CHAPTER 2

Natural Gas in the EU in the Twenty-First Century: A Special Emphasis on LNG

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Introduction

LNG is not a miracle fuel. It is ordinary natural gas consisting mostly of methane and cooled down to liquid form. The extreme cooling process—in temperatures below minus 162 °C (−260 °F)—liquefies gas and compresses it down to 1/600 of its original volume (Jensen, 2004). The cooling process enables natural gas to be transported by means other than pipelines. LNG is not a fuel type of its own—rather, it is a rationalised transport solution for natural gas. LNG could be compared to cellular phones, which have liberated mobile phone users from the old-fashioned fixed telephone line network.

LNG is not a new fuel either. Cryogenic industry has its early start already in the nineteenth century, when air and gas separation technologies were developed and methane was liquefied (Chiu, 2008). The first LNG liquefaction plant was opened in 1917–1918 and the first commercial liquefaction plant was built in the USA in 1940–1941. The

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first international LNG transportation took place in 1959, when a ship called MetánPioneer sailed from the Charles Lake in the USA with cargo containing LNG to the Canvey Island in the United Kingdom. The first regular LNG exports took place between Algeria and the UK in the 1960s (Hrastar, 2014; Proprietary, 2021).

Although regular LNG trade started six decades ago, the boom did not begin in earnest until the turn of the millennium. The boom has led to the tripling of LNG exports in the last 20 years. Export growth was strongest in 2010, when exports rose by 20% year on year (BP, 2020; IGU, 2018).

As a result of the corona pandemic, the world economy shrank in 2020 by 3.5%, which led to a decrease of 4–7% in global natural gas consumption (Bresciani et al., 2020; IMF, 2021; Sampson, 2020). The global march of LNG has also slowed down due to the pandemic. However, a survey of the world's largest LNG consumers indicates that the slump in international LNG trade is likely to be temporary (Agosta et al., 2020).

The impetus for this article comes from the LNG boom of this millennium and the EU's quarter-share of global LNG trade. The main objective of the article is to describe how the role of natural gas—and of LNG in particular—has developed in the European Union since the start of the millennium.

This chapter consists of two parts. The first part discusses the role of natural gas in the EU's energy supply. The second part delves into the (r)evolution of LNG.

Natural Gas in the EU

Global natural gas consumption was nearly 4,000 bcm in 2019, which is over 60% more than at the start of the millennium. The EU's share of global natural gas consumption was 12% in 2019.[1] In other words, the EU28 consumed some 480 bcm of natural gas. The three largest gas consumers of the EU28 were Germany, the UK and Italy. Their combined consumption—approximately 240 bcm—amounted to half of the EU's total consumption. The UK alone consumed nearly 80 bcm of natural gas in the last year of the past decade (BP, 2020). Although the

[1] Europe, excluding Russia, accounted for less than two percent of the globe's total proved natural gas reserves in 2019 (BP, 2020).

EU's total gas consumption fell by three percent in 2020, most probably it will increase again as the Union recovers from the pandemic and member states embark on the carbon–neutral energy policy (European Commission, 2020c).[2]

In 2020, the EU member states managed to supply less than 15% of their gas consumption with their own production, i.e. member states had to buy in over 85% of their natural gas consumption from outside of the Union. Gas import dependence will increase in the future as a result of the exit of the UK, which was the largest gas producer within the EU28. In addition to Brexit, it should also be noted that gas production by current member states is nosediving. The EU's gas production fell by nearly a quarter in 2020, and continues to fall (European Commission, 2020c).[3]

This apparent trend is supported by the fact that in 2020, the contemporary EU's largest gas producer, the Netherlands, only produced less than 25 bcm, which is a third its production volume ten years earlier (BP, 2020; European Commission, 2020c). The Dutch gas production will continue to decrease, as the Dutch Government has announced that, due to tremors, it will close down regular production at Groningen, the EU's largest natural gas field, in 2022. The final decision on the shutdown of regular production is expected in autumn 2021 (Meijer, 2019, 2021). In recent years, Groningen has supplied three quarters of the Dutch natural gas production (DW, 2018; BP, 2020).

The rapid weakening of the EU's gas independence is aptly illustrated by the fact that at the start of the millennium, member states were still able to produce a third of the EU's gas consumption. Today, the figure has fallen to less than a half of that. Gas production by the EU member states could fall to five percent of the EU's total consumption by the end of the current decade, which would bring the EU's gas import dependence to the same level as its oil import dependence (European Commission, 2020a; Eurostat, 2020b).

Even though the EU's gas production has decreased sharply, the share of gas in its energy consumption has increased. In 2018, the share of natural gas was 22% of the gross inland consumption of the EU27, which is 1.5 percentage points higher than at the start of the millennium

[2] In 2020, natural gas consumption of the EU27 was 394 bcm (European Commission, 2020c).

[3] In 2020, the EU27 produced 54 bcm of natural gas (European Commission, 2020c).

(European Commission, 2020a).[4] Although the percentage growth may appear modest, it is worth noting that in terms of volume, the EU's gas consumption increased by some 50 bcm between 2014 and 2020 (European Commission, 2020c). It is likely that natural gas and renewables will increase their share of the EU's energy consumption in conjunction with the Union's efforts to reduce its carbon dioxide emissions over the next three decades, as '*the EU aims to be climate-neutral by 2050—an economy with net-zero greenhouse gas emissions*' (European Commission, 2021a).

As a result of the carbon-neutrality goal, the share of renewables in the EU's energy consumption will increase significantly. The EU's target is to have renewables covering 32% of energy consumption by 2030 (European Commission, 2021b). In 2018, the share of renewables in the EU was 15%. The goal is highly ambitious but not entirely unrealistic. The possibility of a successful green revolution is supported by the fact that at the beginning of the millennium, renewables amounted to only six percent of the current member states' energy consumption. This means that the share of renewables has grown 2.5-fold in just two decades (European Commission, 2020a). An increased share of renewables in the EU's energy supply does not mean just a more environmentally friendly energy policy, but also reduced dependence on imported energy.

Map 2.1 shows the share of natural gas in primary energy consumption in 2019. The map illustrates the great variance of gas dependence between member states. For example, Cyprus does not use any natural gas, whereas in Malta, which has the highest gas dependence in the EU, the share of natural gas was half of the country's energy supply (BP, 2020; IEA, 2020).

In Belarus, one of the EU's eastern neighbours, natural gas dependence is even higher than in Malta. The share of natural gas in Belarus is two thirds of the country's primary energy consumption. Because Belarus imports all of its natural gas from Russia, its energy supply is to a great extent dependent on Moscow (BP, 2020). The geopolitical status of Belarus was weakened by the completion of the LNG terminal in the Kaliningrad region in January 2019. The Kaliningrad region is no longer dependent on gas transit through Belarus and Lithuania, since the LNG

[4] The share of natural gas of the EU's primary energy consumption is around two percentage points lower than the global average. In other words, the EU is less orientated towards natural gas than the world on average (BP, 2020).

Map 2.1 A share of natural gas in primary energy consumption in Europe in 2019 (%) (*Source* The Author, based on BP, 2020; IEA, 2021a; mapchart.net, 2021)

unit in Kaliningrad enables the Kremlin to deliver gas to its exclave—situated between Lithuania and Poland—by shipping LNG via the Baltic Sea

(GIE, 2019).[5] Therefore, LNG has also improved the energy security of Russia, the world's largest energy exporter.

