BACHELOR THESIS

THE RESILIENCE OF THE EU TOWARDS A CUT-OFF FROM RUSSIAN GAS

Mart Christiaan Morskieft
s1495518

University of Twente, Enschede
Faculty of Behavioural, Management and Social Sciences
Management, Society and Technology

Supervisor: Dr. M. Rosema
Co-supervisor: Dr. M.J. Arentsen

May 27th 2020

Word count: 14974

UNIVERSITY OF TWENTE.

Abstract

Energy security has been a topic of importance to nations across the world. Now that tensions arise on the outer borders of the EU and stable suppliers seem to become scarce, an assessment for the future would give insight to the provision of energy services in the EU. The aim of this thesis is to step into the world of energy security and assess the energy relation between the EU and Russia. In order to do this, the research question 'how resilient is the EU towards a cut-off from Russian gas?' is asked. Sub-questions to support the main research question are, 'what are the existing arrangements between the EU and Russia on gas?', 'what are the alternatives for the gas supply of the EU?', and 'what are the current risks related to gas supply from Russia to the EU?'. The data is collected and analyzed through literature study, study of policy documents, and data sets about gas statistics from NAM, Gazprom, Oxford Institute for Energy Studies, and International Energy Agency. Findings show that the EU is making steps to strengthen energy independence over the coming years and increasing overall resilience. However, economic and pragmatic solutions seem to outweigh political interest.

1. Introduction

The energy security of the European Union (EU) has been relevant in order to sustain the lifestyle that many enjoy today. Modern appliances rely on a steady flow of electricity, especially with technologies like electric vehicles and solar panels on the rise. However, it seems that energy security might come more to the foreground as tensions at the outer borders of the EU are rising, the Ukraine conflict most importantly. According to the European Commission (EC), the total amount of energy sources that are imported is 55%, at a cost of an average of around €266 billion (European Commission, 2020b). The dependency rate of imported energy over the Member States in the EU differs from 95% in states such as Malta, Luxembourg, and Cyprus to below 15% in Estonia and Denmark (Eurostat, n.d.-c). Overall, the dependency rate has increased since 2000, when it was 47% (Eurostat, n.d.-c). In the most recent statistics, Russia is the most important EU supplier of crude oil, natural gas, and solid fossil fuels (Eurostat, n.d.-c). For gas, it was 31.4% in 2018 (Eurostat, 2020). Over the last couple of years, it fluctuated between 28.6% and 33.5%. All percentages surrounding gas consumption in the EU can be found in Appendix A. Visual overview of the percentages can be found in Appendix B and C.

The stability of the energy supply could be under threat if large portions of the import are concentrated over a relatively small number of external suppliers. Thus, it is important to maintain a good relationship with suppliers and to decrease the dependency on foreign energy sources. Since the Ukraine conflict, it has been difficult to build and maintain good relations between Russia and the EU. In the wake of the conflict, a number of diplomatic, economic, and individual sanctions have been adopted by the EU while Russia responded with counter sanctions by banning nearly half of the agri-food imports from the EU (European Parliament, 2018).

The decrease of dependency of Member States is an important topic for the sustainable energy goals to be reached in 2020, and for the decades that follow (long term goals for 2030 and 2050). In the sustainable energy strategy, the EU plans to improve its energy efficiency with 20% by 2020 and to increase its use of renewable energy sources, also with 20% by 2020. This strategy was implemented by the EU in 2009 with the two major benefits. It would "create jobs, advance green growth and make Europe more competitive" (EC, n.d.). Furthermore, it would "increase the EU's energy security – reducing dependence on imported energy and contributing to achieving a European Energy Union" (EC, n.d.). From creating more jobs, to matters of national security, energy security is crucial to the development of the

EU and its Member States.

