10 New sources of natural gas for Finland: The Balticconnector pipeline and LNG imports

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Abstract

This chapter examines the impact of new sources of natural gas on the Finnish energy sector and the diversification of gas supply, focusing on the Balticconnector pipeline between Estonia and Finland and liquefied natural gas (LNG) infrastructure development. Both LNG terminals and Balticconnector have been advocated to contribute to diversified gas supply in Finland, thus enhancing energy security. Although LNG terminals have allowed the delivery of gas outside the reach of the national gas grid, due to their small capacity, currently only pipeline gas has strategic significance for Finland. Balticconnector has enabled the integration of the gas markets of Finland and the Baltic States, which is a step towards the creation of the EU-wide internal gas market. However, the true diversification of the sources of gas supply in Finland necessitates connecting the Finnish-Baltic and Central European gas transmission networks, particularly by completing the Gas Interconnection Poland-Lithuania (GIPL) pipeline. Natural gas is increasingly seen as an interim solution in the transition towards carbon neutrality that the European Union (EU) strives for by 2050. This calls into question the long-term viability of the expensive investments in gas infrastructure. On the other hand, the benefit of gas infrastructure is that it can be utilised in the transmission of biogas and retrofitted to the use of hydrogen, thus enabling the transition to more climate-friendly energy sources in the future.

Introduction

The Finnish natural gas sector experienced notable changes at the beginning of the 2020's. The natural gas market was opened to competition by unbundling the transmission and sales of gas and by launching the Balticconnector pipeline between Finland and Estonia. Balticconnector also enabled the creation of integrated gas market for Finland and the Baltic States. Since the mid-1970's, Finland has been receiving piped natural gas from a single supplier, first from the Soviet Union and subsequently from Russia. Creating new gas supply routes has been visioned for years in Finland and at first, building a connecting pipeline to Sweden was under consideration. However, in the 2010's, creating a connection between Finland and Estonia became established as the main development direction. The construction of Balticconnector begun in 2018 and the work was completed by the end of 2019 (Gasgrid 2020c; Gasum 2019b). Finland has also facilitated the construction of LNG import terminals to enable the delivery of gas outside the reach of the national gas transmission network. The LNG imports to Finland begun in 2016, when the first import terminal in Pori was opened for commercial use (Gasum 2016). Both LNG terminals and Balticconnector are seen as contributing to diversified gas supply in Finland.

This chapter examines the impact of new sources of natural gas on the Finnish energy sector and the diversification of gas supply, focusing on pipeline imports through Balticconnector and LNG imports. For Finland, Balticconnector brings promises of diversifying gas transfer routes and hence, enhancing energy security. However, when examining the potential sources of gas imported through Balticconnector, this study raises the question if the pipeline alone will bring true diversification for the sources of gas supply. The LNG imports to Finland, in turn, have remained small-scale, mainly due to the lack of a large-capacity import terminal. While the share of natural gas in the Finnish energy mix is rather small, the country's natural gas market also remains limited, creating challenges for the cost-effectiveness of gas infrastructure projects. Within this context, this chapter addresses the challenges related to LNG infrastructure development in Finland, as well as the more general question of the sustainability of natural gas use in the face of tightening climate goals.

This chapter proceeds as follows: first, the recent developments in the Finnish natural gas sector, including natural gas consumption and the market liberalisation are reviewed. The chapter then turns to examining the sources of natural gas supply to Finland and the significance of the Balticconnector pipeline in terms of their diversification. Next, the prospects and limitations of LNG use in Finland are analysed, paying particular attention to the LNG infrastructure development, as well as the environmental impact of gas use and its potential alternatives. The chapter ends with conclusions.

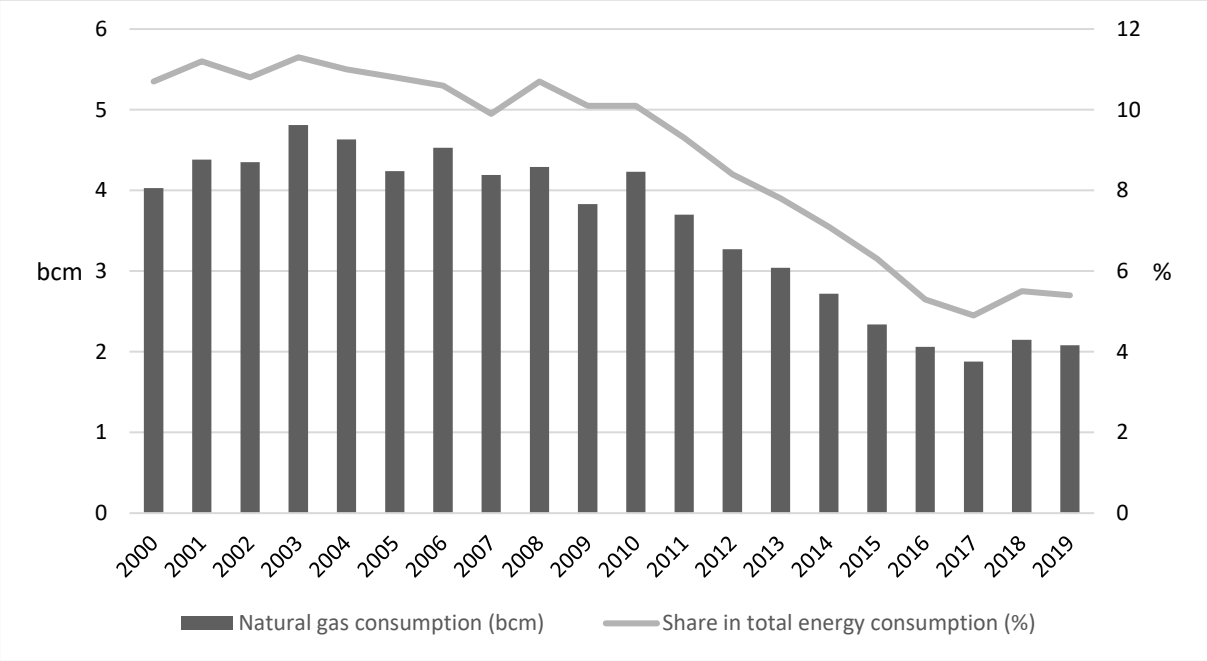
Recent developments in the Finnish natural gas sector

Natural gas consumption in Finland

According to Statistics Finland (2020a), total energy consumption in Finland in 2019 was 1.36 million terajoules (TJ). In 2019, wood fuels, oil and nuclear energy had the largest shares in Finland's total energy consumption – 28, 23 and 18 percent respectively – and the share of natural gas was five percent. Compared with the previous year, total energy consumption fell by one percent, mainly due to the six percent fall in the consumption of fossil fuels and peat. The decrease in the consumption of fossil fuels and peat resulted, among others, from the

reduced use of fossil fuels in separate production of electricity, tax increases for particularly coal and peat, and the considerable rise in the prices of emission rights (Koistinen 2019; Tax Administration 2019; Statistics Finland 2020a). The consumption of natural gas decreased by four percent compared with the previous year, amounting to 73,000 TJ, or 2.1 billion cubic metres (bcm). During the past ten years, the natural gas consumption has approximately halved, as has also its share in total energy consumption (Figure 10.1).