In 2019, the share of natural gas exceeded 35% of energy consumption in Hungary, Italy, Malta and the Netherlands (BP, 2020; IEA, 2021a). In Hungary, gas consumption has its origins in the joint projects of the CMEA countries in the 1960s, which saw the construction of gas pipelines from the Soviet Union to Central and Eastern Europe and further west.[6] Unlike the majority of the former socialist countries, Hungary has not found it necessary to reduce its dependence on gas imports from Russia, the primary successor of the Soviet Union. In Italy, the share of natural gas has grown gradually over the last 50 years. At the beginning on the 1970s, natural gas amounted to less than ten percent of Italy's primary energy consumption. Today, its share is as high as 40% (BP, 2020). Malta has only been using natural gas since 2017, when its first and only LNG terminal was opened (GIE, 2019). Due to Malta's small economy, the share of natural gas in the country's total energy supply reached nearly 50% just one year after the opening of the terminal (IEA, 2021a). In the Netherlands, gas dependence rose rapidly when the country increased its own gas production in the late 1960s. Gas has retained its importance despite the steep fall in the Netherlands' own production in recent years. In 2010, the country was still producing 75 bcm of natural gas. Today, its production has fallen below 25 bcm,

[5] The FSRU in the Kaliningrad region has an annual capacity of nearly four billion cubic metres (GIE, 2019), while the region's gas consumption is around two billion cubic metres (Usanov & Kharin, 2014). At the 50% capacity utilisation rate, the FSRU could cover the entire gas consumption of the region, i.e. without gas transit via Belarus and Lithuania. However, the FSRU has not been used to supply energy to the region, except during test runs. In fact, at the start of 2021, the Kaliningrad FSRU unit was leased out for LNG transit between Africa and China (Pipeline & Gas Journal, 2021), which suggests that, despite the cold relations between the EU and Russia, the geopolitical situation in Europe has not reached a point where Russia would deem it necessary to return the FSRU to Kaliningrad.

[6] The Bratsvo (Brotherhood) pipeline was completed in the late 1960s, and Soyuz (Union) in the latter half of the 1970s. Both pipelines travel across Ukraine to the European Union (UA Transmission System Operator, 2021). Further pipelines have been built from Russia to the west, including Yamal-Europe across Belarus (1996), Blue Stream beneath the Black Sea to Turkey (2003), the sub-Baltic Sea pipeline Nord Stream to Germany (2011) and a second sub-Black Sea pipeline to Turkey, TurkStream (2020) (EIA, 2021; Gazprom, 2021a).

and will continue to fall as the Netherlands is set to close down the EU's largest gas field in Groningen in 2022 (BP, 2020).

If the four aforementioned countries are the most gas addicted, the other extreme is represented by Cyprus, Sweden, Bulgaria, Estonia, Finland and Slovenia. In these six countries, the share of gas in primary energy consumption is fairly low, less than 15%. At the time of writing, Cyprus does not consume gas at all, but its first LNG import terminal is set to open in 2022 (NS Energy, 2020). In Sweden, the share of gas is only a couple of percent. In fact, natural gas has never been a strategic energy source in Sweden. The situation is different in Bulgaria, Estonia and Finland. In these countries, the share of gas has decreased since the dissolution of the Soviet Union. Bulgaria and Estonia appear to have consciously sought to reduce their dependence on Russian energy supplies. In Finland, the main reason for the reduction in gas consumption is the preference towards domestic fuels—such as biogas—instead of gas imported from Russia. This preference is enforced by stricter taxation of natural gas. In Slovenia, natural gas has held its position despite the dissolution of the Soviet Union. Its share of Slovenia's primary energy consumption has remained around ten percent for the past three decades (BP, 2020).

In the remaining 17 member states, the share of natural gas in primary energy consumption ranges between 15 and 35%. The role of natural gas has evolved in these countries in different ways. In Denmark, Latvia, Luxembourg, Romania and Slovakia, the share of natural gas has decreased since the turn of the millennium, whereas in Croatia, Germany, Greece, Ireland, Poland, Portugal and Spain it has increased. The share of natural gas has increased particularly rapidly in Greece, Portugal and Spain. It has more than doubled since the turn of the millennium in these three Mediterranean countries (BP, 2020).

There are several reasons for the different trajectories. In some countries, their own gas production has decreased, which has then led to a smaller gas share of total energy consumption. These countries have compensated for the decrease in gas production with domestically produces renewables instead of importing gas. Similarly, certain eastern member states of the EU have sought to curb Russia's economic leverage by buying less gas from Russia, which has decreased the share of

natural gas in primary energy consumption.[7] Conversely, in some member states, nuclear power plant closures and reduced coal consumption have increased the share of natural gas and led to more gas imports, especially from Russia. In addition, increased LNG supply and its highly affordable price due to global oversupply have led some EU member states to increase the share of natural gas in their energy mix. This has been evident in the Mediterranean region in particular.

Although the role of natural gas has changed in the 12 member states mentioned above, there has been little change in its strategic importance in Austria, Belgium, Czechia, France and Lithuania between 2000 and 2019. The change between the two years is unremarkable, but it does not mean that there have been no changes in the interim period. Lithuania is a good example.

In 2009, Lithuania closed down the Ignalina nuclear power plant. In the following year, the share of natural gas in the country's primary energy consumption leapt from 30% to almost 45%. After the sudden spike, the situation began to stabilise, and currently the share of natural gas is 'only' a third of the country's primary energy consumption. Another significant change in Lithuania was the opening of the LNG terminal in Klaipeda in December 2014 and the resultant geographical diversification of Lithuania's gas imports. That said, the Klaipeda terminal has not freed Lithuania entirely from Russian natural gas. It should be noted that Lithuania continues to import pipe gas from Russia, and a fifth of its LNG also originates from Russia.

In 2020, 48% of natural gas imported by the EU originated from Russia. Norway's share was 24%. The remainder originated mainly from Qatar, North Africa and the USA. The US share was six percent. Three quarters of the EU's natural gas imports was pipe gas. The remaining quarter was delivered by LNG tankers (European Commission, 2020c).

Pipe gas also dominates in Russian gas imports into the EU. In 2020, the share of pipe gas was 90% versus ten percent for LNG in the EU's gas imports from Russia. In 2020, the first Nord Stream twin pipeline

[7] The Russo-Georgian War (2008) and the Ukraine War (since 2014) have not had a notable impact on the EU's energy purchases from Russia. Although the volume of crude oil imports from Russia fell by approximately 15% between 2010 and 2018, the volumes of gas imports and hard coal imports increased by 25 and 60%, respectively (European Commission, 2020a). It should be noted that in 2019, member states purchased mineral fuels from Russia at a value of nearly EUR 100,000 million, which corresponds to two thirds of the EU's total imports of goods from Russia (European Commission, 2020d).

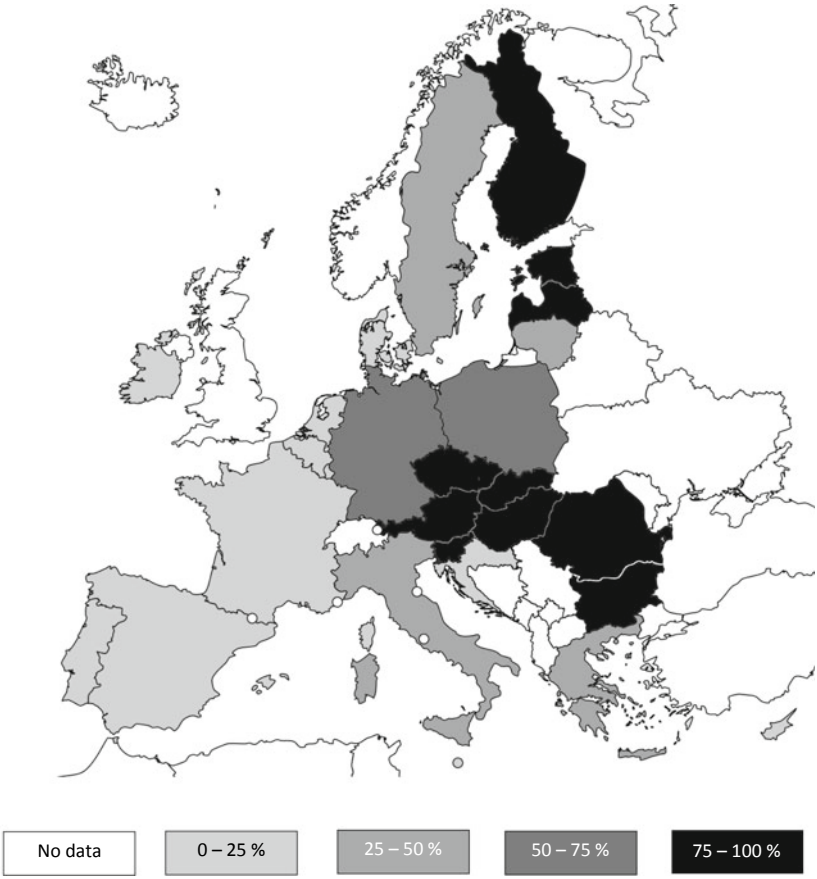
took over as the main transit route of gas imports from Russia to the EU. The share of Nord Stream was 40%, while the Ukraine transit route delivered 30% of Russia's pipe gas supplies to the EU (European Commission, 2020c). The change is significant from the point of view of the geopolitical balance in Eastern Europe. Before the 2011 completion of the first Nord Stream pipeline, roughly 80% of the EU's gas imports from Russia came via the Ukraine transit route (Henley, 2014). In the 1990s, Ukraine's share was even higher, i.e. approximately 95%. Map 2.2 shows the share of Russian natural gas in EU member states' gas imports in the first half of 2020.