There have been instances where disruptions in the supply chain caused for shortages. The Ukraine conflict in 2009 is the best example of such a disruption. Here, a gas dispute between Russia and Ukraine left a lot of EU countries shortages. A stress test was deployed in 2014 in order to measure the impact that disruptions would have. The stress test was focused on the supply of gas, but nevertheless showed that a prolonged disruption would have serious consequences, especially for Eastern countries of the EU. However, the effects of a cut-off from Russian gas anno 2019/2020 are not known and the stress test is in need of a much-needed update. As the numbers show now, a break-away from Russia has not really been set in motion (see Appendix B and C).

A history of conflicts

The relationship between the EU and Russia has suffered from serious setbacks over the last years. Most famous are arguably the annexation of Crimea and its alleged involvement in the crash of MH17, a civilian airliner. And although the tensions between the EU and Russia seem to stem from recent years, the history of conflicts between Russia and its 'customers' of energy sources is one that stretches to the Soviet Union era. It was in the 1980s that one of the first gas disputes occurred. The Soviet Union was constructing a pipeline carrying gas from the Urengoy field on the Yamal peninsula in Western Siberia to the Soviet satellite states in Central Eastern Europe (and also to Western European states) (Austvik, 2015). The Reagan administration saw this move as a clear threat to Western security. But despite these protests, the pipeline was still constructed and supplied the Eastern and Western states with gas, thus facilitating in the expansion in the quantity of gas usage in Europe.

After the Soviet Union ceased to exist, the world stage changed. Russia was removed as a superpower and the 'bipolar world' that once dominated the geopolitical field transformed in favor of the US. These changes also meant that Russia lost control over its satellite states as some turned to the NATO and later, the EU. For the gas industry, changes came partially in the form of privatization. From the Ministry of Gas, Gazprom evolved a 'joint-stock company with the government being the main shareholder' (Austvik, 2015, p. 4). Today, Gazprom is still the main actor that holds control over most of Russia's gas supply and production facilities. According to Gazprom's information, it holds the largest natural gas reserves in the world. 'The company's share in the global and Russian gas reserves amounts to 16 and 17 per cent respectively' (Gazprom, 2019). Next to this, Gazprom owns the world's largest gas transmission system with a length of 172600 kilometers. Furthermore, it holds the

sole rights to export this gas to Europe. In a practical sense, not much changed from Soviet times. The company basically holds a monopoly on the domestic market, with strong involvement from the government in terms of strategic, political, and economic decisions.

After 1991, the energy authorities in satellite states and former Soviet republics turned into national gas companies. Gazprom subsidized gas both in Russia and to its allies. However, when former satellite states seemed to act 'less than friendly' with its former superior due to them joining the NATO and/or the EU, they had to enter renegotiations where hard prices were demanded in contrast of the more symbolic ones from the past. 'Some states such as Armenia, Belarus and the Ukraine under President Kuchma have been favored with heavily subsidized energy. Others, such as Georgia, Moldova, the Baltic States and the Ukraine under President Yushchenko have been targeted by supply disruptions and punitive price increases' (Austvik, 2015, p. 4).

Research question

In light of decreasing the energy dependency, it is important to ask the following question: *how resilient is the EU towards a cut-off from Russian gas?* This question is also important to ask if the EU truly wants to work towards an integrated energy market with a limited number of imported sources. To further investigate this matter, I elaborate on a number of matters that are related to resilience and the impact of energy cut-off.

Firstly, *what are the existing arrangements between the EU and Russia on gas?* Here, a description of the existing relationship and agreements between the EU and Russia is done.

Secondly, *what are the alternatives for the gas supply of the EU?* Right now, the amount of imported energy is relatively high and relies on questionable partners (Russia, Saudi Arabia). According to the Oxford Institute for Energy Studies (OIES) (2014) and Norwegian Petroleum (NP) (2020), Norway has an oil and gas supply and is already supplying to the EU. Moreover, the rise of sustainable energy sources would help to decrease the import dependency. One could also think to look at the other side of the globe, to North America for instance (EC, 2019).

