation is to become zero carbon. Fossil fuels, including natural gas, are to be completely replaced by renewables,

[75] Ministry for the Environment, Climate Change and Planning. (2021). Malta Low Carbon Development Strategy.

	interconnectors supplying electricity from continental Europe, and hydrogen.	
Sectoral approach		
Energy sector	Until 2030 the electrical grid is to be still highly dependent upon gas, given the assumed increase in energy demand and high share of natural gas in electricity production: it is expected that emissions from the CCGT plant will grow from 2020 to 2030 as plant utilisation increases. The CCGT power plant will continue to run until 2030 at least.	
	The use of gas for electricity generation is to be heavily reduced after 2030 as a new electricity interconnector will be constructed. The development of another additional electricity interconnector to Italy is also being considered by the Maltese government. Therefore, there will be a gradual moving away from the use of gas, which will result in a natural gas phase out by 2050, practically due to up to two additional electricity interconnectors as an alternative source of supply which would offset the reduction in natural gas consumption.	
Industry	*NI*	
Transport		
Residential & tertiary		
Agriculture		
Alternative fuels		
General measures	Hydrogen is to be one of three pillars (alongside RES and electricity interconnectors) of the Maltese energy system in 2050 and beyond.	
	The use of alternative fuels such as biofuels and synthetic fuels will be looked into as a potential source of energy supply beyond 2030.	
Sector	*Fuels to be used*	*Measure*
Energy sector	Hydrogen	Hydrogen power station could act as a back-up to intermittent renewables if battery storage were not in place, or able to store charge over longer periods of time to smooth supply from wind resources.
Industry	*NI*	
Transport	Electricity	Maltese vehicle fleet is to switch to electricity. As a result, overall electricity demand increases in the short term. At the beginning, i.e. until 2030, a significant amount of this electricity will come from Maltese CCGT plants, but since Maltese energy grid is to be fully decarbonized by 2050, vehicles will be powered with renewables by then.
Residential & tertiary	*NI*	
Agriculture		
Natural gas infrastructure		
Natural gas grid	There is a plan underway to build a natural gas pipeline between Malta and Sicily which, subject to funding, could be completed by 2024.	

	Unless a separate hydrogen pipeline is built, the proposed natural gas pipeline will be built hydrogen-ready, as is currently being proposed by government, to enable the switch from gas to hydrogen at the time any EU hydrogen supply network is commissioned.
Power and heating plants	The hydrogen power station will based upon the retrofit of the current CCGT power stations. Hydrogen fuel will be then used to operate CCGT power plants.
	The existing CCGT plants could have their operating lifetimes extended, if their capacity factors are reduced, and might be utilised for grid balancing or backup in case of constraints on the use of the interconnectors.
Filling stations	*NI*
Storage sites	
LNG terminals	
Security of supply	
Natural gas	Malta is to secure both natural gas and hydrogen imports from the European market by building either a hydrogen-ready natural gas pipeline, or separate pipelines for natural gas and hydrogen.
Alternative fuels	
Natural gas beyond 2050	
The CCGT plant might be utilised for grid balancing or backup in case of constraints on the use of the interconnectors until 2050 and beyond. The use of natural gas for this purpose is not excluded, although hydrogen will be preferred. Moreover, some fossil fuels (including natural gas) may still need to be supplied to Malta for heating purposes in industrial plants, manufacturing processes and welding, amongst others. However, they are not expected to be a significant proportion of the total national emissions.	

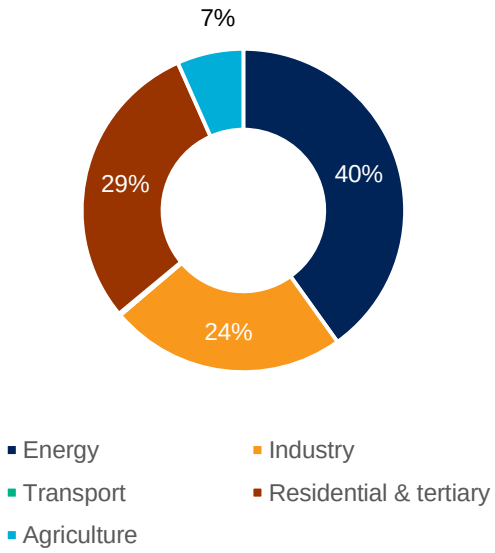
NI – no information

7.20. Netherlands

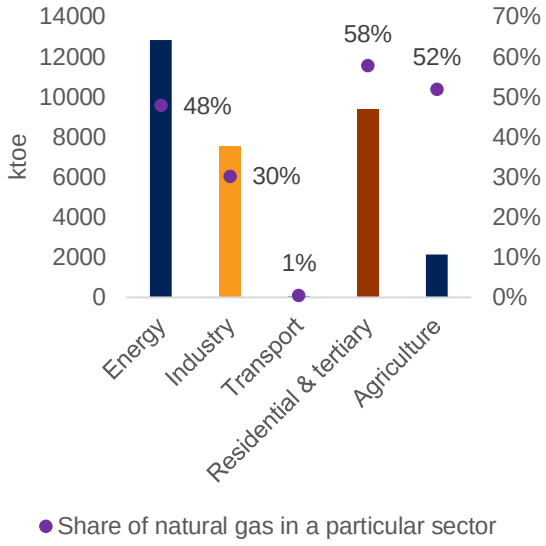
Natural gas in the Netherlands in 2019

Gross inland natural gas consumption	**32 046.1 ktoe**
Share of natural gas in gross inland energy consumption	**42%**

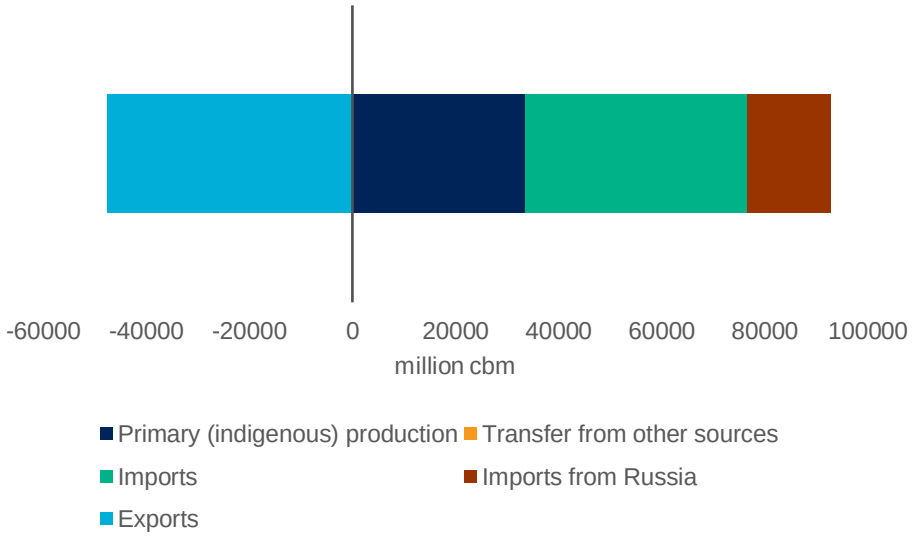
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Dutch LTS[76]

General measures pertaining to natural gas	*NI*

Sectoral approach

[76] Ministry of Economic Affairs and Climate Policy of the Kingdom of the Netherlands. (2019). Long term strategy on climate mitigation.