The media, in particular, often draws far-reaching conclusions about the EU's dependence on Russian natural gas solely on the basis of Russia's share in gas imports. Such conclusions are inadequate, as they do not take into account the role of natural gas in individual countries' energy consumption. By combining the two indicators, a somewhat more accurate tool can be provided for the analysis of member states' strategic dependence on Russian gas. The two indicators are examined in Table 2.1.

Table 2.1 shows that Hungary has the highest addiction to Russian natural gas among member states, because natural gas represents a very high proportion of Hungary's energy supply, the country does not produce significant volumes of natural gas, and it imports practically all of its gas supply from Russia. When analysing Hungary's dependence on Russian natural gas, it should be noted that its gas imports have nearly doubled in the past decade, i.e. during Viktor Orbán's premierships (Eurostat, 2021b). On the other hand, the fact that Hungary has a large gas storage capacity is often overlooked in dependence analyses. Hungary's operational storage capacity covers over 60% of its annual gas consumption (GIE, 2018).

Other high-risk consumers of natural gas include Romania, Latvia, Slovakia and Italy. However, closer examination reveals that Romania's dependence on gas imports is very low thanks to its own production, which also means that it has low dependence on natural gas imports from Russia. In fact, Romania's gas import dependence is the second lowest in the EU after Denmark, which continues to be a net exporter of natural gas (Eurostat, 2020b).

Whereas Romania is able to satisfy a large part of its natural gas needs with its own production, the situation is not that good in Latvia and Slovakia. They have to import all of their gas supply from other countries,



Map 2.2 A share of Russia in the natural gas imports from outside the EU in January–June 2020 (*Source* The Author, based on Eurostat 2020a; mapchart.net, 2021)

which in their case is Russia. Latvia's strategic position is strengthened by the Inčukalns underground gas storage, which could meet the country's natural gas needs for nearly two years.[8] Alternatively, the Inčukalns

[8] It is technically possible to increase the capacity of Inčukalns to 3.2 bcm (Conexus Baltic Grid, 2021).

Table 2.1 The Russia gas dependence matrix of the EU27 in 2019–2020

	Not dependent on Russian gas (0–25% of gas imports)	*Moderately dependent on Russian gas (25–50% of gas imports)*	*Highly dependent on Russian gas (50–75% of gas imports)*	*Extremely dependent on Russian gas (75–100% of gas imports)*
Extremely dependent on gas (over 35% of primary energy consumption)	Malta, **Netherlands**	Italy		Hungary
Highly dependent on gas (25–35% of primary energy consumption)	Croatia,[8] Ireland	Lithuania		Latvia, **Romania**, Slovakia
Moderately dependent on gas (15–25% of primary energy consumption)	Belgium, **Denmark**, France, Luxembourg, Portugal, Spain	Greece	Germany, Poland	Austria, Czechia
Not dependent on gas (below 15% of primary energy consumption)	Cyprus	Sweden		Bulgaria, Estonia, Finland, Slovenia

Note The countries with natural gas import dependence (gas imports/gas consumption) less than 25% have been marked in bold. Denmark is an exception among the exceptions, as it was the EU's only net gas exporter, i.e. its gas exports exceeded its gas imports in 2019
Source The Author, based on BP (2020), Eurostat (2020a), and IEA (2021a)

storage could provide enough gas through even the coldest winter for all three Baltic States and Finland, provided that the storage is full before winter. The Baltic States and Finland could also acquire additional natural gas via Lithuania's LNG terminal in the event of a sudden disruption in Russian gas supply. Slovakia also has significant gas storage that can cover nearly two thirds of its annual gas needs (BP, 2020; GIE, 2018).

[8] Three quarters of Croatia's natural gas came from Hungary in 2019. Because Hungary imports virtually all of its natural gas supply from Russia, it would be appropriate to place an equal sign between deliveries from Hungary and Russia (Eurostat, 2021a). In other words, Croatia should be placed alongside Latvia, Romania and Slovakia in Table 2.1.

Whereas Latvia and Slovakia have to import all gas they consume, Italy's situation is slightly better, as it produces around five percent of its gas consumption. To put it differently, Italy has to import some 95% of its gas. Although nearly half of Italy's gas imports came from Russia in 2019, the country's strategic dependence on Russian gas is alleviated by the pipelines from Algeria, Azerbaijan and Libya, Italy's LNG terminals and the gas storage facilities which can hold a quarter of Italy's annual gas needs (GIE, 2018; Eurostat, 2021a).[10]

The total capacity of operational gas storage facilities in the EU was approximately 100 bcm in 2018. It would last the EU for two very cold winter months, provided that the storage facilities are full before the winter season (Table 2.2).[11]

The above analysis shows that when assessing strategic dependence on Russian gas, at least the following five factors should be taken into account: (1) the share of natural gas in total energy consumption, (2) the share of imported natural gas in gas consumption or, conversely, the share of the country's own production, (3) the share of Russian gas in imports, (4) the capacity and fill rate of gas storages, and (5) how extensively and rapidly alternative energy sources can be accessed in the event of a sudden disruption in the supply of gas from Russia.

Whichever method is used to assess the EU's dependence on Russian natural gas, it is clear that the Union's energy supply would face great difficulty if Russia were to completely stop delivering energy to the Union. As things stand, the EU would be unable to compensate for a complete energy supply stoppage from Russia with its own production or by importing energy from other countries.

[10] The Trans-Mediterranean natural gas (Transmed) pipeline is nearly a 2,500-kilometre pipe from Algeria via Tunisia to Italy. The construction of the pipe was completed in 1983. The annual capacity of the pipe is more than 30 bcm (Hydrocarbons Technology, 2021). In turn, the 500-kilometre Greenstream underwater pipeline connects Libya and Italy. The annual capacity of this pipe is over ten billion cubic metres per year (GEM, 2020). Due to the social turbulence in North African countries after the Arab Spring in 2011, supply cuts and supply irregularities have occurred in the pipe between Libya and Italy. In addition to the North African pipes, Trans Adriatic Pipeline (TAP), connecting Azerbaijan via Turkey, Greece and Albania to Italy was put into operation in December 2020 (IGU, 2021). The current operational capacity of the pipe is ten billion cubic metres but the pipe can be expanded to deliver 20 bcm per annum (TAP, 2021). TAP began its operation in December 2020 (European Commission, 2020c).

[11] In January 2020, the EU consumed 50 bcm of natural gas (European Commission, 2020c).