Thirdly, *what are the current risks related to gas supply from Russia to the EU?* It is important to have an estimation of this in order to evaluate the current situation and to identify areas where improvements should or could be made.

Reading guide

The first chapter discusses the relation and formal arrangements made between the EU and Russia. The second chapter mentions the alternative energy sources that may be available to the EU. The final chapter discusses the risks related to the energy supply from Russia. The conclusion and discussion form the final part of this thesis. Here, some recommendations can also be provided in terms of further research to be made.

2. Theory

Energy security is a term that has evolved over time and it has had different meanings. But some issues have always been present on the agenda. The perceived threats to national security of the dependency of oil producing countries, for example. As well as the supply routes that these sources have. According to Månsson, A., Johansson, B., & Nilsson, L. (2014), energy security was most often described in theory as the 'security of oil supply', but more recently, also other energy carriers such as sustainable energy sources and natural gas are included. An article by Månsson et al. (2014) gives an overview of the methodologies that are commonly used in assessing energy security.

Although the concept is widely used, the methodologies used for the evaluation and assessing the security remain less pronounced. This is partly because the concept can have a multitude of vague, different meanings. The strengthening of these methodologies would thus improve the existing energy security analyses. Chester (2010) describes the concept of energy security as 'polysemic' and 'slippery', in reference to the tendency of the concept to symbolize different dimensions at the same time. The underlying cause for this could be the different views that stakeholders have of what is meant with security and how to reach an adequate level of energy security. Johansson (2013) proposed to broaden the typology on energy and security by making a distinction between when the energy system is analyzed as an 'object that is exposed to threats', and 'when the system works as an agent that generates or enhances security' (Månsson et al., 2014, p. 2). It might be less desirable for researches to agree upon just one meaning of the concept and interpretation of energy security.

Different aspects are mentioned by Månsson et al., (2014). Upstream supply stages are analyzed on long term trends. Downstream stages are analyzed on reliability, vulnerability and resilience to disturbances. 'Some researchers evaluate and compare several aspects and integrate different perspectives, using complex indicators and/or multi criteria analyses' (Månsson et al., 2014, p. 9). Not one method is the best, it depends on the question that is

asked. Thus, energy security is a complex term that can have different meanings in different circumstances. It is important to keep this in mind in trying to define it in the context of this research.

The term resilience in the context of energy security means according to Azzuni & Breyer (2018) the ability to continuously deliver energy services while experiencing disruptions without change in the energy security baseline. In the words of Gracceva & Zeniewski (2014), resilience means that the energy system can find alternative sources of production or consumption in response to unforeseen and short-lived shocks. They go on to mention that resilience is an interplay of the energy systems physical and abstract aspects. The physical aspects are related to more technical matters (e.g. spare capacity and fuel-switching capabilities), whereas the abstract involves the market structure and regulatory environment that the energy systems is based in.

To further dive into the different aspects and perspectives of energy security, Cherp and Jewell (2011) offer us three perspectives on energy security. Energy security began as separated policy problems and policy making was informed and advised by linking the knowledge of separate fields of expertise together (Cherp & Jewell, 2011). The first is the so-called 'sovereignty perspective'. Problems relating to the security of oil have molded this perspective on energy security. It can find its roots in strategic energy security studies, international relation theories and political science. The main threats in this perspective are embargoes, hostile use of the market, or acts of sabotage and terrorism. The analyses related to this perspective focus on different configurations of interests, power alliances, and maneuver space (the ability to switch suppliers or energy options, for example). Strategies in this perspective to minimize risks are 'switching to more trusted suppliers or weakening a single agent's role through diversification, substituting imported resources with domestic ones, and casting military/political control over energy systems.' (Cherp & Jewell, 2011, p. 5) The second perspective described is the 'robustness perspective'. The increasing importance of energy in general poses a policy challenge to ensure a smooth functioning network. The main threats to security in this perspective are seen as ''objective', largely quantifiable factors such as growth in demand, scarcity of resources, aging of infrastructure, technical failures, or extreme natural events' (Cherp & Jewell, 2011, p. 6). Upgrading the infrastructure, switching to more available or renewable energy sources, adopting technologies that are safer, and managing the growth of demand are all part of minimizing risks in this school of thought. The third perspective is the 'resilience perspective'. Practical challenges related to ensure the