Figure 10.1 The consumption of natural gas and its share in total energy consumption in Finland, 2000–2019



Source: The Authors, based on Statistics Finland 2020c.

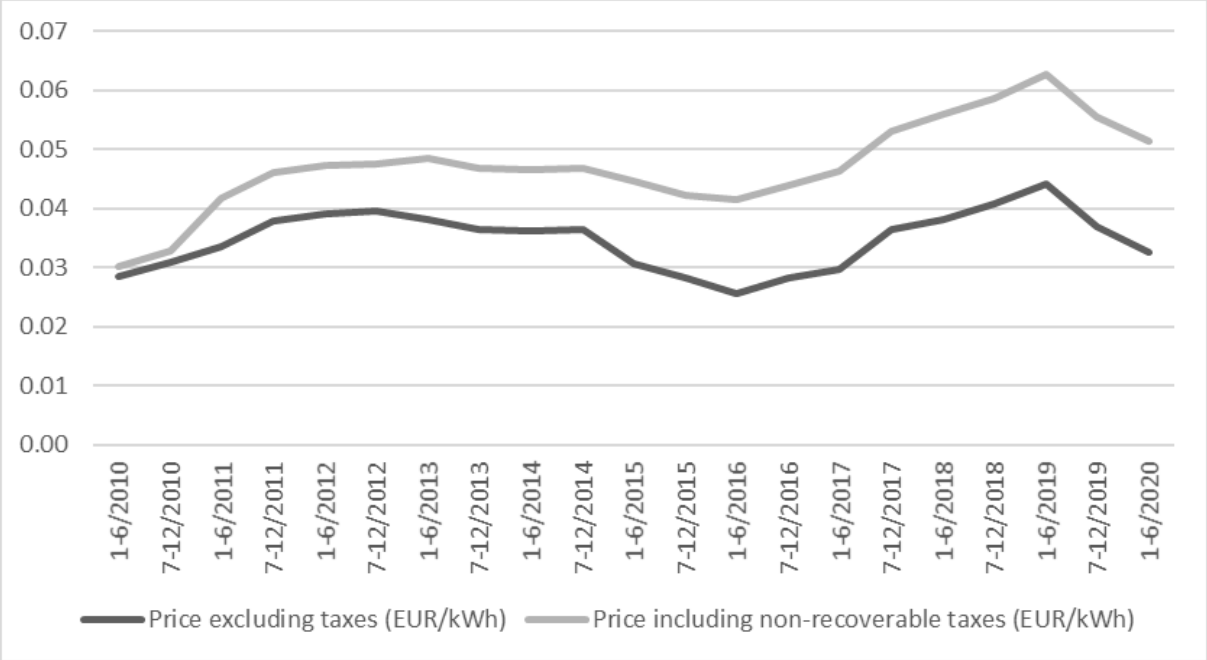
In Finland, the main consumers of natural gas are industry and energy production and, unlike in Central and Eastern Europe, household consumption of gas is marginal. The share of industry in natural gas consumption is almost 60 percent and the share of heat and power production nearly 40 percent (Energy Authority 2019), making the share of other uses of gas, such as direct gas heating of buildings and cooking in households and restaurants, insignificant. Chemical and forest industries are the main industrial users of natural gas. Natural gas is utilised as raw material in the production of hydrogen in oil refining and other chemical industry's processes. It is also an ideal fuel in industrial processes where, for instance, high temperatures and fast adjustability are needed. In energy production, natural gas is mainly used in combined heat and power production where both electricity and heat are produced in the same power plant and, to a lesser extent, in the production of district heating. One of the main benefits of the gas-based heat and power production is its fast adjustability for the changes in energy demand (Finnish Gas Association 2020). The gas transmission network covers the southern and south-eastern parts of Finland, as well as the Pirkanmaa region around the City of Tampere (Gasgrid 2020b). Natural gas is available for consumption in around 40 municipalities (Energy Authority 2019).

The limited transmission network restricts the growth of the natural gas consumption. Although the carbon dioxide (CO_2) emissions of natural gas are lower than other fossil fuels,

the consumption of gas in Finland has dropped remarkably during the past ten years (Statistics Finland 2020c). Some reasons behind the downward trend in consumption have been the raising taxation of natural gas and the decreasing use of gas in electricity production (Energy Authority 2019). In 2019, the share of natural gas in electricity production was six percent whereas nuclear power (35%), biomass (18%) and hydropower (19%) constituted the main energy sources in electricity production (Finnish Energy 2020). In 2010, the share of natural gas in electricity production was more than two times higher, i.e. 14 percent (Statistics Finland 2011).

Figure 10.2 shows the development of natural gas prices for non-household consumers in Finland from 2010 to 2020, with non-recoverable taxes included and all taxes excluded. According to Eurostat (2020a), in the second half of 2019, the share of non-recoverable taxes in the price of natural gas in Finland was the highest among the EU member states, i.e. 34 percent. Due to the high taxation, the price for natural gas for non-household consumers (excluding VAT and other recoverable taxes and levies) was also the most expensive among the EU member states, EUR 0.0555 per kilowatt hour (EUR/kWh) (Eurostat 2020a). During the first half of 2020, the natural gas price in Finland has slightly dropped, to 0.0513 EUR/kWh, but the share of non-recoverable taxes has grown to 37 percent. Excluding all taxes and levies, the respective prices are 0.0369 EUR/kWh for the second half of 2019 and 0.0326 EUR/kWh for the first half of 2020 (Eurostat Data Browser 2020). When looking at the report of the working group on energy taxation reform appointed by the Finnish Ministry of Finance, it seems that no tax reductions for natural gas are in sight. On the contrary, in the report published in September 2020, the working group proposes moderate increase in the taxation of natural gas, along with other fossil fuels (Ministry of Finance 2020).

Figure 10.2 Bi-annual natural gas prices for non-household consumers in Finland, 2010–2020 (EUR/kWh)



Source: The Authors, based on Eurostat Data Browser 2020.

Regarding the security of supply of natural gas, the gas supply from Russia to Finland has been steady during the past decades and no significant supply disruptions have occurred. Nevertheless, because Finland has no gas storage facilities, it has to prepare to replace natural gas by another energy production method or alternative fuel in case of a supply disruption. According to National Emergency Supply Agency (2019), if a disruption occurs in the single largest gas infrastructure – the second parallel gas import pipeline from Russia – Finland's total gas demand can be satisfied for a day of exceptionally high gas consumption with the capacity of the remaining infrastructure. However, a long-term disruption in the supply of pipeline gas from Russia would create a challenging situation for Finland. In that case, gas companies have to deliver either vaporised LNG or biogas to protected gas customers, that is households connected to the gas distribution network. Regarding all imported fuels (coal, natural gas and oil), Finland keeps reserves equivalent to five months of normal consumption. However, this does not include gas consumption in industry. Excluding households, other users of natural gas are primarily responsible for their own preparedness plans and the functioning of the potential reserve fuel systems (Energy Authority 2019; National Emergency Supply Agency 2019). The latest preventive action and emergency plan concerning the security of gas supply in Finland has been prepared before the commissioning of the Balticconnector pipeline and the integration of the gas markets of Estonia, Finland and Latvia. Hence, the need to reassess the risk scenarios concerning supply security and update the contingency plan is acknowledged in the document (National Emergency Supply Agency 2019).