Energy sector	*NI*	
Industry		
Transport		
Residential & tertiary		
Agriculture		
Alternative fuels		
General measures	*NI*	
Sector	*Fuels to be used*	*Measure*
Energy sector	Hydrogen	It will be possible to feed the electricity system with CO2-free adjustable production in a number of ways: with electricity from CO2-free hydrogen or from other renewable sources, such as biomass and green gas, from nuclear power or from fossil sources where CO2 is captured. During this transition period, biomass could be used in a number of different ways.
	Biomass	
	Green gas	
	Biomass	
Industry	Green gas	Green gas is regarded as part of the industrial feedstock solution, for processes that are difficult to electrify and as a flexible power supply on occasions when there is a limited availability of solar and wind power. The Netherlands is currently working on a roadmap for creating the right conditions for a sufficient supply of green gas and a reduction in production costs.
Transport	Green hydrogen	In the long term, the Netherlands has envisaged a significant role for green hydrogen as a fuel for both heavy and long-distance transport.
Residential & tertiary	Electricity	Sustainable heating will be provided by means of heating networks, electrical heat pumps and the occasional use of green gas and hydrogen, provided the future supply of these latter two resources is assured.
	Green gas	
	Hydrogen	
Agriculture	*NI*	
Natural gas infrastructure		
Natural gas grid	*NI*	
Power and heating plants		
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	*NI*	
Alternative fuels		
Natural gas beyond 2050		
NI		

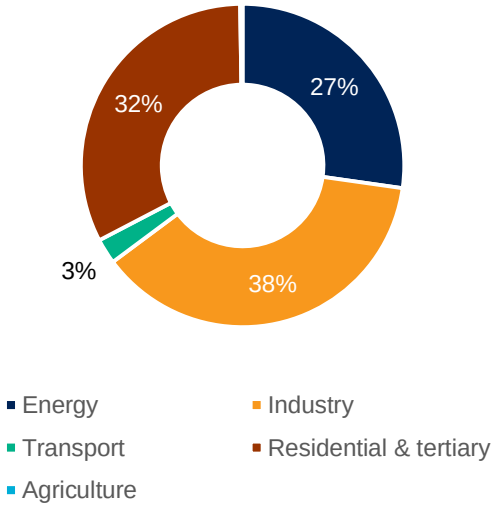
NI – no information

7.21. Poland

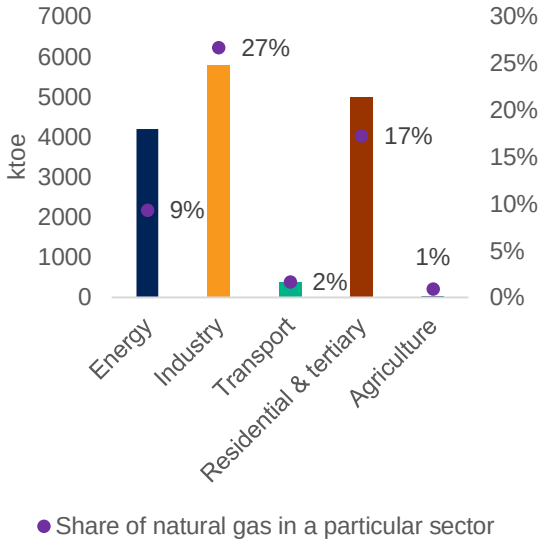
Natural gas in Poland in 2019

Gross inland natural gas consumption	**16 227.9 ktoe**
Share of natural gas in gross inland energy consumption	**15%**

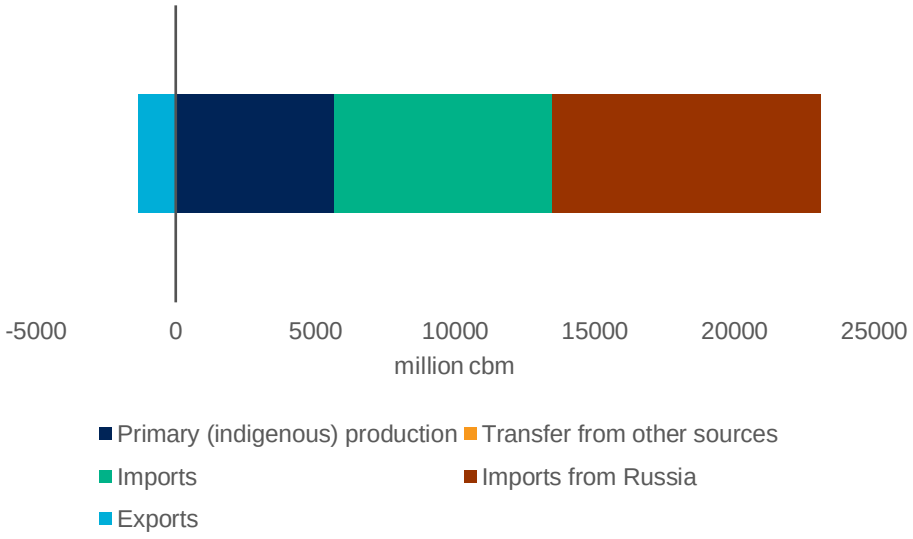
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply

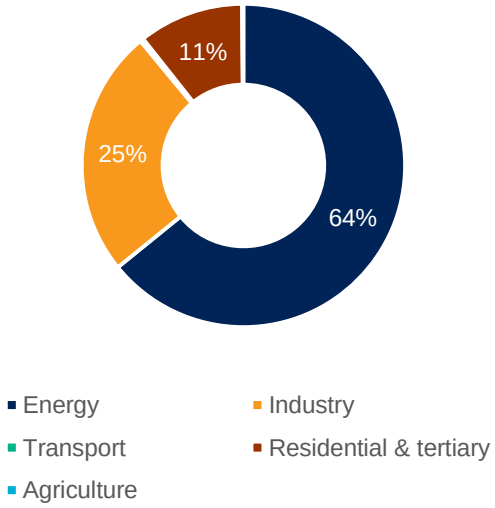


7.22. Portugal

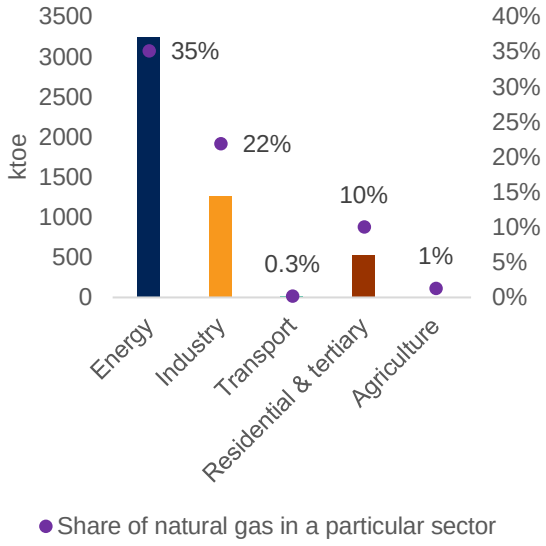
Natural gas in Portugal in 2019

Gross inland natural gas consumption	**5 302.7 ktoe**
Share of natural gas in gross inland energy consumption	**22%**

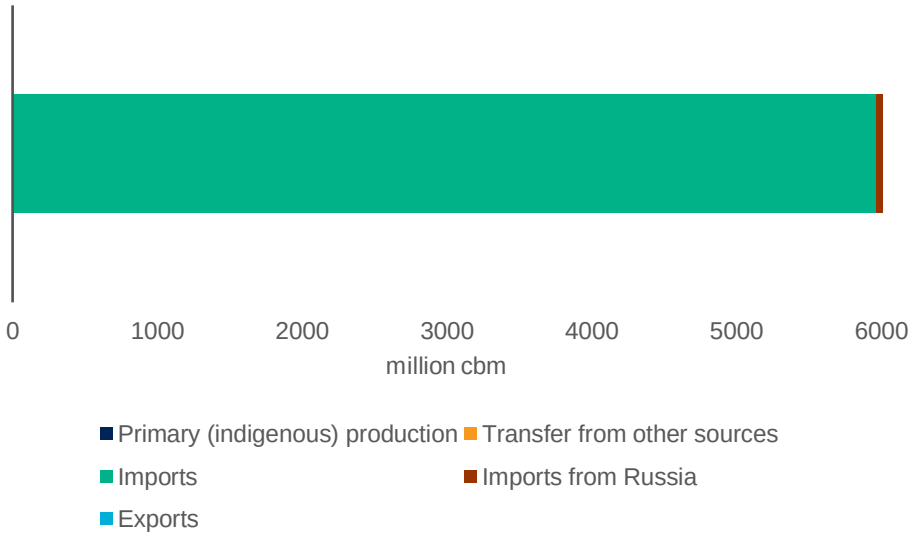
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