Table 2.2 Natural gas storages in the EU27 in 2018 (bcm)

	Operational capacity	*Capacity under construction*	*Planned capacity*	*Total capacity*	*Operational capacity/consumption 2019 (%)*
Austria	8.4			8.4	94
Belgium	0.8			0.8	5
Bulgaria	0.6		1.0	1.6	21
Croatia	0.5		0.1	0.6	17
Cyprus				0.0	0
Czechia	3.7	0.2		3.9	45
Denmark	0.9			0.9	31
Estonia				0.0	0
Finland				0.0	0
France	12.1		0.4	12.5	28
Germany	23.7	0.0	0.9	24.6	27
Greece			0.4	0.4	0
Hungary	6.2			6.2	63
Ireland				0.0	0
Italy	17.8	3.0	3.7	24.5	25
Latvia	2.2			2.2	169
Lithuania				0.0	0
Luxembourg				0.0	0
Malta				0.0	0
Netherlands	11.8		0.1	11.9	32
Poland	3.3	0.2	0.8	4.2	16
Portugal	0.3	0.0		0.3	5
Romania	3.1		1.1	4.2	28
Slovakia	3.2		0.3	3.6	65
Slovenia				0.0	0
Spain	2.9			2.9	8
Sweden	0.0			0.0	1
Total	101.6	3.3	8.8	113.8	28

Source The Author, based on GIE, 2018; BP, 2020

It should be noted that the EU also imports other energy supplies from Russia, and not just natural gas. Russia contributes approximately 20% of the EU's uranium imports, 30% of crude oil imports and 40% of coal imports (Euratom Supply Agency, 2020; European Commission, 2020a,

2020b).[12] Overall, Russian energy covers a quarter of the EU's primary energy consumption, which means that over 100 million EU citizens are entirely dependent on Russian energy. Russia's share in the EU's energy supply has grown far too high due to the drop in the EU's own energy production and its eastern enlargements.[13] The EU's excessive energy dependence on Russia limits the Union's freedom in foreign policy and even weakens its cohesion.

Although Russia depends on income from its energy exports, it should be noted that the dependencies of the EU and Russia are asymmetrical in terms of time. In winter, energy supply in the EU would descend into chaos in a matter of weeks if Russia decided to stop energy deliveries. Russia's reserve funds would delay the impact of loss of revenue from energy exports further into the future, because, as the following analysis shows, Russia is not immediately dependent on its gas export revenues.

In 2019, oil and natural gas contributed together 40% of Russia's budget revenues (Ministry of Finance, 2021). When assessing specifically the role of natural gas in the federal budget, it should first of all be noted that Russia's revenue from natural gas does not come exclusively from exports, as the federal budget also gets domestic tax revenues from natural gas. Secondly, it should be noted that natural gas exports

[12] China, Russia's eastern neighbour, is considerably less dependent on Russian fossil fuels compared to the EU. Russia contributes only 15% of China's crude oil imports and two percent of its oil product imports. In 2019, Russia contributed just three percent of China's natural gas imports, including LNG. Although Russia's share in China's natural gas imports is set to increase in the coming years, China's dependence on Russian energy will still be nowhere near as high as the European Union's dependence (BP, 2020; Liuhto, 2019). On the other hand, China is dependent on natural gas imports, although currently not specifically on imports from Russia. In 2019, China's gas import dependence was already 45%. Ten years earlier, it was only 15% (O'Sullivan, 2021).

[13] The EU as a whole is not particularly dependent on electricity imports from third countries (European Commission, 2019b; Eurostat, 2020c). Finland and Lithuania are the only member states currently importing electricity from Russia (INTERRAO, 2021). The share of Russian electricity in Finland's electricity consumption was only around three percent in 2020 (Finnish Energy, 2020). In Lithuania, the share of electricity imported from Russia is significantly higher. In 2018, it was approximately a third of Lithuania's electricity consumption (IAEA, 2020; INTERRAO, 2021). On the other hand, although Lithuania imported six terawatt hours of electricity from Russia, it exported four terawatt hours to other countries according to 2019 figures (INTERRAO, 2021; KNOEMA, 2021). Since electricity is perhaps the most sensitive energy to react to geopolitical changes, reducing its import dependence should be among the European Commission's top priorities.

contribute significantly less budget revenue than oil exports. Taking the year 2020 as an example, Russia's oil export revenues rose to approximately USD 120 billion, whereas natural gas exports contributed only a quarter of that (Liuhto, 2020c; Bank of Russia, 2021). Thirdly, it should be noted that one fifth of Russia's natural gas exports are destined outside of Europe, and the volume of these exports—especially to Asia—is increasing (BP, 2020). Although the author did not have access to detailed budget accounts of the Russian Federation, the available information indicates that natural gas exports to the EU contribute less than five percent of Russia's federal budget revenue. In addition, it should be noted that Russia has considerable reserve funds. At the beginning of 2021, the value of the funds was USD 180 billion (BOFIT, 2021). Since Russia's budget revenue was around USD 250 billion in 2020 (Ministry of Finance, 2021; TASS, 2021), the reserve funds would cover nearly two years of complete loss of budget revenue from oil and natural gas. To put it differently, the value of Russia's reserve funds at the beginning of 2021 was over five times the value of Russia's total revenues from natural gas exports in 2020 (Bank of Russia, 2021; BOFIT, 2021).

This simple calculation of energy dependence shows that the EU is more dependent on Russia than vice versa. In addition, the EU's dependence on Russia has an immediate effect, whereas Russia is dependent on the EU in the long term or until it is able to cut the EU's share in its exports. The analysis of the EU's role in Russia's exports shows that in 2020, the share of the EU27 in Russia's exports was only 34%, which is 17 percentage points lower than in 2013 before the start of the Ukraine War (Customs Russia, 2021a, 2021b). And further, when analysing Russia's dependence on the EU, it should be noted that since the turn of the millennium Russia has systematically reduced its dependence on exports to the EU by constructing oil and gas pipelines to China (Liuhto, 2019, 2020a, 2020b).

If Russia's aggressive foreign policy and slip away from democratic principles have led to a new low in EU-Russia relations, on the other hand the EU has a stable and close relationship with Europe's other energy superpower, Norway. In 2020, Norway was the EU's second largest natural gas supplier, with a 24% share (European Commission, 2020c). Although Norway is the world's fourth largest natural gas exporter after Russia, Qatar and the USA, it primarily exports to Europe rather than globally (BP, 2020). In other words, the majority of Norway's exports are destined to the EU or the UK. Another distinct feature of Norway's

energy exports is that the share of LNG in its total natural gas exports was only six percent in 2019 (BP, 2020). Since Norway exports its gas mostly by pipelines, it is clear that its share of the EU's LNG imports cannot increase significantly. According to IGU (2020a), Norway's share of the LNG imports of all European countries was only five percent in 2019.[14]

Although Norway is a major supplier of natural gas to the EU, forecasts indicate that its natural gas production will fall to just over 90 bcm by the start of the 2030s—a significant drop from the peak of 2017, when Norway produced over 120 bcm of natural gas (BP, 2020; Hall, 2018). Chapter 6 contains detailed discussion of Norway's natural gas production and exports, and therefore no further discussion of the current state and future of Norwegian natural gas is provided here.

In addition to Russia and Norway, LNG was another important 'source' of natural gas. LNG's share of the EU's natural gas imports was a quarter in 2020 (European Commission, 2020c). A role of LNG in the EU is examined more closely in the following section.

Liquefied Natural Gas in the EU

In 2019, the global volume of natural gas trade was nearly 1,300 bcm, which means that a third of all natural gas produced in the world was exported to another country. The share of LNG in international gas exports has increased. In 2000, the volume of international LNG trade was 140 bcm. By 2019, it had risen to 485 bcm, which represents 40% of the total global trade of natural gas. Ten years earlier, LNG's share had been ten percentage points lower (BP, 2011, 2020). Some 20 years from now the share of LNG in natural gas trade will be close to 60% (IGU, 2020b). RD Shell expects global LNG demand to reach 950 bcm by 2040 (OGJ, 2021b).

The bulk of natural gas trade across EU borders still takes place via pipelines. However, the situation is evolving rapidly. At the turn of the millennium, the share of LNG was just over ten percent of the EU28's natural gas imports from outside the Union. By 2020, it had risen to a quarter (European Commission, 2019a, 2020c).