The liberalisation of the natural gas market

The Finnish natural gas market experienced notable changes at the beginning of 2020 when the import and wholesale of natural gas were opened to competition. Until January 2020, the Finnish gas company Gasum had a monopoly in the transmission and sale of natural gas in Finland (Gasum 2019a) [1]. Since the beginning of the year 2020, transmission and sale of natural gas were unbundled from each other and a new state-owned company, Gasgrid Finland, took over the responsibility of the transmission system operator (TSO). In accordance with the new market model, Gasgrid Finland sells transmission capacity whereas shippers and traders sell gas energy in gas exchange or over the counter (OTC) (Gasgrid 2020a). The construction of the Balticconnector natural gas pipeline between Finland and Estonia was an essential part of the market opening. The launch of the pipeline at the beginning of 2020 indicated the creation of common gas market for Finland and the Baltic States. As a part of the integrated gas market, Finland, Estonia and Latvia agreed on the formation of a regional tariff zone, which included removing cross-border transmission tariffs between the countries and harmonising entry point tariffs on the zone's external borders (Gasgrid 2020c).

Lithuania did not join the single market area due to disagreements over its exact design, in particular regarding the compensation mechanism between the TSOs. Lithuania's absence from the regional tariff zone can, for instance, complicate the functioning of virtual trading platform GET Baltic that is used to trade gas in the Baltic States (Jakštas 2019), and from the beginning of 2020 also in Finland. Along with the opening of the Balticconnector, Finland gained connection to the Inčukalns underground gas storage (UGS) facility in Latvia and the

[1] Gasum has been fully state-owned since the State of Finland acquired the remaining 25 percent share of Gasum from Gazprom in December 2015 (Gasum 2015b).

Klaipeda LNG terminal in Lithuania. Furthermore, through GIPL Finland will gain connection to the Central European gas network and be able to further diversify the potential gas sources (Gasgrid 2020a). Consequently, the Balticconnector pipeline is important in terms of Finnish energy security because it diversifies natural gas supply routes. Not being dependent on one single source of gas also provides an asset for Finland to negotiate for the gas price with the suppliers. Thus, the pipeline promotes competition in the gas market.

Creating a regional gas market for Finland and the Baltic States by constructing the interconnecting Balticconnector pipeline was one of the goals in the National Climate and Energy Strategy until 2030, prepared by the previous government in Finland in 2016. According to the strategy, the regional gas market facilitates gas use both as raw material and fuel in the period of transition towards carbon neutral society (Ministry of Economic Affairs and Employment 2017). At the time of writing of this article, the Finnish Government has begun to prepare the new climate and energy strategy that is traditionally prepared by each government. The policy measures and the related scenarios outlined in the new strategy will pay particular attention to achieving the government programme's target of carbon neutrality by 2035 and the EU's energy and climate targets for 2030 (Ministry of Economic Affairs and Employment 2020). The key targets of the EU's 2030 Climate and Energy Framework include cutting greenhouse gas emissions by at least 40 percent from 1990 levels, raising the share of renewable energy to at least 32 percent and improving energy efficiency by over 32 percent (European Commission 2020f). In December 2020, the European Council decided to raise the target for the reduction of greenhouse gas emissions to at least 55 percent by 2030 (European Council 2020). The more ambitious emission reduction target is intended to act as a stepping stone to reach carbon neutrality by 2050 (European Parliament 2020b). Regarding the progress in the EU's energy and climate targets, the 2020 target of 20 percent emission reduction was reached ahead of schedule (European Parliament 2020a). EU-wide assessment of National Energy and Climate Plans of the European Commission (EC) (2020c) indicates that if fully implemented, the member states' energy and climate plans will enable surpassing the renewable energy target, as well as the previous emission reduction target of 40 percent by 2030 but fall a little short of the energy efficiency target. However, in order to reach the emission reduction target of 55 percent by 2030 – and carbon neutrality by 2050 – the EU countries need to adopt new measures and accelerate the pace further.

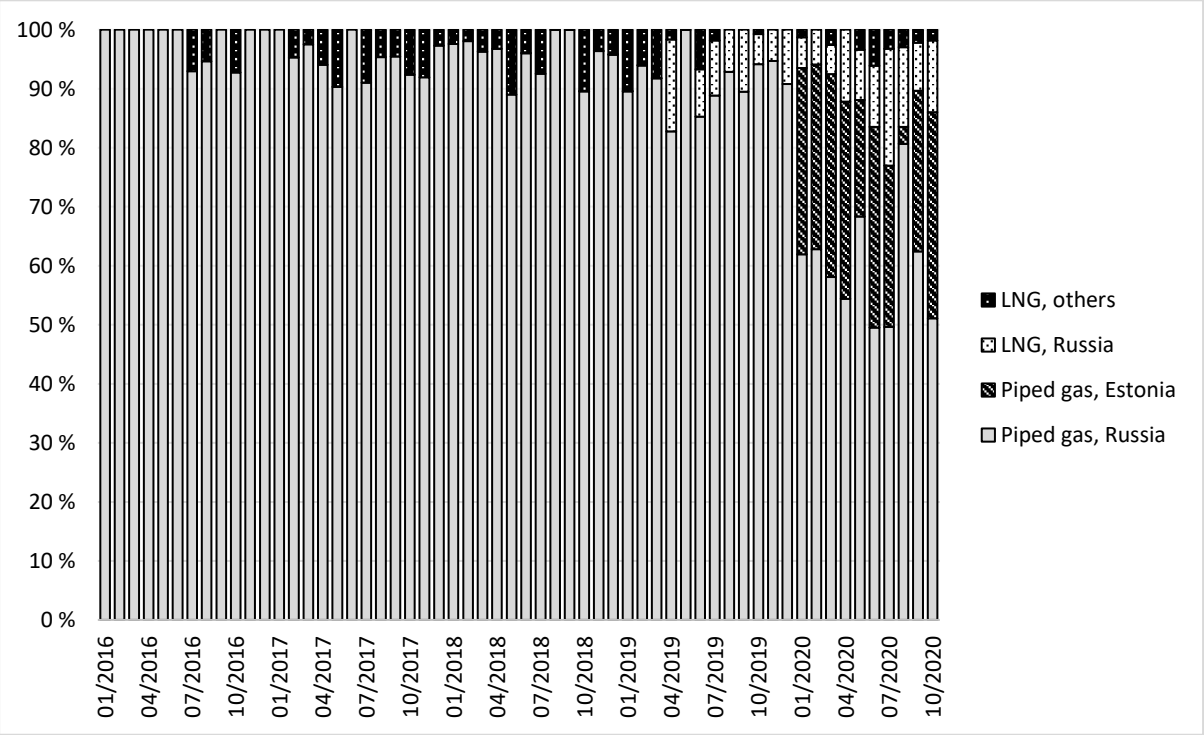
Decreasing dependency on energy imports from outside the EU, diversifying energy sources and supplies and creating a single energy market are among the main goals of the EU's Energy Union strategy adopted in 2015 (European Commission 2015a). Because being dependent on one single supplier, Finland was granted an exception from the EU's Natural Gas Directive (European Union 2009) that establishes common rules for the internal market in natural gas, including the separation of gas distribution networks from production, supply and storage activities. In terms of energy security, the natural gas transit from Russia to the EU via Ukraine has been among the main concerns for the EU, particularly since the 2014 Ukrainian crisis (Europe Information 2015). The creation of the regional gas market for Finland and the Baltic States is in line with the EU's goals of increasing security of supply of natural gas and forming a functional and interconnected internal gas market.