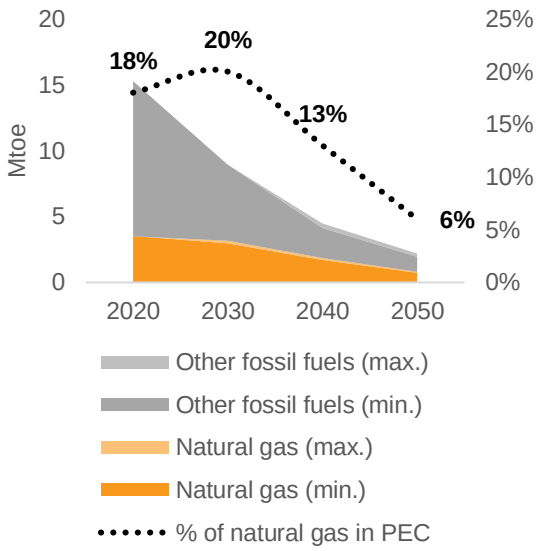
Portuguese LTS[77]

General measures pertaining to natural gas	The LTS presents two alternative macro-economic, low-carbon scenarios by 2050: **Peloton**: socio-economic developments and new technologies compatible with carbon neutrality, but not enough to significantly change either the production structures or the population's lifestyles.

[77] Ministry of the Environment and Energy Transition of Portugal. (2019). Roadmap for Carbon Neutrality 2050. Long-term strategy for carbon neutrality of the Portuguese economy by 2050.

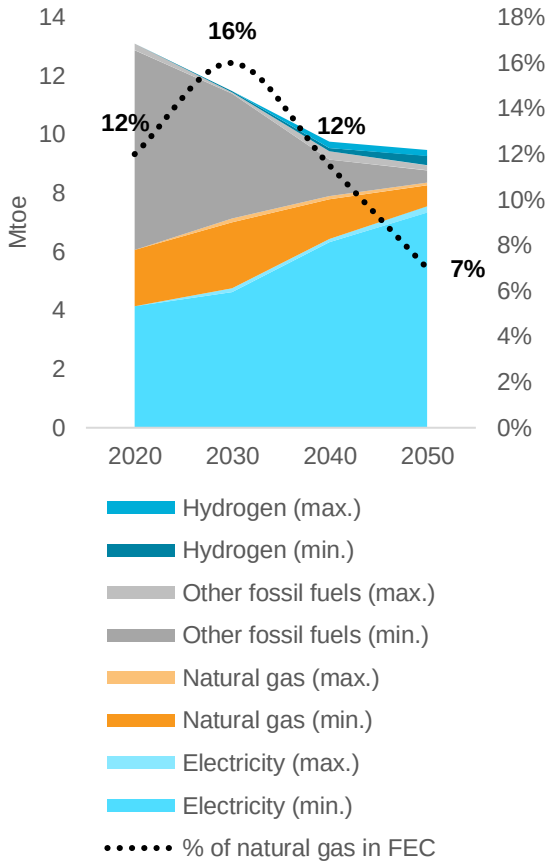
	Modest adoption of circular economy models. Population concentrated in cities; **Yellow Jersey**: socio-economic developments compatible with carbon neutrality, with structural change in production chains. More effective adoption of circular economy models. Growth of medium-sized cities.
	Achieving energy transition by significantly increasing energy efficiency in all sectors of the economy, focusing on incorporating endogenous renewable energy sources into final energy consumption, promoting electrification and adjusting the role of natural gas in the national energy system.

Fossil fuels in PEC in Portugal until 2050



Source: WiseEuropa based on the Portuguese LTS[78]

Evolution of FEC up to 2050

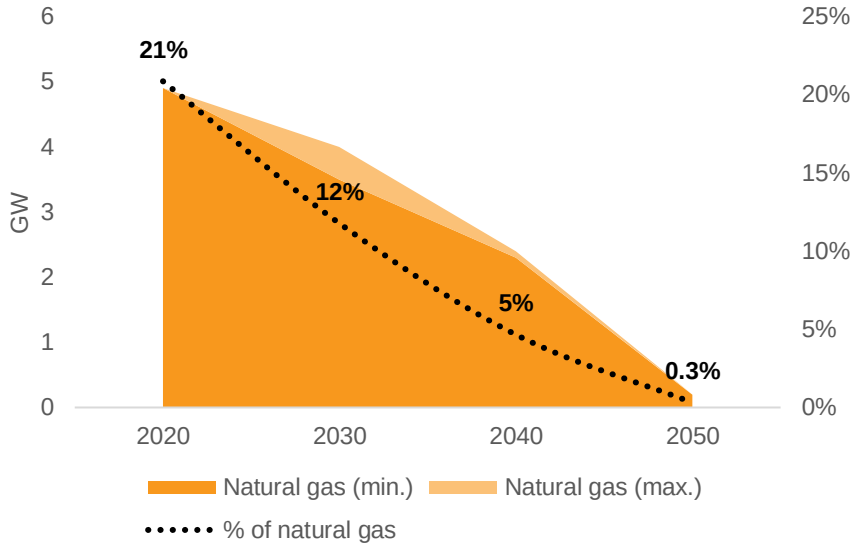


Source: WiseEuropa based on the Portuguese LTS[79]

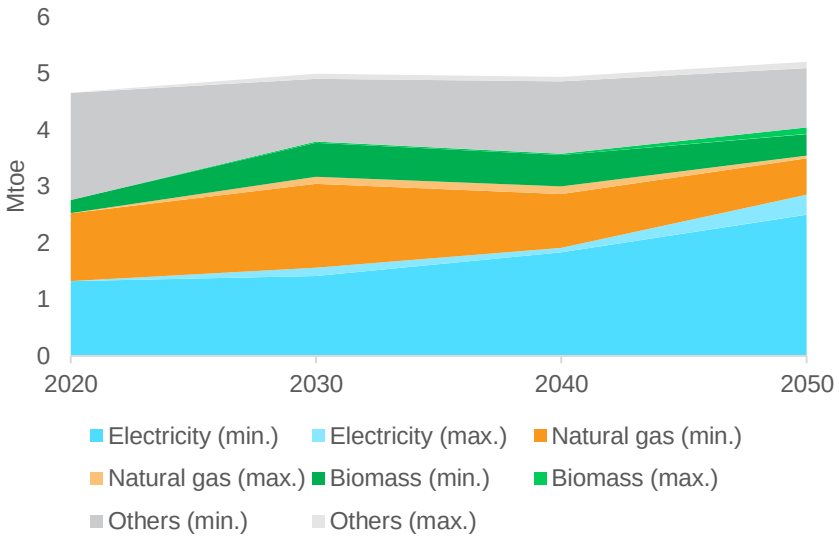
Sectoral approach

Energy sector	Maintaining some natural gas capacity in the national power system until 2040, even if marginally used, ensures the necessary backup to bring about the transition to a renewable-based power system, allowing time for the development and installation of technological storage solutions. In electricity generation, the transformation will be profound (99% reduction in GHG emissions compared to 2005) and will be achieved with significant investments in new renewable capacity, in particular wind and photovoltaic energy, and in a big reduction or abandonment

[78] Ibid. p. 26.
[79] Ibid. p. 28.