[14] In the 4th quarter of 2020, Norway's share in the EU's LNG imports was just 0.1% due to a fire incident in the Hammerfest LNG plant. The plant is estimate to work normally in October 2021 (European Commission, 2020c).

To compare, it should be noted that LNG contributed only two percent of the US natural gas imports. In China, the share of LNG in natural gas imports was over 60% in 2019 (BP, 2020). On the other hand, the share of pipeline gas is set to increase, as Russia opened a gas pipeline with a capacity of nearly 40 bcm towards China in December 2019, and there are plans to increase pipeline capacity in the coming years (Afanasiev, 2020; Gazprom, 2021b).[15] In the light of current export volumes, the pipeline capacity expansion may seem odd at first glance, as Russia exported less than five billion cubic metres of pipeline gas to China in 2020 (Argus Media, 2020). Russia is expanding its export capacity to China despite the low export volumes, because the Russian leadership believes that China's gas consumption will increase as the country aims for carbon neutrality by 2060 (McGrath, 2020). In addition to economic motives, the Russian leadership also seeks to reinforce Russia's geopolitical status in the eyes of its eastern neighbour through energy exports.

Spain, France, Italy, the Netherlands and Belgium were the EU's largest LNG importers in 2020. These countries' combined share of the Union's LNG imports was over 80%. The three largest suppliers of LNG to the EU were the USA, Qatar and Russia.[16] These three countries supplied almost two thirds of LNG in the EU. In 2020, the EU's LNG imports declined by five percent. In terms of volume, the EU27's LNG imports totalled to 84 bcm (European Commission, 2020c).

Although LNG represents a quarter of the EU's natural gas imports, it should be noted that half of the current 27 EU member states did not import any LNG in 2019 (Table 2.3). LNG's absence from the energy mix of these 14 member states is explained by the fact that five of them—Austria, Czechia, Hungary, Luxembourg and Slovakia—do not have any coastline and are therefore unable to build LNG import ports. Austria,

[15] '*China is aiming to grow its transmission pipeline network by 60% by 2025. … China is also aiming to raise storage capacity to 10% of its demand*' (IGU, 2020b, 5). "*China is aiming to grow its transmission pipeline network by 60% by 2025. …China is also aiming to raise storage capacity to 10% of its demand*" (IGU, 2020b, 5). China imported over 130 bcm of natural gas in 2019 (BP, 2020).

[16] The value of the US LNG supply to the EU in 2019 was EUR 2.6 billion (European Commission, 2019a), which corresponds to only one percent of the total value of goods exports from the USA to the EU (European Commission, 2020e). Even if the US LNG exports to the EU may grow, the USA would still see the LNG exports more as a way to protect NATO partners from Russia's leverage, rather than as a money-making opportunity.

Table 2.3 LNG in the natural gas imports of the 27 EU member states in 2019

	Natural gas imports (bcm)	*LNG share in gas imports (%)*	*Three main countries supplying LNG and their share in the LNG imports*
Austria	14.2	0	
Belgium	23.2	29	Qatar (65%), Russia (28%), USA (5%)
Bulgaria	2.9	0	
Croatia	2.0	0	
Cyprus	0.0	0	
Czechia	9.5	0	
Denmark	1.1	0	
Estonia	0.5	5	No data
Finland	2.6	7	Russia (64%), Norway (21%), re-exports received (14%)
France	55.0	37	Russia (32%), Nigeria (19%), Algeria (17%)
Germany	94.8	0	
Greece	5.2	54	Algeria (19%), Qatar (19%), Norway (19%)
Hungary	18.6	0	
Ireland	2.9	0	
Italy	71.1	19	Qatar (48%), Algeria (22%), USA (12%)
Latvia	1.4	0	
Lithuania	2.7	57	Norway (71%), Russia (22%), USA (5%)
Luxembourg	0.8	0	
Malta	0.4	100	Trinidad and Tobago (68%), Norway (16%), Egypt (14%)
Netherlands	59.3	18	Russia (53%), USA (25%), Peru (6%)
Poland	17.7	20	Qatar (68%), USA (27%), Norway (5%)
Portugal	6.1	92	Nigeria (58%), USA (23%), Qatar (12%)
Romania	2.7	0	

(continued)

Table 2.3 (continued)

	Natural gas imports (bcm)	*LNG share in gas imports (%)*	*Three main countries supplying LNG and their share in the LNG imports*
Slovakia	6.7	0	
Slovenia	0.9	0	
Spain	37.2	58	Qatar (20%), Nigeria (20%), USA (20%)
Sweden	1.1	28	Norway (38%), Russia (31%), re-exports received (31%)

Note The natural gas imports include the imports from another EU country as well
Source The Author, based on GIIGNL, 2020; Eurostat, 2021b

Czechia, Hungary and Slovakia import all or most of their natural gas via pipelines from Russia (Eurostat, 2020a; Gazprom, 2020). In addition to these four central member states, Luxembourg—which is nestled among Belgium, France and Germany—also did not import any LNG. In 2019, Luxembourg imported only pipe gas via Belgium or Germany. Luxembourg's natural gas imports consist of three rather similarly sized components. One third was imported from other member states, one third from Norway and one third from Russia (Eurostat, 2021a, 2021b).

History as well as geography explains why some member states do not consume LNG. Of the fourteen member states that consume only pipe gas, eight are former CMEA countries, over which the Soviet Union exerted control by way of pipelines. Three of the eight countries are landlocked: Czechia, Hungary and Slovakia. In other words, five ex-socialist countries that consume only pipe gas have a coastline: Bulgaria, Romania, Latvia, Slovenia and Croatia.

The two member states that have coastline on the Black Sea—Bulgaria and Romania—have no plans, at least not officially, to build LNG port terminals. Latvia has plans for an FSRU, but currently it looks like its large-scale LNG port initiative will be replaced by gas collaboration between the Baltic States and Finland (GLE, 2019). Latvia's LNG plans are discussed in more detail in Chapter 9. Slovenia has also continued with pipe gas due to the country's low consumption of natural gas. For Croatia, the data in Table 2.3 is out of date, as its first LNG terminal

received the first LNG delivery on the 1st of January 2021. Croatia's LNG terminal will reduce the country's dependence on pipe gas, which in its case means reduced dependence on Russia. The capacity of Croatia's LNG terminal is 2.6 bcm, which exceeds the country's annual gas consumption (BP, 2020; LNG Croatia, 2021).

Of the ex-socialist countries with coastline, Lithuania and Poland opened LNG terminals in the mid-2010s. Lithuania opened an FSRU unit in Klaipeda in 2014 (Jakštas, 2019; Liuhto, 2015). The unit's capacity is four billion cubic metres, which means that the terminal is able to cover Lithuania's annual gas needs at the 50% capacity utilisation rate.[17] Poland opened a five-billion-cubic-metre natural gas terminal in Świnoujście in the northwest of the country in 2016. Poland intends to increase the unit's capacity to at least 7.5 bcm—possibly even to ten billion cubic metres. In addition to expanding the Świnoujście unit, Poland plans to open an FSRU with a capacity of over four billion cubic metres in Gdańskin the near future. The combined capacity of the two units would in theory cover over half of Poland's natural gas consumption (BP, 2020; GIE, 2019). The LNG units of Poland and Lithuania are discussed in more detail in Chapters 7 and 8, and therefore the terminals and their strategic importance are not covered in further detail here.

Currently, Cyprus does not consume any natural gas, and therefore understandably does not have an LNG terminal (IEA, 2021b). The situation will change in 2022 with the completion of the first LNG import terminal in Cyprus (NS Energy, 2020). The terminal's annual capacity will be 2.4 bcm, which will give natural gas an important role in the energy supply of the island state and its million citizens (GLE, 2019). Confusingly, Cyprus appears to have no plans for an LNG export terminal, even though it is planning to start natural gas production in its territorial waters. It is possible that Cyprus is refraining from relying too much on natural gas production because Turkey, a NATO member, has sought to obstruct the start of Cypriot offshore production (Cyprus Profile, 2020; Pitel & Sheppard, 2020; GEM, 2021a).[18] Co-operation between Cyprus

[17] The capacity utilisation rate of Lithuania's terminal was just under 50% in 2019 (IGU, 2020a).