functioning of energy markets and the long-term investment in energy systems gave birth to this perspective. It sees the future as inherently unstable and unpredictable because of the high complexity and uncertainty of energy systems, markets, technologies, and societies. The threats are thus also unpredictable and can range from a number of things (e.g. change of political regimes, economic crises, and climate changes). According to Cherp & Jewell (2011), this perspective does not focus on analyzing, quantifying or minimizing risks. Instead, it relies on general notions of energy systems that safeguard the protection against hazards by spreading the risks and preparing for eventual surprises. Many concerns of these perspectives overlap with each other, as well as the solutions.

Cherp & Jewell further argue that the contemporary challenge is integration. 'Isolated analysis from political scientists, engineers or economists is no longer sufficient for public policy advising; rather, policy makers require an integrated view of energy security' (Cherp & Jewell, 2011, p. 7). Studies seek to integrate the lists of energy security concerns by classifying them into so-called 'dimensions'. Von Hippel et al. (2011) proposed the dimensions of energy supply, economic, technological, environmental, social, and military security. Sovacool & Brown (2010) talk about availability, affordability, efficiency, and environmental stewardship. All these are just the beginning of developing a systematic understanding of energy security challenges. 'Moreover, classification is not integration. Placing several concerns in one group does not necessarily help us to understand them better or to develop integrated solutions' (Cherp & Jewell, 2011, p. 8).

There are attempts to construct a framework on risks management and energy security assessment. Keppler (2007) makes use of the dimensions geopolitical, technical, and economic to describe energy security and lie close the three perspectives mentioned before. In another work by Cherp & Jewell (2013), an energy security assessment framework is presented. A framework would give us more grip on energy security assessment as it provides a step by step guide. In their article, they mention that 'methodological choices in energy security assessment should be transparent. They should reflect the configuration of energy systems (real and perceived), justified based on the purpose on the assessment and clearly explained for the intended audience' (Cherp & Jewell, 2013, p. 149). The energy security framework consists of five steps to guide an assessment:

1. “Defining energy security for the purpose of the assessment”
2. “Delineating vital energy systems”
3. “Identifying vulnerabilities of vital energy systems”
4. “Selecting and calculating indicators for these vulnerabilities”
5. “Interpreting the indicators to answer the questions posed by the assessment”

At the first step, a selection of the definition should be made that is acceptable to the readers or receiving party of the assessment and adequately operational to the energy systems that are analyzed. At the second step, the ‘vital energy systems’ are described with reference to both policy concerns that exists in relation to the energy systems and the matters of energy flows. The third step identifies vulnerabilities that exist. Current policy concerns are a solid starting point, but the danger here is that these might be biased by human perceptions of risks. The fourth step requires the selecting of indicators that reflect the identified vulnerabilities, but do not necessarily measure it. Here, it is easier to use metrics already used in policy making in order to interpret and communicate them better. In the fifth and last step the indicators are interpreted and presented in such a way that fits the assessment in answering the questions. Figure 1 gives a visual representation of the framework. The ‘energy systems approach helps making informed choices at each stage of the assessment’ (Cherp & Jewell, 2013, p. 169).

The framework developed by Cherp and Jewell (2013) is used in this research as it gives a structured approach to the main question. According to Cherp and Jewell (2013) their framework is useful to make effective energy security assessments, specific enough to reflect context-specific issues and is generic enough to enable sufficiently wide comparisons. In this part, it becomes apparent that energy security is a complex topic that entails many different interactions, facets, and requires knowledge from several different fields.