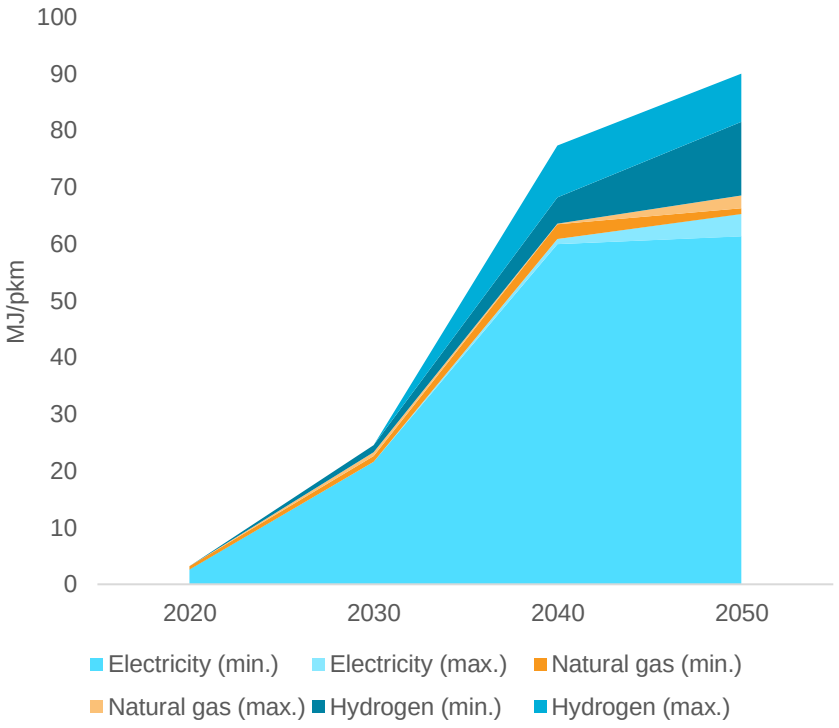
	of electricity produced with fossil fuels such as coal, fuel oil and natural gas, supported by a resilient, flexible and modern system. End of gas-fired power production from 2040. However, little installed natural gas capacity (0.2 GW) is to remain in the power generation sector yet in 2050, probably as an operating reserve.
	Evolution of the installed natural gas capacity of the power generation sector
	 *Source: WiseEuropa based on the Portuguese LTS*[80]
Industry	In 2020 +25% of energy consumption in industry is satisfied by natural gas. In 2050 13-15% of industry energy consumption is satisfied by natural gas; industry-based natural gas consumption amounts to 90% of total natural gas consumption of the country.
	Evolution of final energy consumption and energy intensity in industry by 2050

[80] Ibid. p. 32.



Source: WiseEuropa based on the Portuguese LTS[81]

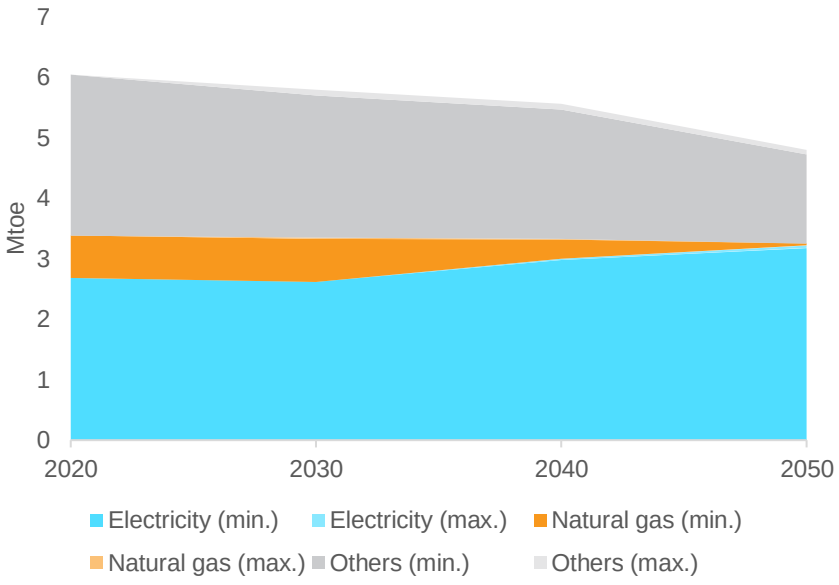
Transport	**Evolution of final energy consumption and energy intensity in the transport sector**



Source: WiseEuropa based on the Portuguese LTS[82]

Residential & tertiary	Natural gas remains an option in housing in the time horizon until 2040, virtually disappearing over the following decade.
	Evolution of final energy consumption and energy intensity in buildings (residential and services)

[81] Ibid. p. 42.
[82] Ibid. p. 37.

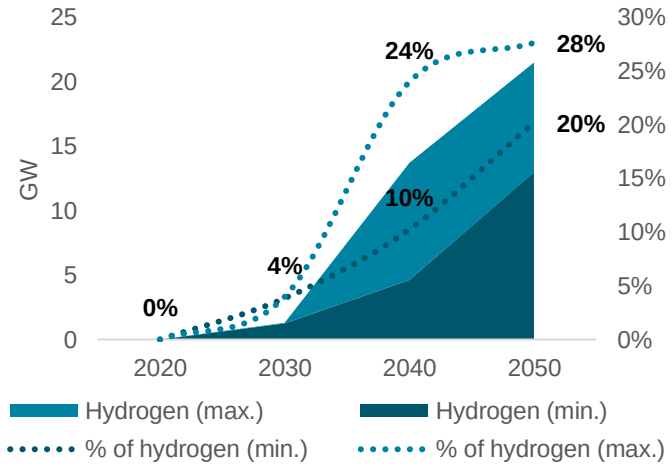


Source: WiseEuropa based on the Portuguese LTS[83]

Agriculture	*NI*

Alternative fuels

General measures	*NI*	
Sector	*Fuels to be used*	*Measure*
Energy sector	Hydrogen	**Evolution of the installed hydrogen capacity of the power generation sector**



Source: WiseEuropa based on the Portuguese LTS[84]

Industry	Electricity	For detail see: *Sectoral approach*
Transport	Electricity	For detail see: *Sectoral approach*
	Hydrogen	
Residential & tertiary	Electricity	For detail see: *Sectoral approach*

[83] Ibid. p. 47.
[84] Ibid. p. 32.

Agriculture	
Natural gas infrastructure	
Natural gas grid	*NI*
Power and heating plants	
Filling stations	
Storage sites	
LNG terminals	
Security of supply	
Projections on energy dependence are provided. Since the national energy system moves from an essentially fossil base to an essentially renewable base by 2050, the energy dependency drops from the current (as of 2015) 78% of dependence on foreign countries to less than 20% in 2050.	
Natural gas	*NI*
Alternative fuels	
Natural gas beyond 2050	
Remaining electricity capacities based on natural gas (very limited) may be an operating reserve.	