[18] Several significant offshore gas fields have been found in the vicinity of Cyprus, with estimated combined reserves in excess of 500 bcm (Henderson, 2019). For comparison, Norway's proved gas reserves are 1,500 bcm (BP, 2020).

and Israel increases the possibility of natural gas production around Cyprus becoming a reality (Geropoulos, 2021).

In addition to Cyprus, the northern maritime country Denmark also does not have its own LNG terminal or any apparent plans to acquire one (GLE, 2019). There are many reasons for Denmark's reluctance to build an LNG import terminal. First of all, Denmark is expected to remain a net exporter of natural gas until at least 2035 (DEA, 2018; Elliott & Hunter, 2020). Secondly, the country's location adjacent to another gas producer, Norway, supports pipe gas as a solution. And thirdly, it appears that instead of compensating for the reduction in its natural gas production with imported gas, Denmark intends to take a leap from fossil fuels to renewables as it winds down its oil and gas production (Greenpeace, 2020; Hall, 2020).

In terms of natural gas, Germany is a peculiarity. It is the largest consumer of natural gas in the EU and the second largest in the world after China (Liuhto, 2020c). In spite of its gigantic gas import volumes, Germany has not built a single LNG terminal on its soil. Germany's natural gas supply currently consists of the country's own production, which covers five percent of its gas consumption, and imports—95%—by pipelines from other countries. In 2019, approximately half of Germany's gas imports came from Russia, one quarter came from Norway, and the remaining quarter arrived from the Netherlands. Germany's gas imports from the Netherlands are about to change in the coming years, as the Dutch gas production plummets. In 2019, Germany imported nearly 25 bcm of natural gas from the Netherlands (BP, 2020).[19]

In addition to the production decline in the Netherlands, another headache for Germany is the fact that Germany's gas consumption is likely to increase after the planned closure of its nuclear power plants by the end of 2022 (World Nuclear Association, 2019). In order to cover for the loss of nuclear energy exclusively with natural gas, Germany would have to import nearly 20 bcm more than today (BP, 2020; Liuhto, 2020c). That said, even an increase of 45 bcm would not necessarily require the

[19] When analysing Germany's gas imports from the Netherlands, it is important to remember that in 2019, the Netherlands was already importing around a quarter of its natural gas from Russia, and the share of Russian gas is likely to grow significantly in the coming years (Eurostat, 2021a).

construction of Nord Stream 2, as the Ukraine pipeline network has sufficient unused capacity.[20] The pipeline network of Ukraine and its capacity are discussed in Chapter 5.

In recent years, Germany has been planning four LNG terminals. The proposed locations are Brunsbüttel, Rostock, Stade and Wilhelmshaven (GIE, 2019). In the plans, the size of the Brunsbüttel terminal is eight billion cubic metres, but the final decision on the investment is not expected until mid-2021, and therefore the terminal would not be completed in 2022 as originally scheduled (German LNG Terminal, 2021; GLE, 2019). Russian Novatek has announced that it will build a medium-scale LNG import terminal in Rostock by 2023. Set to be the only German terminal on the Baltic Sea coast, the unit has a planned capacity of 0.4 bcm (PortNews, 2020). The Stade facility is the largest of the planned LNG import terminals. The port's planned capacity is 12 bcm. The terminal is expected to open in 2025 (Elliott, 2020, 2021).[21] There are also plans for a ten-billion-cubic-metre LNG import terminal for Wilhelmshaven. Finnish-owned Uniper has announced that it will build an FSRU unit there. However, in late 2020 the future of this LNG terminal seemed quite uncertain, as German city authorities and businesses that use gas had not placed binding LNG orders in sufficient numbers (Bajic, 2020; LNG Wilhelmshaven, 2021). In addition to the corona pandemic, the possible completion by the end of 2021 of the Nord Stream 2 gas pipeline also adds to the uncertainty (Assenova, 2021).

On the other hand, even if Nord Stream 2 were not to open, the majority of Germany's natural gas imports would still rely on pipelines, as the combined capacity of the four LNG terminals would only cover a third of the volume of Germany's current gas imports (BP, 2020). Since it is certain that not all four terminals will be built, and the ones that are built would not run at 100% capacity, the share of LNG would remain well under ten percent of Germany's natural gas imports by the end of this decade.

Whereas Germany has an unusually reserved stance on LNG, Ireland's relationship with LNG is quite peculiar as well. Natural gas plays an important role in Ireland's energy supply, and yet the island nation

[20] There is some scepticism about the capacity of the Ukraine network to transmit Russian natural gas (Bochkarev, 2021).

[21] The owner of Stade LNG is Hanseatic Energy Hub (GEM, 2021e; HEH, 2021).

consumes no LNG. The reason for the peculiar situation is that Ireland covers over a third of its gas needs with its own production, and the rest comes from the UK via pipelines (GIE, 2019; SEAI, 2021).

For a long time, Ireland had plans for two major LNG terminals, Cork LNG and Shannon LNG. Their combined capacity would have been 12 bcm, and at the 50% capacity utilisation rate they could have supplied all of Ireland's natural gas consumption (BP, 2020). Resistance to the projects from the Green Party was surprisingly strong, and in the end both projects had been shelved by the start of 2021 due to the political opposition (Chapa & Shiryaevskaya, 2021; Crosson, 2020, 2021; Elliott & Weber, 2021; GEM, 2021c, 2021d). Abandoning the LNG terminal projects is not entirely rational in light of Ireland's future energy plans and the decreasing gas production in Great Britain, as the British ability to export its natural gas becomes weaker year by year. However, it appears that, in preventing the construction of the LNG terminals, Ireland wanted to both protect its domestic gas production from foreign competition and make room for renewable sources of energy (DCENR, 2020).

While LNG has no role in the gas imports of Germany and Ireland, the EU member state with the highest share of LNG in its gas imports is Malta. The island nation imports all of its natural gas in a liquefied form, because it has no pipeline connection to gas-producing North African countries and no interconnection to Sicily, which is Italy's gas logistics hub for gas transported from North Africa. Malta's natural gas consumption is very low (less than 0.5 bcm), and therefore the construction of pipelines would not be economically feasible, which means that LNG will hold its monopoly in Malta's natural gas market (Eurostat, 2021a).

Alongside Malta, Portugal also uses primarily the liquefied form of natural gas. In 2019, LNG contributed over 90% of Portugal's gas imports, and its share was growing (Eurostat, 2021b). By 2020, LNG covered 100% of Portuguese gas consumption. In fact, Portugal even exported natural gas to Spain. The strong position of LNG in Portugal shows that LNG can be competitively priced compared with pipe gas, since Portugal's alternative would have been to import more of its gas via pipelines from Algeria via Morocco and Spain (BP, 2020; Gallarati, 2020).[22]

[22] There are two natural gas pipes between Algeria and Spain, namely Medgaz (a 200-kilometre subsea pipe with a capacity of some 8 bcm) and Maghreb-Europe Gas Pipeline

Although Greece, Lithuania and Spain are not as addicted to LNG as Portugal, LNG still covered over half of their natural gas imports. Greece and Spain have a much longer history of using LNG terminals than Lithuania, which opened its FSRU unit in December 2014. Another notable difference is the share of Russia in the LNG imports of these three countries. Russia has no share in the LNG imports of Greece and Spain, whereas in Lithuania, Russian LNG contributed a fifth of the country's LNG imports in 2019 (GIIGNL, 2020).

In Belgium, France and Sweden, LNG covered roughly 30–40% of natural gas imports. Whereas Belgium and France have long traditions of using LNG and it plays a strategic role in their energy supplies, the situation is completely different in Sweden, which has built two small-scale LNG terminals in the past decade. The two small-scale LNG terminals do not have a strategic role in Swedish energy supply, as the share of natural gas in the country's primary energy consumption is only a couple of percent (BP, 2020). What the three countries have in common, however, is the considerable share of Russia in their LNG imports. In 2019, Russian LNG contributed approximately 30% of their LNG imports (GIIGNL, 2020).