The supply of natural gas to Finland

Overview on pipeline and LNG imports

Finland does not have any natural gas reserves of its own and, consequently, neither any natural gas production. Hence, all natural gas consumed in Finland is imported. From the mid-1970's until the opening of Balticconnector, all pipeline gas consumed in Finland was imported from Russia through a twin pipeline via the southeastern border town of Imatra. Finland's total monthly natural gas imports by the country of origin since January 2016 (measured by the import value in euros) are illustrated in Figure 10.3.

Figure 10.3 Finland's total monthly natural gas imports by origin, January 2016 – October 2020

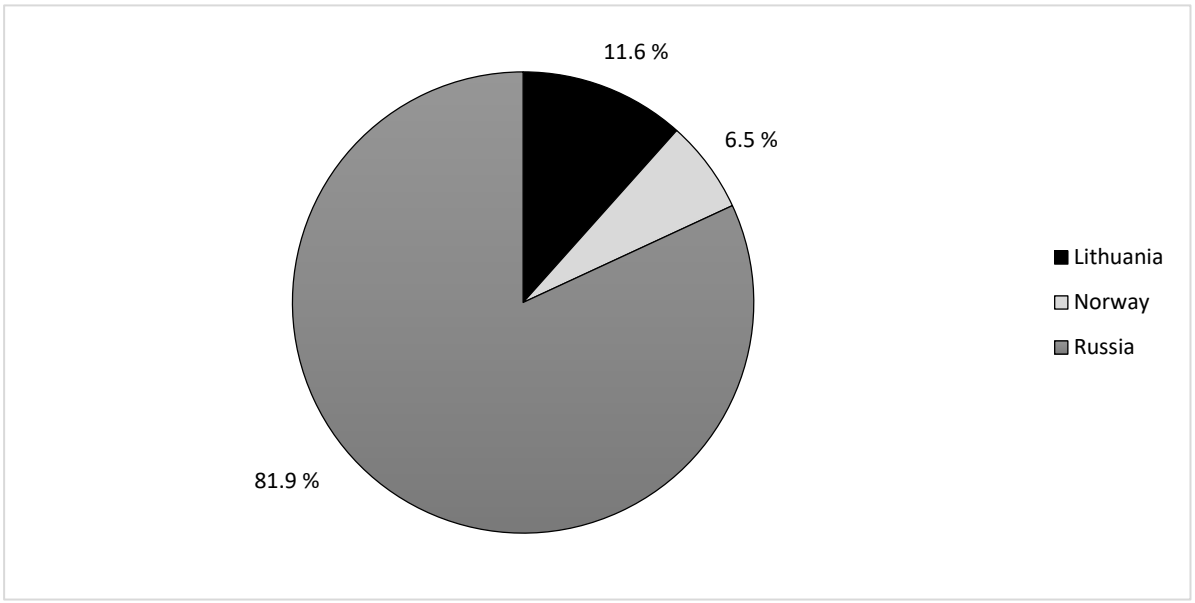


Source: The Authors, based on Finnish Customs 2020.

According to the Finnish Customs (2020), in January-October 2020, one third of the total pipeline gas imports have originated from Estonia through Balticconnector and two thirds from Russia, when measured by the import value in Euros. Exact information on the original sources of the gas imported through Balticconnector is not available, but it is either from Russia or from the Klaipeda LNG terminal in Lithuania (Kyytsönen 2020; Nuotio 2020). In addition to pipeline gas, Finland has been importing LNG since July 2016. According to the Finnish Customs (2020), the first imports originated from Belgium but throughout the years, the largest LNG importers to Finland have been Russia and Norway, with roughly 40 percent share each when measured by the import value in euros. Other countries from which Finland has been importing LNG include Lithuania and the Netherlands. LNG imports from Russia begun in June 2018 in small scale but have since grown in value. In fact, during the first ten months of 2020, over 80 percent of the total LNG imports have originated from Russia, more than one tenth from Lithuania and roughly seven percent from Norway, when measured by the import value in Euros (Figure 10.4). Regarding the total value of natural gas imports in

2020, almost 70 percent originated from Russia and a little over 30 percent from other countries (Finnish Customs 2020). When considering the potential sources for gas flowing through Balticconnector, Finland's dependence on Russian natural gas is even higher.

Figure 10.4 LNG imports to Finland by origin, January-October 2020



Source: The Authors, based on Finnish Customs 2020.

Due to the market limitations, the natural gas consumption in Finland can mainly grow in the form of LNG, the use of which as fuel is growing, for instance, in marine and heavy road traffic. LNG can act as an interim solution in the transition towards carbon neutral economy because it is the cleanest fossil fuel available. For instance, the use of LNG as ship fuel is estimated to reduce greenhouse gas emissions for maximum 21 percent during the whole life cycle of the fuel (Liikennefakta 2020a). There are two small-scale LNG import terminals currently operating in Finland, in Pori and in Tornio (Finnish Gas Association 2020). In addition, one LNG terminal is under construction in Hamina, due to be in commercial use in April 2021. Unlike other LNG terminals in Finland, Hamina LNG terminal will be connected to the Finnish gas transmission network and will thus be serving as a new entry point to the gas market of Finland and the Baltic States. The connection to the transmission network is expected to be completed in August 2021 (Hamina LNG 2020b).

The benefits of LNG include that transforming natural gas into liquid phase allows maintaining the energy content of the gas while simultaneously reducing the gas volume by 600 times, and it can thus be transported by tankers and trucks over very long distances (IGU 2020). Consequently, LNG is flexible fuel in the sense that its trade is not dependent on existing pipeline infrastructure. LNG trade has been growing on a global scale, and in 2019, the focus of LNG import growth has shifted from Asia to Europe. In 2019, LNG imports to Europe increased by almost 70 percent, totalling to 120 bcm. The main sources of LNG imports to Europe were Qatar, Russia, the USA, Nigeria and Algeria (BP 2020). The utilisation of LNG also brings promises of diversifying Finland's energy mix and thus strengthening the energy security of the country. Nevertheless, due to the small capacity of the LNG import terminals in Finland, only pipeline gas has strategic significance for the country for now.

Balticconnector: ending isolation?

Balticconnector, a bi-directional gas pipeline between Finland and Estonia, entered into commercial use at the beginning of 2020. The pipeline is co-owned by two state-owned companies: Finnish Gasgrid and Estonian Elering. With a daily transmission capacity of 7.2 million cubic metres (annual capacity of 2.6 bcm), the Balticconnector pipeline has three sections: a 21-kilometre long onshore pipeline in Finland, a 77-kilometre long offshore part and a 54-kilometre long onshore pipeline in Estonia. The stated aim of the project is to enable diversified gas supply, as well as to improve regional supply in general (Baltic Connector 2019). On the Estonian side, the pipeline brings a new direction for possible gas supply. For Finland, it primarily opens the national market for competition. It also strengthens the security of supply in the country.