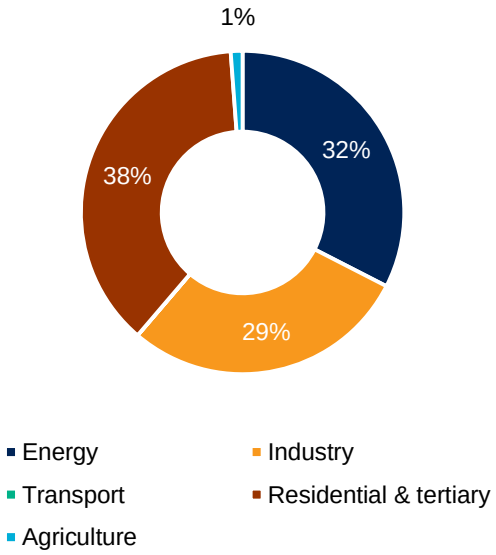
NI – no information

7.23. Romania

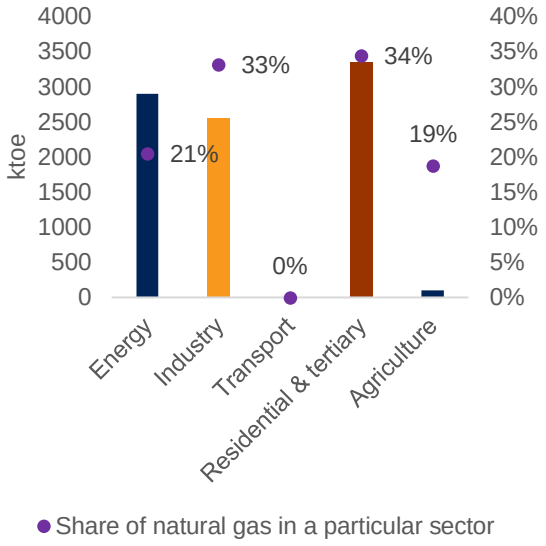
Natural gas in Romania in 2019

Gross inland natural gas consumption	**9 264.8 ktoe**
Share of natural gas in gross inland energy consumption	**28%**

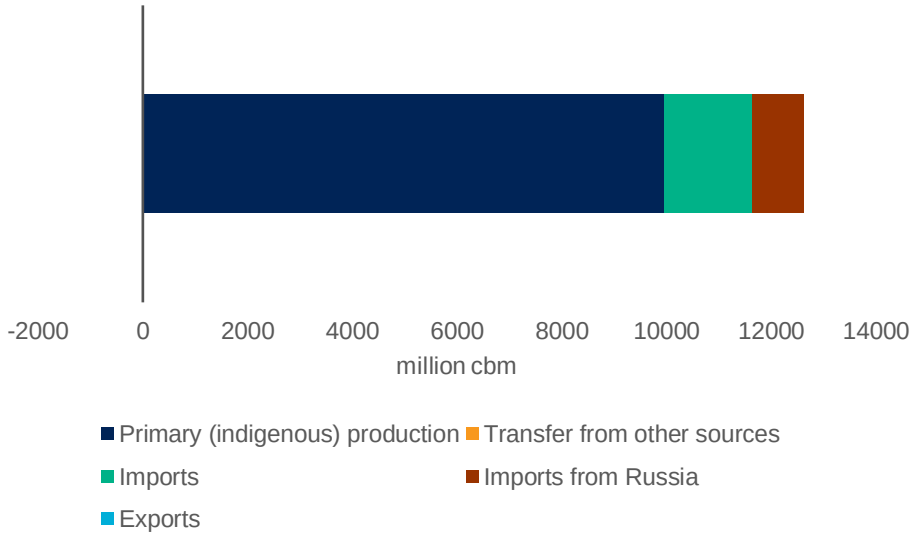
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply

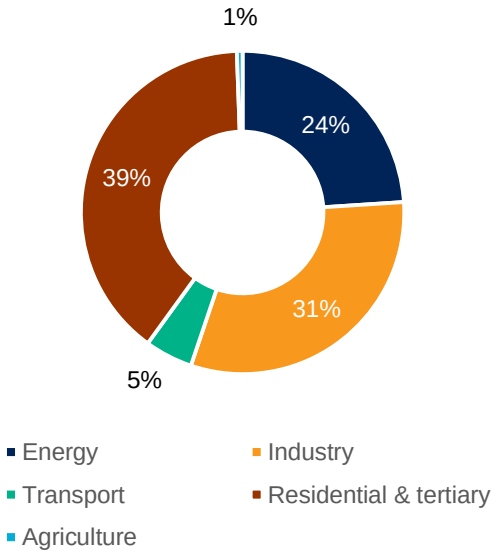


7.24. Slovakia

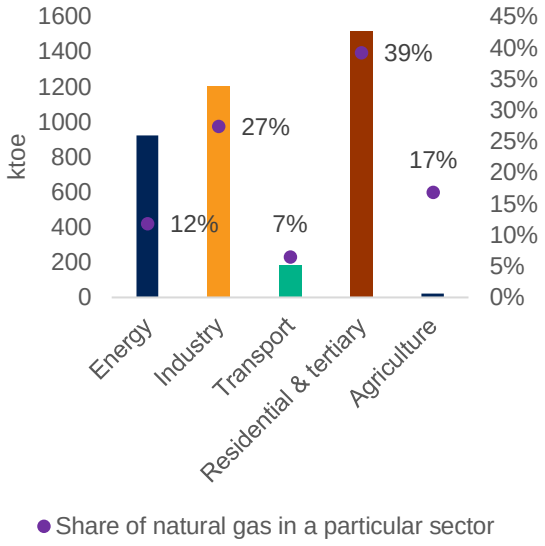
Natural gas in Slovakia in 2019

Gross inland natural gas consumption	**4 086.2 ktoe**
Share of natural gas in gross inland energy consumption	**24%**

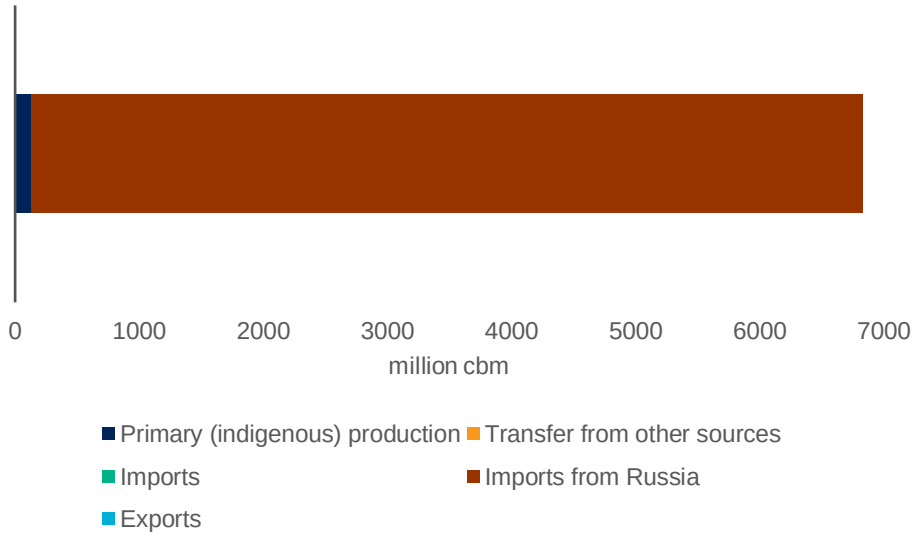
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Slovak LTS[85]

General measures pertaining to natural gas	According to the NECP plan Slovakia has space for the decarbonisation of energy mainly in the substitution of coal with low-emission sources, energy efficiency measures and transport decarbonisation, given the high share of nuclear sources in electricity production and the high share of natural gas in the heat sector.

[85] Government of the Slovak Republic. (2019). Low-Carbon Development Strategy of the Slovak Republic until 2030 with a View to 2050.