In Italy, the Netherlands and Poland, LNG accounts for around one fifth of natural gas imports. Although the percentage is relatively small, the imported volumes are very high: total natural gas imports are around 60–70 bcm in Italy and the Netherlands, and nearly 20 bcm in Poland (Eurostat, 2020a). In Poland and Italy, Russian LNG does not have a significant role, even though Russia dominates the pipeline gas market.[23] In the Netherlands, Russia already contributes half of LNG imports, and its share could well increase as the Dutch gas production plummets (GIIGNL, 2020).

LNG does not have a particularly significant role in the gas imports of Estonia and Finland. In both countries, LNG contributed less than ten percent of total imports of natural gas in 2019. The strategic importance of LNG is further diminished by the fact that natural gas does not play a major role in the two countries' energy consumption. Due to the co-effect of these factors, for Estonia and Finland LNG is more of a maritime

(capacity over 10 bcm). Maghreb-Europe Gas Pipeline travels from Algeria via Morocco to Spain and further to Portugal (EMPL, 2021; NS Energy, 2021).

[23] In 2019, Russia's share of gas imports was over 50% in Poland and nearly 50% in Italy (BP, 2020; Eurostat, 2021a).

fuel than a strategic component of their energy mixes. Nevertheless, the Estonian LNG imports are worth noting and somewhat curious due to the fact that the country has no LNG import terminal, not even a small-scale one, even though it imports LNG. The main reason for the imports appears to be LNG's use as fuel in vehicles and ships (LNG EestiGaas, 2021; Industry, 2019). Whereas Estonia does not have its own LNG terminal, Finland had two relatively small LNG terminals at the time of writing, and a third one was set to open in October 2021 (Hamina LNG, 2020; Finnish Gas Association, 2021). Russian LNG forms the lion's share of LNG imported to Finland, and its share is increasing. In 2020, Russian LNG accounted for approximately 80% of Finland's LNG imports. This represented an increase of 20 percentage points from the previous year (GIIGNL, 2020; Finnish Customs, 2021). LNG in Finland and the Finnish LNG terminals are discussed in more detail in Chapter 10.

In 2019, the combined nominal annual capacity of the EU28's operational LNG terminals was over 210 bcm, of which member states were able to utilise around half (GLE, 2019; Eurostat, 2021b).[24] As a result of Brexit, nearly 50 bcm was lost from the capacity of the EU's LNG terminals, and the combined capacity of the EU27's LNG terminals fell to around 165 bcm (GLE, 2019). Although the EU can import natural gas from/via the UK, it is worth remembering that Great Britain was able to produce only half of its natural gas consumption in 2019, and the production has dropped to a third of what it was at the start of the millennium (BP, 2020). In practice, this means that the EU is not able to increase its reliance on the British LNG terminals in its energy security plans. The British LNG terminals can therefore be set aside in the following analysis of the EU's LNG terminals (Table 2.4).[28]

By May 2019, nine of the current EU27 had built themselves a large-scale LNG import terminal. However, since thirteen member states were consumers of LNG, in practice four member states which consumed

[24] The capacity utilisation rate of the EU's LNG import terminals is slightly higher than the global average. The average global utilisation rate of LNG terminals was approximately 45% in 2019 (IGU, 2020a).

[28] '*The UK has always been playing an important role as berthing site of LNG vessels for continental Europe and shipments are transported to Europe* via *gas interconnectors with Belgium and the Netherlands. However, during the winter period LNG shipments rather serve for domestic consumption in the UK, especially regarding the limited storage capacities*' (European Commission, 2020c, 14).

Table 2.4 Operational large-scale LNG importing terminals in the EU as of May 2019[25]

Country	*Name*	*Start-up year*	*Annual capacity (bcm)*	*Capacity / gas consumption 2019*
Belgium[26]	Zeebrugge LNG	1987	9	0.52
France	Fos-Tonkin LNG	1972	3	0.78
	Montoir-de-Bretagne LNG	1980	10	
	Fos Cavaou LNG	2010	8	
	Dunkerque LNG	2016	13	
Greece	Revithoussa LNG	2000	7	1.37
Italy	Panigaglia LNG	1971	3	0.21
	Porto Levante LNG (OS)	2009	8	
	FSRU OLT Offshore LNG Toscana (F)	2013	4	
Lithuania	FSRU Independence (F)	2014	4	1.82
Netherlands	Gate terminal Rotterdam	2011	12	0.33
Poland	Świnoujście LNG	2016	5	0.25
Portugal	Sines LNG	2004	8	1.31
Spain[27]	Barcelona LNG	1968	17	1.75
	Huelva LNG	1988	12	
	Cartagena LNG	1989	12	
	Bilbao LNG	2003	9	
	Sagunto LNG	2006	9	
	Mugardos LNG	2007	4	

Note The abbreviation 'OS' means an offshore unit and the abbreviation 'F' a floating unit. All the other units are onshore LNG terminals. The British LNG terminals have been excluded from the table above

Source The Author, based on GIE, 2019; BP, 2020; IGU, 2020a; Eurostat, 2021a

[25] One may find the following small-scale and medium-scale units in the EU: Tornio Manga and Pori in Finland, Delimara in Malta, and Lysekil and Nynäshamn in Sweden (GIIGNL, 2020). For a more detailed description of Europe's LNG receiving terminals, see King & Spalding (2018).

[26] The capacity of Zeebrugge LNG terminal is to be expanded by eight billion cubic metres by 2026 (OGJ, 2021a).

[27] El Musel LNG terminal in Gijon with an annual capacity of seven billion cubic metres was completed in 2021 but it was mothballed and it has not been put into operation (GEM, 2021b).

LNG did not have their own large-scale LNG terminal. These countries are Estonia, Finland, Malta and Sweden (GIE, 2019). Estonia has no LNG terminal, and Finland, Malta and Sweden each have small-scale or medium-scale LNG import terminal(s). Malta's small-scale LNG terminal has strategic importance in the energy supply of the country and its half a million citizens.[29]

Belgium, France, Italy and Spain are long-standing consumers of LNG. They opened their first large-scale LNG terminals in the late 1960s and early 1970s. With the exception of Italy, these countries are in theory able to satisfy at least half of their annual natural gas consumption with their LNG terminals. Spain has the highest LNG terminal capacity of the four countries relative to its natural gas consumption. The capacity is nearly double Spain's annual gas consumption. Italy trails behind the other three countries, as the maximum capacity of its LNG terminals can only cover one fifth of its annual gas consumption. The situation will not change in the near future, since the planned eight-billion-cubic-metre LNG port in Sicily appears to have been postponed to an unknown date (GLE, 2019; IGU, 2020a).

Whereas Belgium, France, Italy and Spain have decades of experience with LNG, Greece, Lithuania, Portugal, Poland and the Netherlands have opened their first large-scale LNG import terminals in this millennium (GIE, 2019; IGU, 2020a).