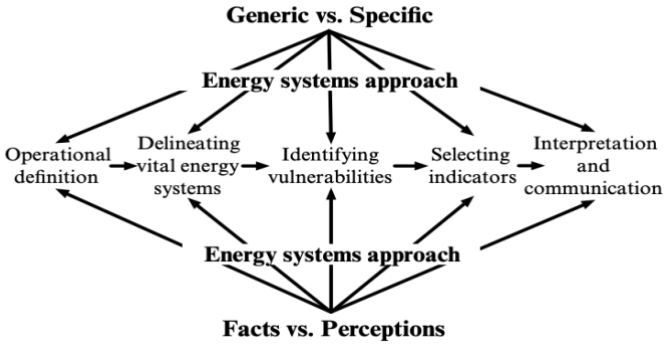


Figure 1. Energy security assessment framework (Cherp & Jewell, 2013)

3. Research design

As mentioned above, the research question of this thesis will be 'how resilient is the EU towards a cut-off from Russian gas?'. The approach that would be taken is to use the energy security assessment framework explained in the previous part. The definition of energy security in this research is the 'uninterrupted provision of vital energy services' as is used by the Global Energy Assessment (GEA) (Cherp, Adenikinju, Goldthau, Hernandez, Hughes, Jansen, Jewell & Vakulenko, 2012). There is no set of metrics fit for assessing energy security for every purpose and in every situation. So instead, 'energy security should be measured through application of an assessment framework sufficiently systematic to ensure scientific rigor and sufficiently flexible to account for specific circumstances and perspectives' (Cherp & Jewell, 2013, p. 146). The steps in this framework are explained in previous parts and require a collection of data associated with the steps. The type of data that is analyzed is qualitative in nature.

The research question can be answered at the hands of the sub-questions that are proposed for this thesis. The first sub-question consists of the arrangements between the EU and Russia on energy. These are typically found in policy documents. In this case, the EU has several sources on the energy relation with suppliers including Russia, including sources from the EC, EP and Eurostat. The second sub-question is about the alternatives available to the EU in terms of energy supply. There are numerous technological advancements being made in the sustainable energy sector by both public and the private actors. Think about universities and large energy corporations/suppliers (Shell, Vattenfall). Furthermore, other suppliers might be considered depending on the ability to fulfill the energy need of the EU. For the latter, looking into Norway's production of energy sources and current trade agreements is useful as it is already a substantial supplier of gas (NP, 2020), as well as overseas countries such as the USA because of the upscaling of LNG trade (EC, 2019) and non-EU sources such as North African regions and the Caspian Sea regions (OIES, 2014). In the case of the former, a document analysis of these activities can be employed to investigate these matters. The third of these sub-questions relates to the risks attached to the energy relation with the EU and Russia. In other words, what are the chances of an actual cut-off between the EU and Russia? This question can be answered by looking at historical events and policy papers that describe the situation. Furthermore, threats can be identified in the framework (step three: identifying vulnerabilities). In this case, the 'sovereignty perspective' might be best suited. Here, risks are

described as ‘intentional actions by malevolent agents including politically motivated disruptions, political extortion and price manipulations.’ (Cherp & Jewell, 2013, p. 156). However, most of the energy security strategies make use of multiple perspectives combined (Cherp et al., 2012).

Some of the energy security literature provides measures and/or metrics for resilience. Possible indicators to use here are proposed by the GEA which uses energy security concerns. Regarding oil and gas, these are ‘exposure to the global oil market (import dependency, cost of imports)’, ‘demand-side vulnerabilities (annual growth in oil consumption, oil intensity)’, and ‘domestic availability of oil (R/C - reserves to consumption ratio)’ (Cherp et al., 2012, p. 338). The research question does not mention a time frame, but this shall be indicated as up until the year 2025. The reason to set the time frame is to assess the situation as it is right now at the time of writing. However, as future events can unfold in unexpected ways it is difficult to address energy security in the (far) future and part of answering the main research question means looking at alternative suppliers for energy sources, hence the short look into the future.