<table>
<tr><th colspan="3">Sectoral approach</th></tr>
<tr><td>Energy sector</td><td colspan="2">The optimization of district heating systems through, i.a., a shift from fossil fuels to biomass and natural gas.</td></tr>
<tr><td>Industry</td><td colspan="2">NI</td></tr>
<tr><td>Transport</td><td colspan="2">A growing trend of, i.a., natural gas consumption in road transport and its increasing share in fuel consumption.</td></tr>
<tr><td>Residential & tertiary</td><td colspan="2">NI</td></tr>
<tr><td>Agriculture</td><td colspan="2">NI</td></tr>
<tr><th colspan="3">Alternative fuels</th></tr>
<tr><td>General measures</td><td colspan="2">NI</td></tr>
<tr><td>Sector</td><td>Fuels to be used</td><td>Measure</td></tr>
<tr><td rowspan="3">Energy sector</td><td>Biogas</td><td rowspan="3">RES support scheme for electricity generation with envisaged RES technologies such as solar photovoltaics, onshore wind turbines, biogas/biomethane and biomass.
One of the envisaged measures is to improve separate collection of biodegradable municipal waste for the production of biogas from waste (e.g., biodegradable waste and waste from wastewater treatment plants) with regard to the use of digestate for land, its subsequent transformation into biogas/biomethane (e.g., for its subsequent use in transport or injection into the distribution system) and the production of electricity and heat from biogas/biomethane.</td></tr>
<tr><td>Biomethane</td></tr>
<tr><td>Biomass</td></tr>
<tr><td>Industry</td><td>Hydrogen</td><td>The use of hydrogen as an innovative technology (including the transition of hydrogen-based steel production in the case of sufficient hydrogen supply).</td></tr>
<tr><td rowspan="5">Transport</td><td>Electricity</td><td rowspan="5">One of the measures is to lower the carbon footprint of urban public transport with available technology (electrification, bioCNG, liquid biofuels, hydrogen).
A growing trend of, i.a., biogas/biomethane consumption in road transport and its increasing share in fuel consumption.</td></tr>
<tr><td>bioCNG</td></tr>
<tr><td>Liquid biofuels</td></tr>
<tr><td>Hydrogen</td></tr>
<tr><td>Renewable gas</td></tr>
<tr><td>Residential & tertiary</td><td>Renewable hydrogen</td><td>Heating in the residential sector will rely on renewable hydrogen.</td></tr>
<tr><td>Agriculture</td><td colspan="2">NI</td></tr>
<tr><th colspan="3">Natural gas infrastructure</th></tr>
<tr><td colspan="3">Existing gas infrastructure can be used for renewable energy sources due to the highly developed transmission and distribution network, including underground reservoirs, which is a precondition for further decarbonisation of the economy.</td></tr>
<tr><td>Natural gas grid</td><td colspan="2">The interconnection of the electricity and gas sectors through so-called Power-to-X technology will be promoted, and an increase in the level of hydrogen blending to natural gas will be enabled. A long-term</td></tr>
</table>

	support for increasing the proportion of decarbonised gases (biogas, biomethane, hydrogen, synthetic methane) in the distribution system will be set up.
Power and heating plants	*NI*
Filling stations	
Storage sites	
LNG terminals	
Security of supply	
Natural gas	*NI*
Alternative fuels	
Natural gas beyond 2050	
NI	

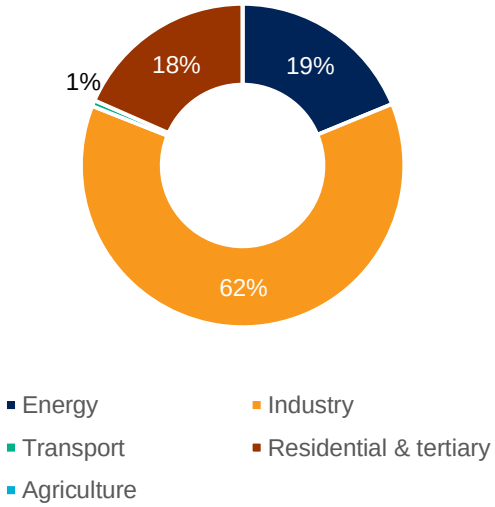
NI – no information

7.25. Slovenia

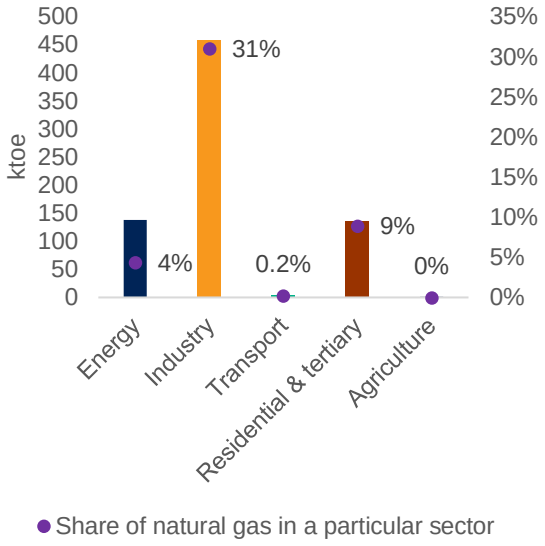
Natural gas in Slovenia in 2019

Gross inland natural gas consumption	**735.6 ktoe**
Share of natural gas in gross inland energy consumption	**11%**

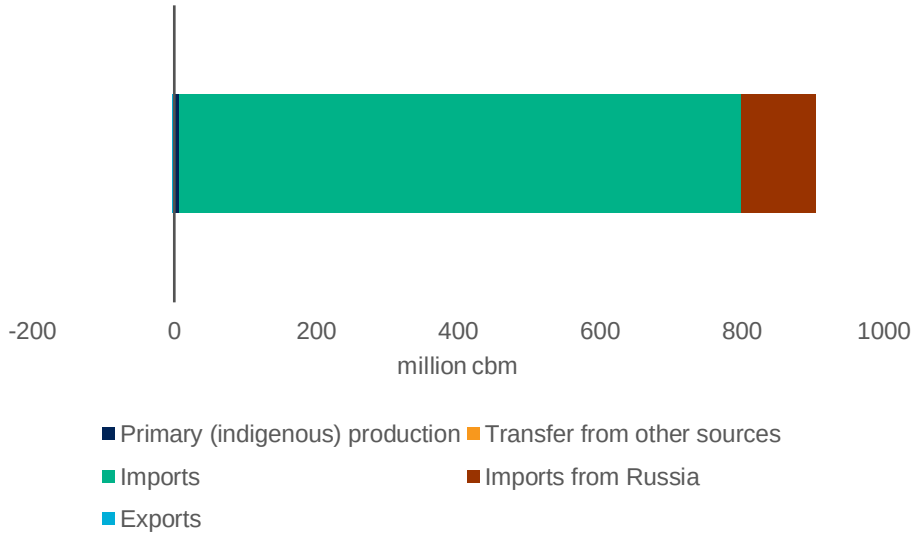
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Slovenian LTS[86]

General measures pertaining to natural gas	Slovenian LTS provides for two scenarios of achieving climate neutrality: the nuclear energy scenario and the scenario based on a high use of synthetic natural gas.

Sectoral approach

Energy sector	*NI*

[86] Državni zbor Republike Slovenije. (2021). Dolgoročna podnebna strategija Slovenije do leta 2050.