The Balticconnector pipeline would not have been commercially viable without considerable support from the EU (Baltic Connector 2020b). In fact, the project was originally initiated by Gasum in 2008 but deemed to be financially unfeasible in 2015 (Gasum 2015a). However, a state-owned company created for the implementation of the Finnish part of the project, Baltic Connector Oy, subsequently picked the project up and agreed on the joint construction of the pipeline with Estonian Elering in 2016 (Baltic Connector 2020a). Connecting Europe Facility (CEF), a key EU financial instrument for infrastructure, provided 75 percent of Balticconnector's USD 294 million (EUR 250 million) budget (European Commission 2020a). For the EU, Balticconnector has a status of a Project of Common Interest (PCI) (European Commission 2020d).

The Russian-Ukrainian gas dispute of 2009 gave the EC an incentive to conduct a stress test on the EU gas supply. The study found that in addition to the EU's Eastern neighbours (in this context, the so-called Energy Community countries) the Eastern member states – along with Finland and the Baltic States – are the most vulnerable to disruptions in gas supply. The calculations indicate that both Finland and Estonia would have been faced with a 60 percent deficit of natural gas in the event of cessation of gas supply from Russia. The EC press release on the stress test states co-operation as the key to improving the resilience of gas consuming countries within the EU and the neighbouring area (European Commission 2014). Purely national projects would not be truly in the interest of any gas consuming country. This is relevant for Balticconnector, which as a joint project between two member states has worked towards reducing vulnerability of both Finland and Estonia, as well as the Baltic Sea region in general.

In addition to improving regional resilience, Balticconnector is an important step towards enhancing Finland's energy security. The annual capacity of Balticconnector exceeds the yearly demand of natural gas in Finland that for the past few years has been around two billion cubic metres. Hence, in theory, Finland could cover its gas consumption with supplies through Balticconnector. Nevertheless, when considering the security of supply, the key benefit brought by the Balticconnector project seems to have been the diversification of transfer routes. Until the launch of Balticconnector, the only natural gas entry point was for the Russian imports in Imatra. In addition to traditional natural gas, Balticconnector can be used to transfer regasified LNG, as well as biogas. In the future, LNG terminals could be connected to the gas grid and thus serve as entry points. It is also be possible to create entry points for biogas (Gasum 2019b) although in its present state, biogas production is very small scale in Finland.

However, it is important to note that Balticconnector alone will not suffice to end the isolation of the Finnish gas grid. The fulfilment of this goal also depends on GIPL that will connect the Finnish-Baltic grid to Poland and the common EU gas network. When completed, GIPL will further improve the resilience of the gas pipeline network in the Baltic Sea region, bringing economic benefits and possibly leading to lower gas prices. GIPL is a bi-directional pipeline, with an annual capacity of 2.4 bcm from Poland to Lithuania and 1.9 bcm to the opposite direction (Amber Grid 2020). With technical adjustments, GIPL also renders possible the delivery of gas to Belarus or Ukraine (Patricolo 2020). However, since Belarus alone consumed more than 19 bcm natural gas in 2019 (BP 2020), the capacity of GIPL is not sufficient to reduce the dependence of Belarus and Ukraine on Russian energy and thus influence the balance of energy market in a larger sense.

The GIPL project is implemented by two natural gas TSOs, Lithuanian Amber Grid and Polish Gaz-System S.A. According to Amber Grid that is responsible for the project implementation in Lithuania, the construction of the 165-kilometre long Lithuanian part of GIPL begun in January 2020. By the end of the year 2020, 60 percent of the construction work has been completed, including filling the first 72 kilometres of the pipeline with gas and welding a 125-kilometre long section of the pipeline. Amber Grid expects to complete the construction of the pipeline to the Lithuanian-Polish border in 2021 and open GIPL for commercial use in the beginning of 2022 (Amber Grid 2020). However, while we could not find any information on the progress of the construction of the 343-kilometre long Polish section of the pipeline, the timely completion of GIPL remains unclear.

Even combined, the gas market of the Baltic States and Finland is rather small, with the annual consumption of approximately six billion cubic metres of natural gas in 2019. Of the three Baltic States, Lithuania consumed the largest amount of natural gas, i.e. 2.4 bcm (Ministry of Energy of the Republic of Lithuania 2020). Latvia consumed 1.4 bcm (Central Statistical Bureau of Latvia 2020) and Estonia 0.5 bcm natural gas in 2019 (Elering 2020). Finland and the Baltic States have shared the dilemma of being dependent on Russian gas and isolated from the EU grid. According to Eurostat (2020b), during the first half of 2020, Estonia and Latvia relied on Russia for 75-100 percent and Lithuania for 25-50 percent of their natural gas imports. In Finland, one third of pipeline gas imports originated from Estonia through Balticconnector and two thirds from Russia during the first ten months of 2020 (Finnish Customs 2020). On the face of it, this clearly indicates a change compared to the situation preceding Balticconnector. However, as Estonia and Latvia rely almost completely on Russian pipeline gas, one has to bear in mind that in practise, there are only two possible sources for the gas flowing through Balticconnector, i.e. the Klaipeda LNG terminal in Lithuania and pipeline gas from Russia.

The Klaipeda LNG terminal, that has been in operation since 2014, aims to become a regional gas hub supplying natural gas not only to the Baltic States but also to Finland and Poland (Sytas 2019). The terminal comprises a floating storage regasification unit (FSRU) called ‘Independence’, owned by a Norwegian company Leigh Höegh LNG, a berth and an 18-kilometre long pipeline connecting the LNG terminal to the Lithuanian gas grid. The terminal is operated by a Lithuanian oil and gas company Klaipėdos Nafta. The total capacity of the terminal tanks is 170,000 cubic metres and it can regasify up to 3.8 bcm per year (CEEnergynews 2020; Klaipėdos Nafta 2020). In 2019, Lithuania received 1.4 million tonnes of LNG in net imports, which equals to 1.9 bcm of natural gas. A little over 70 percent of LNG imports originated from Norway, more than 20 percent from Russia and five percent from the USA (GIIGNL 2020).

The combined annual supply capacity of GIPL and the Klaipeda LNG terminal is around six billion cubic metres, which is roughly the same as the annual gas consumption in the Baltic States and Finland. However, in 2019, Lithuania delivered only 0.6 bcm of natural gas from the Klaipeda terminal to Estonia and Latvia (Ministry of Energy of the Republic of Lithuania 2020). In 2020, the LNG imports from the USA have grown due to the favourable market situation. There has been an abundance of supplies from the USA while many European gas storage facilities have been full. Consequently, the users of the Klaipeda terminal have been able to purchase LNG imported from the USA for affordable prices (Woellwarth 2020). Nevertheless, LNG input from overseas would need to radically increase in order to change the overall dominance of Russian gas in the gas market of the Baltic States and Finland. Furthermore, the completion of GIPL is important for source diversification in both Finland and the Baltic States.

Whereas Lithuania aims to strengthen the security of gas supply by importing LNG, Latvia has constructed an UGS facility that ensures the availability of natural gas when it is needed the most, that is during the heating season. The Latvian company JSC Conexus Baltic Grid that operates the gas infrastructure in Latvia also owns the Inčukalns UGS (Conexus Baltic Grid 2020b)[2]. The Inčukalns UGS is the only functioning gas storage within the reach of the gas market of the Baltic States and Finland and has a capacity of up to 3.2 bcm of active natural gas. The storage is filled up with natural gas in the summer and it fully covers the demand for gas in Latvia during the heating season. Consequently, Latvia does not need to rely on pipeline imports from Russia in wintertime when the pipelines are very loaded. Along with the launch of Balticconnector, Finland also gained connection to the gas storage, which could also be used to store gas for Finnish needs (Conexus Baltic Grid 2020b).