Greece, Lithuania and Portugal have taken great strides in incorporating LNG into their energy mix. In these three countries, the capacity of LNG terminals exceeds annual natural gas consumption (BP, 2020; GIE, 2019). 'The overcapacity' is justified, since in practice the utilisation rate of LNG terminals cannot reach 100%—due to weather conditions, for a start. Poland as a close fourth is set to increase the capacity of its existing LNG terminal in Świnoujście, northwest Poland, to at least 7.5 bcm, and the country is about to open a four-billion-cubic-metre FSRU unit in Gdańsk in the northeast. With the Świnoujście expansion and the new LNG terminal in Gdańsk, the combined capacity of Poland's LNG terminals could cover more than half of the country's current consumption of natural gas in the near future (GLE, 2019; Eurostat, 2020a). In the Netherlands, the gas supply situation is challenging. Natural gas

[29] The Maltese LNG unit has a strategic importance to Malta's energy supply, as the country may satisfy all its natural gas needs with this terminal. Natural gas provided nearly a half of Malta's overall energy supply in 2018 (IEA, 2021a).

contributes a large share of the country's primary energy consumption, but its gas production is about to collapse. Despite the impending collapse in production, gas consumption in the Netherlands has decreased very little. The figures are clear: in the 2010s, natural gas production in the Netherlands has fallen by approximately 50 bcm, while its consumption has reduced by only ten billion cubic metres. In 2019, the Netherlands—the EU's largest natural gas producer—was able to cover 'only' three quarters of its consumption with its own production (BP, 2020). The steep drop in natural gas production will force the Netherlands to both grow its renewable energy production and increase its gas imports (IEA, 2020). Since the Netherlands does not intend to increase substantially its LNG import capacity in the coming years (GLE, 2019; IGU, 2020a), its alternatives are more or less limited to increasing the volume of pipe gas imports. It is unlikely that the Netherlands would be able to increase imports from Norway, and therefore it will probably have to import more gas from Russia. In 2019, Russia covered a quarter of the Dutch natural gas imports, but it is within the realms of possibility that Russia's share could rise considerably from the 2019 level (Eurostat, 2021a).

In addition to the large-scale terminals described in Table 2.4, it is worth mentioning the new LNG terminal with a 2.6-bcm annual capacity, which opened on the Krk Island in Croatia in January 2021 (LNG Croatia, 2021). Cyprus is also currently in the process of building a large-scale LNG terminal. The FSRU unit with a capacity of over two billion cubic metres is expected to open in 2022 (GIIGNL, 2020; NS Energy, 2020).

As at February 2020, the IGU list of LNG terminals currently under construction does not include any projects in the member states apart from the Croatian unit, which opened at the start of 2021, and the terminal under construction in Cyprus. The absence of the German units from the list suggests that their construction will probably be delayed or some projects will be cancelled (IGU, 2020a).

When examining the role of LNG in the EU's energy supply, attention should be paid to LNG tankers as well as import terminals. In late 2019, the world's LNG tanker fleet consisted of approximately 600 vessels, whose combined operational capacity was nearly 90 bcm (GIIGNL, 2020). Despite the fact that the world's largest LNG fleet is owned by one of the EU member states, namely Greece (Hellenic Shipping News, 2019), the European Commission's assessments should include critical examination of the ownership of European LNG fleets and the role of

the owner's nationality in terms of the EU's energy security. Although the risks relating to the availability of LNG tankers are ultimately borne by individual governments and owners of LNG import terminals in the EU, the European Commission could perhaps act as a catalyst for increasing LNG tanker ownership in the EU. Co-ownership of tankers by LNG terminal owners in the EU could be one way to increase ownership and thus improve LNG supply security in the EU.

Concluding Remarks

Although the EU27 consumes roughly the same amount of energy as it did at the start of the millennium, the structure of energy consumption in the Union has changed. The shares of oil, coal and nuclear power have decreased, and the shares of renewables and natural gas have increased (European Commission, 2020a). And although consumption of natural gas in the EU fell by three percent in 2020 due to the corona pandemic, the drop is likely to be temporary (European Commission, 2020c). The share of gas in the EU's energy consumption will grow as a result of the Union's actions towards carbon neutrality and Germany closing its nuclear power plants in 2022. After the nuclear power plant closures, in order to make up for the drop in its energy production with natural gas alone, Germany would have to source nearly 20 bcm more than it currently does (BP, 2020).

Despite the growing role of natural gas, the EU's gas self-sufficiency has fallen sharply in this millennium, and it will fall further as the largest producer, the Netherlands, is set to close down the EU's largest gas field in 2022 (Eurostat, 2020b). It is worth emphasising that in 2019, the Netherlands supplied nearly 25 bcm of natural gas to the EU's largest consumer, Germany, whose annual natural gas consumption is around 100 bcm (BP, 2020).

The drop in the EU's own production, combined with increasing demand for natural gas, will lead to an increase in gas imports. Even if LNG imports were to grow, it seems likely that Russia's share in the EU's natural gas imports will rise well above 50% by the end of this decade and will continue to grow in the next decade as the decrease in Norway's gas production accelerates.

Pipelines will continue to be the main way of distribution for Russian natural gas despite the fact that Russia is one of the EU's main suppliers

of LNG. At the time of writing, it seems possible that Nord Stream 2 could be completed by September 2021. (Gardner, 2021).

Although the EU is able to cover more than a quarter of its annual natural gas consumption with its gas storage capacity, its strategic dependence on Russian natural gas is very high. Bearing in mind that the EU also imports a significant part of its uranium, oil and coal from Russia, the total share of Russian energy is around a quarter of the EU's total primary energy consumption. The eastern member states of the EU have the highest dependence on Russian energy.

In terms of the EU's future, excessive dependence on authoritarian Russia that engages in aggressive foreign policy would be risky, especially in a scenario where Russia's dependence on the EU decreases as Russia seeks to reduce its dependence on exports to the EU by exporting more to China and other Asian countries. In fact, one would have expected the wars in Georgia and Ukraine to prompt European politician and policy-makers to reduce member states' dependence on imports from Russia. This has not happened in all EU member states.

The EU's dependence on Russian energy imports could be reduced in a number of ways. Firstly, it could be done by investing in energy savings, which would reduce the need for imported energy. A second noteworthy way to reduce dependence on Russia is to invest in the production of renewable energy. Renewables currently cover around 15% of the EU's energy consumption. With the Green Deal, the EU aims to double the share of renewables in its energy consumption in less than ten years (European Commission, 2021b). Thirdly, the EU could reduce its dependence on Russian energy by diversifying its energy imports. LNG offers great diversification potential, although it should be remembered that Russia was the EU's third-largest LNG supplier in 2020 (European Commission, 2020c).

At the start of the millennium, LNG's share in European natural gas imports was a bit over ten percent. By 2020, it had risen to a quarter (European Commission, 2019a, 2020c). Future growth of LNG's share is hindered not so much by the lack of LNG import infrastructure, but rather by the new pipelines from Russia towards the west. For example, the completion of TurkStream under the Black Sea may suppress interest in the development of LNG import terminals in Bulgaria and Romania

(Gazprom 2021a).[30] And similarly, the completion of Nord Stream 2 will probably delay or even stop some of the plans for LNG terminals in Germany (Bajic, 2020).

Although Poland is in the process of expanding the capacity of its existing LNG terminal in the northwest and constructing another unit in the northeast, it is possible that no new large-scale LNG receiving terminals will follow in the Baltic Sea basin.[31] The LNG revolution is being hindered in the Baltic Sea region by gas pipelines as well as the possible hydrogen revolution.

The total investment in renewable hydrogen production in Europe is expected to reach EUR 200–500 billion over the next three decades (European Commission, 2020f, 2021c). Although hydrogen currently covers less than two percent of the EU's energy consumption, its share is estimated to reach 13–14% by 2050. This means that in 30 years' time, hydrogen is expected to produce energy volumes equivalent to the combined output of the EU's current 120+ nuclear power plants (Euratom, 2020).

Although hydrogen can play a significant role in the EU's energy supply in 30 years, it is important to remember that 'transitional energy' will be needed in the interim period, which probably means that lower-pollution conventional energy sources such as natural gas will retain their place in the EU's energy supply for some decades yet. And as long as natural gas is a part of the EU's energy mix, so will LNG also continue to have a role in the Union's energy scene.

[30] The EU used half of its LNG import terminal capacity in 2020 (GLE 2019; European Commission 2020c).

[31] Of the four LNG terminals being planned in Germany, only the Rostock unit is on the Baltic Sea coast, and it is not a large-scale unit. The Nordic countries currently have no plans to construct any large-scale terminals on their soil. The large-scale LNG terminal plans of Estonia and Latvia may not come to fruition, and Lithuania has no need for a larger LNG terminal. Russia already has an FSRU unit that can service the Kaliningrad region. In summary, it is possible that after the large-scale LNG projects of Poland, only small-scale and medium-scale LNG import terminals will be constructed in the Baltic Sea region.

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