<table>
<tr><td>Industry</td><td colspan="2"></td></tr>
<tr><td>Transport</td><td colspan="2">A suitable, supportive environment for the use of liquefied and compressed natural gas will be provided until 2030.</td></tr>
<tr><td>Residential & tertiary</td><td colspan="2">NI</td></tr>
<tr><td>Agriculture</td><td colspan="2">CNG will to some extent replace diesel in powering agricultural machinery – in 2050 the share of CNG in this sector will be 6%.</td></tr>
<tr><td colspan="3">Alternative fuels</td></tr>
<tr><td>General measures</td><td colspan="2">Slovenia will become actively involved in the development of the generation and supply of synthetic, carbon-neutral, gaseous and liquid fuels (also known as "e-fuels": H_2, CH_4, NH_3, etc.).
By producing these fuels, particularly from surplus electricity generated from RES, Slovenia will significantly contribute to the stable functioning of the electricity system and the storage of surplus electricity.</td></tr>
<tr><td>Sector</td><td>Fuels to be used</td><td>Measure</td></tr>
<tr><td>Energy sector</td><td>Synthetic gas</td><td>Slovenia will have to build two or more power plants on the path to climate neutrality: either a new reactor in the nuclear power plant (several smaller nuclear power plants, alternatively), or power plants using carbon neutral synthetic gases.</td></tr>
<tr><td rowspan="3">Industry</td><td>Synthetic gas</td><td rowspan="3">Slovenia will promote technological developments in the area of hydrogen and synthetic gas, and will provide an appropriate environment for the deployment of the related infrastructure, e.g. through a supportive regulatory framework.
Slovenia will examine the use of synthetic gas or hydrogen as a substitute for natural gas in pilot projects by 2040 or sooner.
The substitution of natural gas with synthetic gas would be carried out in a few stages:
10% substitution in 2030;
25% substitution in 2040;
all natural gas substituted with synthetic gas by 2050.
In industry and in certain energy-intensive branches, where technological development allows for this, the replacement of gas with electricity is anticipated in heat treatment processes. Opportunities for a switch to electricity are found in the manufacture and processing of glass, steel and aluminium.</td></tr>
<tr><td>Hydrogen</td></tr>
<tr><td>Electricity</td></tr>
<tr><td rowspan="5">Transport</td><td>Synthetic gas</td><td rowspan="5">Natural gas will be gradually replaced by synthetic gas (syngas), electricity, hydrogen, LPG (only temporarily), and biofuels.</td></tr>
<tr><td>Electricity</td></tr>
<tr><td>Hydrogen</td></tr>
<tr><td>LPG</td></tr>
<tr><td>Biofuels</td></tr>
</table>

Residential & tertiary	Synthetic gas	District heating and cooling systems will primarily be based on the exploitation of excess/waste heat and renewable and other climate-neutral energy sources (e.g. climate-neutral synthetic gas).
Agriculture	Biodiesel	Diesel fuel represents a 100% share in powering the agricultural machinery, which will be however reduced by 58% by 2050. Diesel fuel will be replaced, i.a., by biodiesel (expected 30% share in this sector) and biomethane (expected 7% share in this sector).
	Biomethane	
Natural gas infrastructure		
The scenario based on a high use of synthetic natural gas ensures the upgrade of gas infrastructure.		
Natural gas grid	In 2030 there will be a 10% share of methane or renewable hydrogen in the natural gas transmission and distribution grid.	
	Electrical grid will be being integrated with district heating systems and gas network for the purpose of the energy storage.	
Power and heating plants	*NI*	
Filling stations		
Storage sites		
LNG terminals		
Security of supply		
Natural gas	The scenario based on a high use of synthetic natural gas ensures the reliable and competitive supply of synthetic gas in the future.	
Alternative fuels		
Natural gas beyond 2050		
NI		

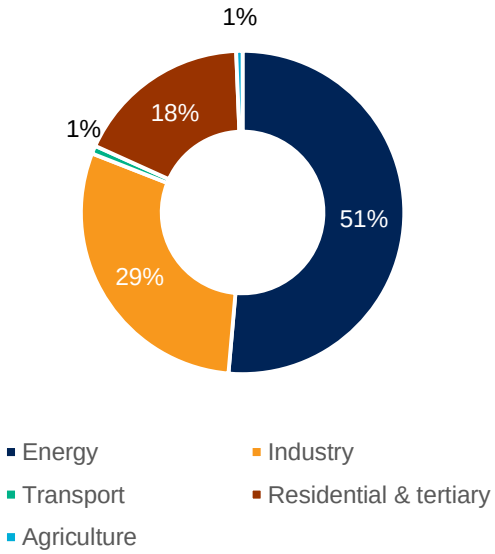
NI – no information

7.26. Spain

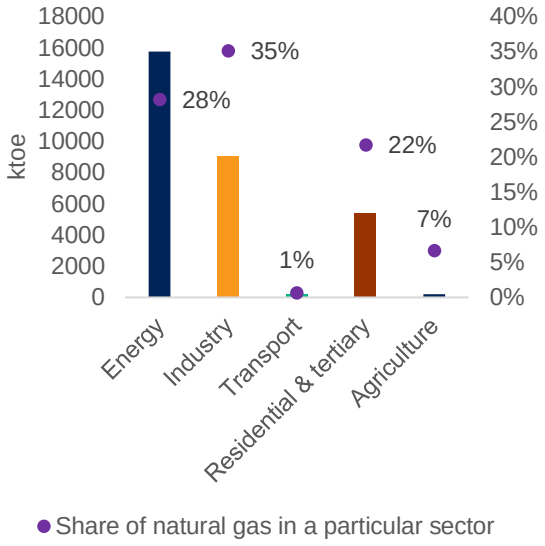
Natural gas in Spain in 2019

Gross inland natural gas consumption	**30 896.8 ktoe**
Share of natural gas in gross inland energy consumption	**24%**

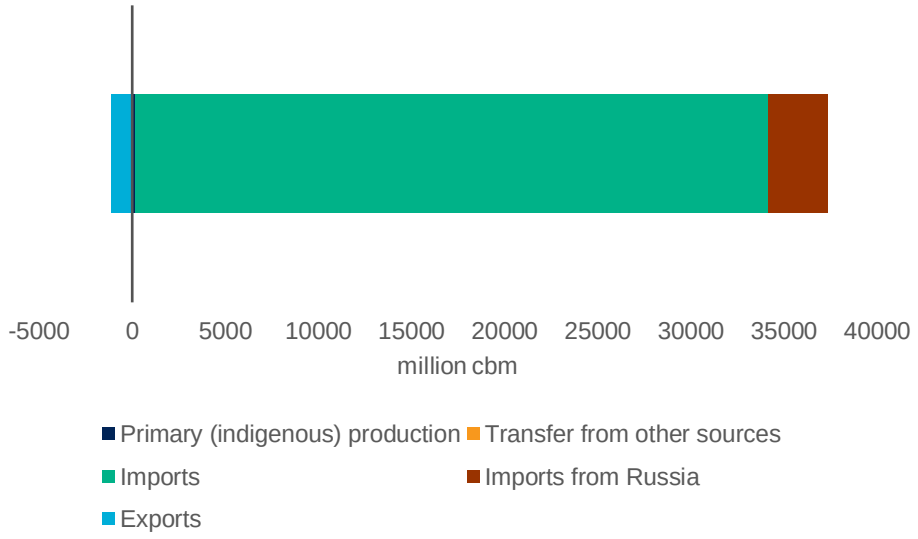
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Spanish LTS[87]

General measures pertaining to natural gas	The consumption of petroleum products and natural gas is little in 2050, since they will have been replaced mainly by renewable energy (or the demand for them will be reduced thanks to the energy efficiency measures).

Sectoral approach

[87] Ministerio para la Transición Ecológica y el Reto Demográfico. (2020). Estrategia a largo plazo para una economía española moderna, competitiva y climáticamente neutra en 2050.