Balticconnector faced some difficulties on its first year of operation in 2020. The unexpected reconstruction work of Conexus Baltic Grid threatened to shut the pipeline down at the time when continued transport was critical for the operation of the pipeline. Conexus's repairs were connected to the Lithuanian Interconnection Improvement (LLSU) project, which is also the EU's PCI project. LLSU is further linked to the gas priority corridor of Baltic Energy Market Interconnection Plan (BEMIP) (Conexus Baltic Grid 2020a). Estonian and Finnish energy companies, having received an advance notice one month beforehand, appealed jointly to the governments and national system operators to postpone the shutdown for one year. The complication came amidst the COVID-19 crisis, during which the additional expenses would bare dire consequences for the market participants (Reiljan 2020). Conexus justified the repairs stating that the improvements would increase supply volumes to Finland (Conexus Baltic Grid 2020a). This example reveals the geopolitical nature and vulnerability of gas infrastructure: projects have commercial goals but are tied to the physical reality and involve actors on various levels. As gas sale contracts are made long-term, sudden disruptions in the access to the pipeline itself create stress for the seller as well as raise questions of reliability of supply for the buyer. Energy infrastructure development supported by the EU aims at improving the function of the internal energy market. However, while the goal of creating a more secure energy market in the EU is common, the actors are bound to have conflicting interests.

The launch of Balticconnector has improved Finland's position on the natural gas market in many ways. However, some questions remain. The realisation of Balticconnector's function in

[2] The largest shareholder (68.5%) of Conexus Baltic Grid is AS Augstsprieguma tikls AST, a power transmission company fully owned by the Latvian State (AST 2020).

securing the diversification of sources of supply is dependent on the pipeline grid upstream. When writing this article, the construction of GIPL was still in progress. What will be the consequences for Balticconnector and, more broadly, to Finland's energy security, if the operations of the connecting pipelines in the Baltic States or Poland are for some reason halted or delayed? Finally, it is relevant to consider the larger question of what is actually the significance of Balticconnector for the Finnish gas market. While the liberalisation of the gas market and the construction of Balticconnector have diversified the market for Finland, they have not removed all restrictions and issues related to pipeline gas. While it would be too early to judge how Balticconnector will influence diversification in the long term, for the time being it seems that the ultimate source of imported gas has not changed that much. This reflects the nature of pipeline gas as a relatively 'slow' commodity. In this context, it is worthwhile to ask, whether LNG could bring true diversification and flexibility for the natural gas and even the whole energy market in Finland?

LNG in Finland: prospects and limitations

LNG infrastructure development

The import and use of LNG in Finland have been modest to date. The existing LNG infrastructure is both new and small-scale, and intended to serve mostly local industry needs near the LNG terminals. The first Finnish LNG import terminal in Pori, owned by Gasum, was commissioned in 2016. The terminal has a storage capacity of 30,000 cubic metres and it delivers LNG to industrial customers. The second terminal, the Manga LNG import terminal in Tornio, was constructed as a joint venture of the industrial companies Outokumpu and SSAB Europe and the Finnish energy companies EPV Energy and Gasum. At the time when the Manga terminal began its operations in 2019, it was the largest LNG terminal in the Nordic countries with a storage capacity of 50,000 cubic metres. The terminal is designed to deliver LNG to industrial customers, as well as to LNG-fuelled ships (Reuters 2019; Gasum 2020b). While it would be technically possible to feed regasified LNG to the Finnish gas grid, the two existing LNG import terminals in Finland are located outside of the reach of the national grid. A third Finnish LNG import terminal in Hamina (with the storage capacity of 30,000 cubic metres) is planned to commence commercial operations in 2021. The terminal is jointly owned by Hamina Energy Ltd, Estonian company Alexela and the Finnish technology company Wärtsilä[3]. It will be the first LNG terminal in Finland to be connected to the national gas grid. In addition, the terminal will be connected to the local gas network in Hamina (Hamina LNG 2020a). The terminal's daily entry capacity to both networks will be 0.5 million cubic metres of gas in total (Ministry of Economic Affairs and Employment 2019). All three LNG terminals have received investment support from the Finnish state (Ministry of Economic Affairs and Employment 2014a; European Commission 2015b; European Commission 2016).

The liberalisation of the Finnish gas market brought about the creation of market rules also for LNG. Consequently, there is an institutional readiness to develop LNG capacity further and to start new operations in the country. This also clears the path for new actors to operate in the field and helps to create a more versatile gas and energy market in Finland (Gasum 2019b).

[3] Alexela Group is an Estonian holding company that operates in three areas: energy, metal industry and property development. Alexela's majority owner is Estonian businessman Heiti Hääl. Until 2014, 50 percent of the company's shares were owned by Kazakh businessman Igor Bidilo (ERR 2014).

As forthcoming terminals enhance the availability of LNG, new actors may start utilising it for instance in heat and power production, which would then further increase its demand. However, despite the positive developments, practical barriers remain, and due to the small size of the Finnish gas market, the challenge to ensure financial feasibility of LNG infrastructure projects is the main obstacle for further development. Some plans to build LNG infrastructure have already been abandoned as commercially unviable: for instance, the gas company AGA halted its plans to build an LNG terminal in Rauma (Pukkila 2015), despite receiving a positive decision on state investment support (Ministry of Economic Affairs and Employment 2014b). Gasum, in turn, gave up the implementation of the Finngulf LNG terminal project on the South Coast of Finland. Finngulf LNG project was part of the Finnish-Estonian plan to construct a joint LNG import terminal either in Inkoo, Finland or in Paldiski, Estonia, together with an interconnecting pipeline. The terminal would have been large-scale, with annual capacity of 2.5 bcm (Ministry of Finance 2014; Enerdata 2015). The Finnish state-owned gas company Gasum plays a central role in the LNG infrastructure development in Finland. Gasum's operating area stretches to other Nordic countries as well and the company's strategic goal is to create a Nordic gas market and infrastructure (Gasum 2020a). Tightening co-operation in the Nordic gas sector, as well as industry collaboration and creation of clusters may increase the profitability of LNG projects, reducing both costs and emissions for the industrial partners. Furthermore, state aid has been a precondition for carrying out LNG infrastructure projects in Finland.

While Finland lacks a large LNG terminal, following the creation of the gas market of the Baltic States and Finland it can benefit from the pre-existing infrastructure elsewhere, such as the LNG terminal in Klaipeda, Lithuania. The LNG import terminals on the shores of the Baltic Sea are listed in Table 10.1.