Data collection

The sources used for this thesis range from policy documents, scientific articles, data sets from gas authorities, and news articles. Because the goal of this study is to give an updated and most recent view on the gas relationship between the EU and Russia, the most recent published data known was used. Inclusion and exclusion criteria were based on using the most recent published data concerning gas production and agreements. Scientific articles are acquired through Google Scholar, news articles were selected based on the topic of ‘energy security’, or ‘EU-Russia gas’, for example.

In their explanation of the energy security framework, Cherp and Jewell (2013) describe three programs that strive to combine analyses of energy systems and insights from energy security policies. The first one, MOSES (Model of Short-term Energy Security), is conducted from the member countries of the International Energy Agency (IEA). It uses approaches that are specific to energy supply of developed market economies. The purpose of MOSES is to ‘depict the energy security landscape of the 28 IEA member countries by characterizing their energy security profiles and grouping together countries with similar energy profiles’ (Cherp & Jewell, 2013, p. 146). The second, GEA, uses quantitative findings to depict the situation with an analysis of energy security policies. It aims to identify common security concerns that affect large parts of the world’s population. This approach is more general as it can be applied

to over 130 countries. And finally, an analysis for future events that makes use of a careful study of the evolution of energy security policy patterns over the last century to identify general concerns which can be presumably accurate for the next 100 years (Cherp & Jewell, 2013).

In this case, application of the framework shall be applied to the energy relationship between the EU and Russia. From what can be read on the webpage of the EC concerning this relationship, an uninterrupted provision of energy sources at an affordable price seems to be the main concern, fitting to the definition of energy security in the data set of the GEA and partly of MOSES. Further sources of data used are collected by the different institutions of the EU with relevant data also provided by EUROSTAT to ensure reliable data. Through literature study and document analysis, the data is collected.

4. Analyses

Existing arrangements between the EU and Russia on gas

It is clear that the EU and Russia view each other as vital partners on the energy market while also being mutually dependent on each other. This mutual dependency is one of the first things that the EC recognizes to describe this relationship. The energy policies that are attached to this fit to the concept of the Energy Union, which has the objective to make energy more secure, affordable and sustainable. In this chapter of the thesis, the existing arrangements between the EU and Russia on gas will be used in order to assess the effects on energy security, following the theoretical model put forward by Cherp and Jewell (2013). There are numerous agreements and arrangements between the parties, one of those is the EU-Russia Dialogue that was launched in 2000, and the Early Warning Mechanism. In this chapter, we will take a closer look at both the Energy Union and the EU-Russia Dialogue. Furthermore, the state of these arrangements is discussed by the hand of both experts and media accounts.

The Energy Union

Nowadays, the EU's energy policy is bases on the concept of the Energy Union. The strategy was launched in February 2015 by the EC and is supposed to be 'a new strategy for a resilient Energy Union with a forward-looking climate change policy' (EC, 2015). The goal of this approach is to give consumers more secure, sustainable, competitive and affordable energy. In order to reach these goals, an overhaul of the European Energy and climate systems and policies will be needed so that 'the EU's energy policy fully contributes to the fulfilment of the EU's commitment to the Paris agreement on climate change.' (European Union and the Russian Federation, 2019). The strategy is made up of five dimensions that are closely related to each other and mutually reinforcing.

Firstly, the dimension of energy security, solidarity and trust is about the diversification of energy sources of Europe and making better use of the energy that is produced within the border of the EU. Some of the most important drivers in this context are the completion of the internal energy market and a more efficient energy consumption. 'The spirit of solidarity in energy matter is explicitly mentioned in the Treaty and is at the heart of the European Union' (EC, 2015). Furthermore, this dimension involves the diversification of supplies, by which energy sources, suppliers and routes are meant. The political challenges

that come with this have shown that these aspects are crucial for ensuring secure and resilient energy supplies to European citizens and companies, where it is important that these have access to affordable energy at any moment. Part of this is also looking at the possibilities of liquid natural gas (LNG) as backup when not enough gas is passing through the pipelines. Gas storage in Europe and the regulatory framework needs to ensure the gas storage for the winter months is addressed, and the Commission will work on removing the obstacles that prevent the imports from the US and other possible suppliers for LNG. Another element of this dimension is the cooperation between Member States on the security of supplies. Many Member States have insufficient security of their supplies due to outdated or inadequate frameworks or the inappropriate application of those frameworks (EC, 2015). Finally, there is a call for more transparency on gas supply, which includes that in order to ensure energy security agreements between EU Member States and third countries need to be in full compliance with EU law.