<table>
<tr><td>Energy sector</td><td colspan="2">NI</td></tr>
<tr><td>Industry</td></tr>
<tr><td rowspan="2">Transport</td><td colspan="2">Promotion of biofuels and the use of gas (renewable gas and natural gas for vehicles).</td></tr>
<tr><td colspan="2">The use of LNG in ships.</td></tr>
<tr><td>Residential & tertiary</td><td colspan="2">NI</td></tr>
<tr><td>Agriculture</td></tr>
<tr><td colspan="3">Alternative fuels</td></tr>
<tr><td>General measures</td><td colspan="2">NI</td></tr>
<tr><td>Sector</td><td>Fuels to be used</td><td>Measure</td></tr>
<tr><td>Energy sector</td><td colspan="2">NI</td></tr>
<tr><td>Industry</td></tr>
<tr><td rowspan="3">Transport</td><td>Renewable gas</td><td rowspan="3">Renewable gases (hydrogen in particular) will play an important role from 2030 onwards, mainly in heavy vehicles (vans, trucks and intercity buses).
Use of liquid biofuels and renewable gases in trains (if electrification is not a viable option).</td></tr>
<tr><td>Renewable hydrogen</td></tr>
<tr><td>Liquid biofuels</td></tr>
<tr><td>Residential & tertiary</td><td colspan="2">NI</td></tr>
<tr><td>Agriculture</td></tr>
<tr><td colspan="3">Natural gas infrastructure</td></tr>
<tr><td>Natural gas grid</td><td colspan="2" rowspan="5">NI</td></tr>
<tr><td>Power and heating plants</td></tr>
<tr><td>Filling stations</td></tr>
<tr><td>Storage sites</td></tr>
<tr><td>LNG terminals</td></tr>
<tr><td colspan="3">Security of supply</td></tr>
<tr><td>Natural gas</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Alternative fuels</td></tr>
<tr><td colspan="3">Natural gas beyond 2050</td></tr>
<tr><td colspan="3">Dependency on energy imports, which will persist to a little extent in 2050 and beyond, will be due to the most difficult sectors to decarbonise still requiring some oil and natural gas.</td></tr>
</table>

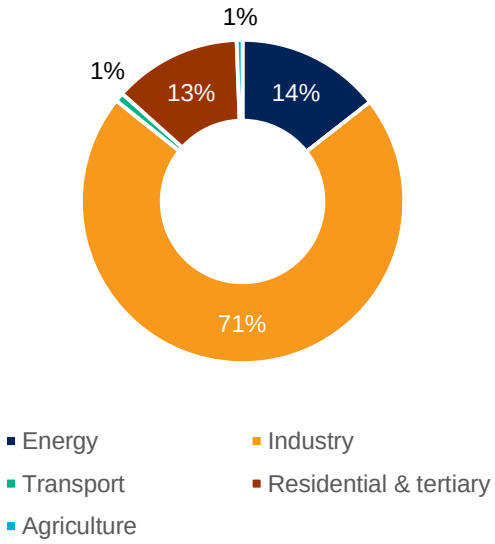
NI – no information

7.27. Sweden

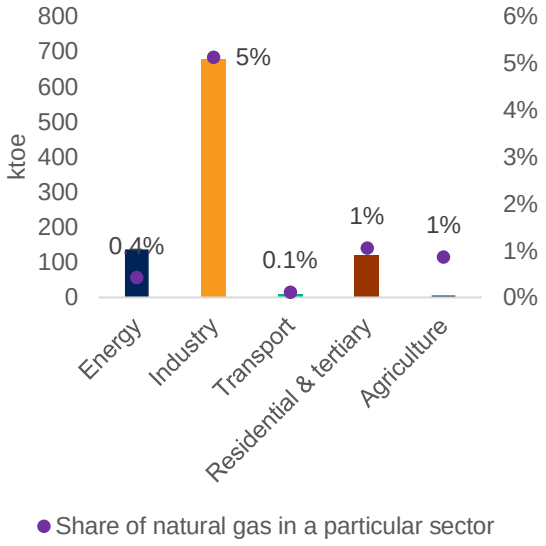
Natural gas in Sweden in 2019

Gross inland natural gas consumption	**942.6 ktoe**
Share of natural gas in gross inland energy consumption	**2%**

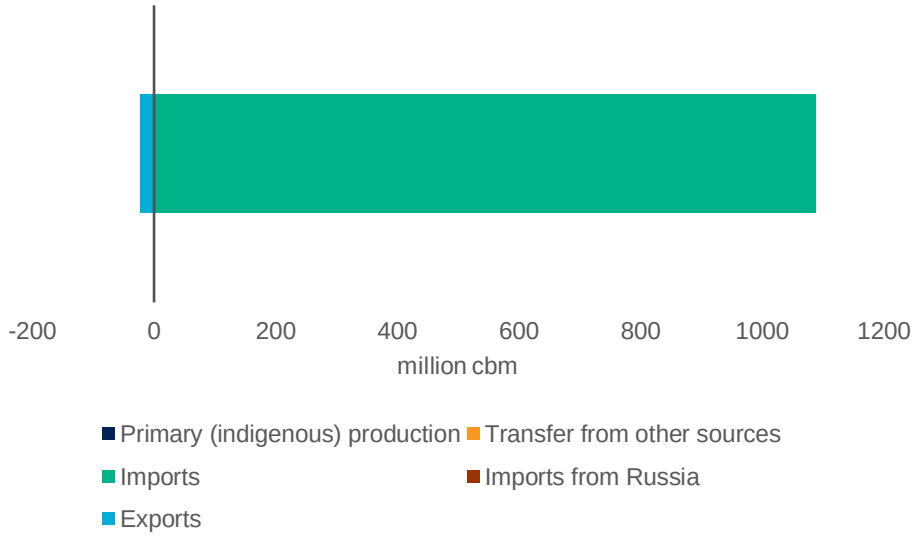
Breakdown of natural gas consumption between sectors



Natural gas consumption in particular sectors



Natural gas supply



Swedish LTS[88]

General measures pertaining to natural gas	Climate neutrality achieved by 2045; negative emissions are to be observed thereafter.
	100 % renewable electricity production in 2040.
Sectoral approach	
Energy sector	*NI*

[88] Miljödepartementet. (2019). Sveriges långsiktiga strategi för minskning av växthusgasutsläppen.

<table>
<tr><td>Industry</td><td colspan="2" rowspan="4"></td></tr>
<tr><td>Transport</td></tr>
<tr><td>Residential & tertiary</td></tr>
<tr><td>Agriculture</td></tr>
<tr><td colspan="3">Alternative fuels</td></tr>
<tr><td>General measures</td><td colspan="2">Energy consumption for heating purposes could be reduced in all sectors through, i.a., higher use of renewable fuels and energy carriers such as electricity and hydrogen.</td></tr>
<tr><td>Sector</td><td>Fuels to be used</td><td>Measure</td></tr>
<tr><td>Energy sector</td><td colspan="2">NI</td></tr>
<tr><td rowspan="2">Industry</td><td>Renewable methane</td><td rowspan="2">The use of renewable methane or hydrogen can reduce the need for carbon and coke in steel manufacturing.</td></tr>
<tr><td>Renewable hydrogen</td></tr>
<tr><td>Transport</td><td colspan="2" rowspan="3">NI</td></tr>
<tr><td>Residential & tertiary</td></tr>
<tr><td>Agriculture</td></tr>
<tr><td colspan="3">Natural gas infrastructure</td></tr>
<tr><td>Natural gas grid</td><td colspan="2" rowspan="5">NI</td></tr>
<tr><td>Power and heating plants</td></tr>
<tr><td>Filling stations</td></tr>
<tr><td>Storage sites</td></tr>
<tr><td>LNG terminals</td></tr>
<tr><td colspan="3">Security of supply</td></tr>
<tr><td>Natural gas</td><td colspan="2" rowspan="2">NI</td></tr>
<tr><td>Alternative fuels</td></tr>
<tr><td colspan="3">Natural gas beyond 2050</td></tr>
<tr><td colspan="3">NA</td></tr>
</table>

NI – no information
NA – not applicable

A report written by **WiseEuropa**

In collaboration with **Ecologic Institute**

as part of the **Climate Recon 2050** project

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