Table 10.1 LNG import terminals on the shores of the Baltic Sea

Status	Location	Name	Nominal annual capacity
Operational	Finland (Pori)	Pori LNG terminal	0.1 bcm
	Finland (Tornio)	Manga LNG terminal	0.4 bcm
	Lithuania (Klaipeda)	FSRU Independence	4.0 bcm
	Poland (Świnoujście)	Świnoujście LNG terminal	5.0 bcm (current), 7.5 bcm (by 2021)
	Russia (Kaliningrad)	FSRU Marshal Vasilevskiy	3.7 bcm
	Sweden (Lysekil)	Lysekil LNG terminal	0.3 bcm
	Sweden (Nynäshamn)	Nynäshamn LNG terminal	0.3 bcm
Under construction	Finland (Hamina)	Hamina LNG terminal	-
Planned	Estonia (Tallinn)	Muuga LNG terminal	0.5-4.0 bcm
	Estonia (Paldiski)	Paldiski LNG terminal	2.5 bcm
	Finland (Rauma)	Rauma LNG terminal	-
	Germany* (Rostock)	Rostock LNG terminal	-
	Latvia (Riga)	Kundzinsalas LNG terminal	-
	Latvia (Skulte)	Skulte LNG terminal	5.0 bcm

	Poland (Gdansk)	Gdansk LNG terminal (FSRU)	4.1-8.2 bcm
	Sweden (Gothenburg)	Gothenburg LNG terminal	0.5 bcm
	Sweden (Gävle)	Gävle LNG terminal	0.3 bcm

* There are also other LNG terminal projects planned in Germany (such as Brunsbüttel, Stade and Wilhelmshaven) but because they are not located on the shores of the Baltic Sea, they are not included in this table.

Source: The Authors, based on GIE 2019.

However, when assessing the importance of LNG imports for the security of supply, the original sources of the imports need to be taken into consideration. As regards the Klaipeda LNG terminal, the Russian company Novatek, which owns an LNG export terminal in the Russian Baltic Sea port of Vysotsk jointly with Gazprombank, aims to increase its LNG imports to the terminal (Baltic Times 2020). Gazprom and RusGazDobycha also aim to construct an LNG production and export facility in the Russian Baltic Sea port of Ust-Luga (Argus 2020). In the case of Finland, from the first Russian LNG imports in June 2018 until October 2020, nearly 60 percent of the total LNG imports in terms of import value have originated from Russia (Finnish Customs 2020). Consequently, so far the role of LNG imports in the diversification of gas supply sources has been rather modest. On the other hand, the focus of the Finnish LNG strategy has been in creating terminal infrastructure that mainly serves local industry needs close to the terminals and LNG-fuelled vessels. A central function of constructing LNG terminals in Finland has been to allow the delivery of gas outside the reach of the gas transmission network, thus contributing to diversified gas supply together with Balticconnector.

Furthermore, the infrastructure intended for LNG imports have other functions as well. For example, the terminal in Tornio can also utilise liquefied biogas (LBG) of Finnish origins. According to industry sources, the use of domestic LBG could decrease the CO_2 emissions by as much as 85 percent (Tiihonen 2019). Consequently, this would remarkably reduce not only the shipping costs and the transportation distance, but also the climate effects of gas use in Finland. The multi-purpose use of the terminals for various types of gas, co-operation with industry partners as well as relieved environmental effects brought by the use of LNG, are all inter-connected benefits that increase the cost-effectiveness of the gas infrastructure initiatives. The position on the energy market as well as the physical location of the terminals near the industry actors increase their viability in the new applications, such as hydrogen, that the transition to carbon neutral future will require (Simon 2020).

Environmental impacts of LNG use and future alternatives

Concerning the environmental impacts of energy production, the general tone in which gas is discussed in the EU policy has been changing. The earlier view is well expressed for instance in the EC's Energy Roadmap 2050, which stated that the role of gas in energy production is relatively stable. According to the document, investments in gas infrastructure are facilitated by low risks and stable returns. Investment cost of building gas-fired power stations is relatively low and the risk of unfavourable energy price development is reduced by the fact

that gas-fired generation often sets the wholesale price for electricity (European Commission 2011). In the more recent EC document A Clean Planet for all – A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy (European Commission 2018, 8), the prospects for the future of natural gas are already less optimistic: "*Sustainable renewable heating will continue to play a major role and gas, including liquefied natural gas, mixed with hydrogen, or e-methane produced from renewable electricity and biogas mixtures could all play a key role in existing buildings as well as in many industrial applications.*" In other words, new buildings are visioned to contain heating technology beyond gas-based solutions. Furthermore, the document Clean Planet for all mentions LNG mixed with bio-methane as one short-term solution for fuelling long distance transportation (European Commission 2018). To conclude, natural gas remains a solution to meet both the energy needs of different sectors as well as the goals regarding the reduction of greenhouse gas emissions. Natural gas is to be utilised in combination with low-emission alternatives.

Already in 2011, the EU Energy Roadmap 2050 recognised natural gas as an interim solution while the energy production chain is reorganised. The document suggests that after the introduction of additional carbon free options, the operational costs of gas-fired power stations may rise and the gas infrastructure may get less use. The large-scale application of carbon capture and storage (CCS) technology could reduce the emissions of gas and maintain its role in the power sector but without CCS gas may stand to lose ground for greener options and remain a back-up technology (European Commission 2011). The CCS technology development has not taken remarkable steps in recent years. However, in 2020 the Norwegian government announced it would fund a large-scale CCS project called Longship with a total budget of close to three billion US dollars. The Finnish energy company Fortum is also partially involved in the project through its waste-to-energy plant in Klemetsrud, which could get funding jointly with the Longship project if additional funding will be granted by the EU or via investments from the private sector (Rokke 2020). While the CCS project in Norway will have an essentially local application tied to capturing CO_2 emissions from a cement plant near Oslo, projects such as this could lead to further technological advancement and reduction of the emissions created both by CO_2-intensive industries and the heat and power production using fossil fuels.

In marine traffic, LNG has been introduced as an alternative to conventional marine petroleum fuels. LNG is indeed a relatively clean fuel: LNG produces practically no sulphur oxides, nitrogen oxides or particulate matter, in addition to which it has lower CO_2 emissions than traditional ship fuels. However, when full cycle emissions and the impact of methane slip (emission of unburnt methane) are considered, the advantages of LNG in terms of greenhouse gas emissions are less evident (Le Fevre 2018). Maritime transport emits substantial amounts of CO_2. In the case of the EU, over three percent of all CO_2 emissions are from the shipping sector and they are expected to grow further in the future. Therefore, as a method of reducing emissions and reaching the targets, the industry has increased its use of LNG. Nevertheless, its use is still modest. In 2018, only three percent of the overall fuels used in the European Economic Area maritime transport were LNG, while heavy fuel oils, marine gas oil and diesel were widely used. LNG is mostly used by vessels that transport LNG and other gas products. Its use has been increasing as a result from stricter emission regulation (European Commission 2020e).

As the Baltic Sea is an Emission Control Area (IMO 2014), the use of LNG has special significance for the Finnish sea areas. In Finland, the share of water traffic in the total CO_2

emissions of the domestic traffic is four percent (Liikennefakta 2020b). Alternative fuels and power sources are used by 15 vessels sailing under the Finnish flag, consisting two percent of the Finnish merchant fleet. Five vessels are using LNG and two vessels bio oil as fuel, whereas eight vessels are using either electricity or wind power (Liikennefakta 2020a). Regarding LNG-fuelled vessels in Finland, the Viking Line's passenger ship Viking Grace, that started operating on Turku-Stockholm route in 2013, was the first LNG-powered large ferry both on the Baltic Sea and globally (Viking Line 2020). The second passenger ship to adopt LNG as fuel was the Estonian shipping company Tallink Silja's LNG-powered fast ferry called Megastar, currently operating under Estonian flag on Helsinki-Tallinn route. Both Viking Grace and Tallink Megastar were built in the Meyer Turku Shipyard in Finland (AS Tallink Grupp 2020; Finnish Shipowners Association 2020). The Finnish shipping company ESL Shipping has two LNG-fuelled bulk carriers that commenced operations in 2018 (ESL Shipping 2018). Finland also has an icebreaker with a dual-fuel engine and a patrol vessel that operates on LNG (Finnish Border Guard 2012; Arctia 2020). In Finland, LNG is currently available for ships to bunker in two LNG import terminals, in Pori and in Tornio (Finnish Gas Association 2020). LNG is also distributed to ports by trucks (Liikennefakta 2020a). LNG-fuelled ships have been mostly bunkered truck-to-ship but bunkering ships are also entering the market, thus alleviating fuel availability issues. Currently, two LNG bunker ships operate on the Baltic Sea (Liikennefakta 2020a).

LNG was, for some time, the fuel of the future. However, the acceleration of climate concerns calls for new solutions especially for the sectors that are not easily transformed into the utilisation of electricity. One potential solution is to use renewable hydrogen that can be produced through electrolysis from water using renewable electricity. As flexible fuel, it is in many ways similar to LNG. Alternatively, fossil-based hydrogen can be made more sustainable by applying carbon capture technologies (European Commission 2020b). The EC officials have urged the gas industry to accelerate the transition to hydrogen. While the existing gas infrastructure can be utilised, the introduction of hydrogen requires changes: any new reconstruction plans should include hydrogen-relevant technology, in addition to which the current pipeline infrastructure needs to be retrofitted for the transition to be possible (Simon 2020). The gas industry faces an interesting challenge: the fuels can be seen as rivals but on the other hand, the development of hydrogen capacity creates continuity for the gas infrastructure in the face of the inevitable change towards zero-net emissions. Regarding the production chain of hydrogen in the EU, one option is to seek co-operation with neighbouring countries: an initiative by Hydrogen Europe to increase electrolyser production in Europe includes close co-operation with North African countries and Ukraine (van Wijk & Chatzimarkakis 2020). The environmental sustainability of hydrogen and other renewables depends on the arrangements in the logistics chain. If the transportation of hydrogen is fuelled by renewable or zero-emission source of energy, then the new solutions can be seen to be applicable for Finland as well.

Besides hydrogen, the use of natural gas and LNG can open doors to the use of biogas and its derivative, LBG. However, the biogas industry in Finland is equally small scale as the LNG industry. According to Statistics Finland (2020b), approximately 0.9 terawatt hours (TWh) of biogas was produced in 2019, equalling to 0.2 percent of the total energy consumption in Finland. The potential of the biogas production is estimated to be 15 to 20 times the amount of the current production (Lampila 2018). The benefits of LBG include that it is completely renewable energy source and has the similar characteristics to LNG. The same infrastructure can be used for both and they can even be mixed. However, large-scale production of biogas

would necessitate gathering masses of organic waste to one spot. One further obstacle to the use of LBG is its price. Currently, LBG is over one third more expensive than natural gas. However, the relative attractiveness of LBG may in the future rise due to increasing emissions trading costs of competing fuel sources (Sallinen 2020). In general, particularly the farming industry has been recognised to have potential in biogas production, which would improve the recycling of nutrients and enhance energy independence of farms. So far, only a few new plants have been constructed on Finnish farms, mainly due to the high cost of investment (Ministry of Agriculture and Forestry 2020; Natural Resources Institute Finland 2020). The fact that biogas and LBG can utilise gas infrastructure is quite promising. However, it seems unlikely that LBG production will reach a scale similar to that of the current LNG exporters. Actors in the field will continue to protect their economic interests, while enjoying the benefits of the image of natural gas and LNG as the lesser of many fossil fuel evils.

Conclusions

The share of natural gas in the Finnish total energy consumption is rather small – only five percent. Furthermore, the consumption of natural gas in Finland has decreased by half during the past decade, amounting to 2.1 bcm in 2019. The downward trend in consumption is mainly related to the high taxation of natural gas in Finland compared to other energy sources. Natural gas as fuel and raw material is significant in particular for the chemical and forest industries as well as for combined heat and power production, whereas its use in households is marginal. The gas transmission network covers only southern Finland and addition to that, the two LNG terminals located on the coast of the Gulf of Bothnia can supply gas locally to industrial users, as well as to ships. Consequently, the market for natural gas in Finland is rather small.

In general, the production, transmission and use of natural gas is characterised by the interdependence of countries. In the EU, this interdependence can lead to positive consequences for the member states' energy security as the community facilitates energy co-operation and the integration of energy infrastructure reduces risks to individual countries. This also allows the EU to strengthen its bargaining position as a buyer of energy. Due to the small size of the national gas market, gas infrastructure projects in Finland have struggled with commercial viability, despite the financial backing from the Finnish state and the EU. This concerns particularly the expensive LNG infrastructure development. Co-operation across industries and national borders is a precondition for making these projects profitable, as well as for working towards the general aim of improving Finland's energy security.

The Balticconnector pipeline as a joint project between Finland and Estonia, as well as the integration of the gas markets of Finland and the Baltic States are steps towards the creation of the EU-wide internal gas market and integrated gas transmission network, which improves the resilience of gas consuming member states. Balticconnector has been promoted as contributing to energy security in the region by enabling diversified gas supply. However, the pipeline alone does not bring true diversification for the sources of gas supply because also the Baltic States lack alternative gas suppliers to Russia. In practice, natural gas of Russian origin will likely continue to dominate the Finnish gas market in the near future. Enhancing the security and diversification of gas supply in Finland and the Baltic States necessitates the completion of GIPL. The interconnection between the Finnish-Baltic and the Central European

gas networks will enable Finland to benefit from existing and forthcoming gas infrastructure projects in other EU countries as well.

Finnish energy policies are formed in the framework of the EU's energy policies. The Programme of the Finnish Government in office has an ambitious target of achieving carbon neutrality by 2035. The EU's energy and climate targets for 2030, in turn, aim to significant reduction of greenhouse gas emissions and increase in the use of renewable energy sources. Furthermore, the EU aims to reach carbon neutrality by 2050. Consequently, the general tone in which natural gas is discussed is shifting from labelling it as the most climate-friendly fossil fuel to seeing it as an interim solution in the transition towards carbon neutral future. Overall, it seems that the diversity of energy sources and technologies is growing, which necessitates individual countries, such as Finland, to keep up with the development. Particularly in the transition phase, this includes balancing between reaching the climate targets and developing financially and technologically feasible forms of energy production. On the other hand, the diversity of alternative energy sources can enhance the energy security of countries such as Finland, lacking conventional energy resources. Consequently, the climate goals create future challenges for the whole natural gas sector. They also raise the question whether investments in pipeline and LNG infrastructure are actually viable in the long term or would it be more sensible to develop solutions related to renewable fuels directly. On the other hand, the benefit of the natural gas infrastructure is that it can be utilised also in the transmission and use of biogas and retrofitted to the use of hydrogen. LNG, in turn, may have potential in some applications, for instance as marine fuel, for some time still.

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