The second dimension mentioned in the strategy is that of a fully integrated internal energy market. By using interconnectors which will enable the free flow of energy throughout the EU – without the technical or regulatory barriers in place. 'Only then can energy providers freely compete and provide the best energy prices' (Eurostat, 2019). At the time of the launch of the strategy, Europe's energy system is underperforming, and a new political boost is needed in order to push for the completion of the internal energy market. In the recent years, work on several infrastructure projects has increased, 'even more so in light of recent events at the European Union's Eastern border.' (EC, 2015). It is fair to say that the recent events being mentioned by the European Parliament (EP) are related to the conflict between Ukraine and Russia. More specifically, the annexation of the Crimea that occurred a year before the launch of the strategy and the overall hostile attitude of Russia towards the EU. The transition to a more secure and resilient energy system will require investments in the generation of energy, networks, and also energy efficiency. These costs are estimated to be around €200 billion annually for the coming decade (EC, 2015). What is further described in this dimension is the need for better regional cooperation within a common EU framework. 'Some elements, such as new market arrangements for short term markets in gas and electricity or integrating the operations of transmission systems operators should be developed and implemented at regional level as a step towards full EU-wide market integration' (EC, 2015).

The third dimension of the strategy is energy efficiency contributing to moderation of demand. The core of this dimension is to lessen the consumption of energy sources in order to reduce the pollution of the climate while also preserving the existing domestic energy sources.

In return, this would mean that the energy dependency on third countries that exists for some nations in the EU would decrease. This is also important when keeping the 2030 goals in mind in terms of energy efficiency which is set for 27% improvement. Most of the work here needs to be done at the national, regional and local level. The role of the Commission here is to provide a solid, appropriate framework. The EU already has done a lot in this respect to help the consumers cut back on their energy usage, such as correct labelling of energy and eco-design legislation so that consumers can make informed choices on the products that they are buying. Think about the labels on cars, houses, and electrical appliances. The consumers that use the most energy are the buildings and transport sector. The buildings sector uses most of its energy for heating and cooling in the EU and most of the gas imports are used for this. Financial support can play a strong role here at the regional and local level of government. However, this remains a challenge according to the EP because of low levels of awareness in these circles (EC, 2015). The European Fund for Strategic Investments can provide funds in order to renovate buildings to make them more energy efficient. The transport sector accounts for over 30% of the total energy consumption of the EU. For this sector, the Commission shall take action to de-carbonize it. 'This will require a gradual transformation of the entire transport system as well as an increased development and deployment of alternative fuels.' (EC, 2015). These alternative fuels are of course important to break the dependency on fossil fuels.

The fourth dimension is dedicated to de-carbonizing the economy of the EU. The main idea here is to keep pressing for global agreements for climate change and to encourage actors to invest in renovating infrastructures and new technologies. An ambitious climate policy is the cornerstone to realize the 2030 goals that the EU has set for itself. The Emissions Trading System, 'which will deliver a meaningful price on carbon emissions and stimulate cost-efficient greenhouse gas emission reductions' (EC, 2015), is an important element. Another aspect that is crucial for reaching these ambitious goals is that the EU is planning on becoming the most prominent actor in the field of renewable energy. In order to achieve this, heavy investments are needed in alternative fuels (including biofuels), and the green economy in general.

The fifth dimension of the strategy is research, innovation and competitiveness. This means the EU supports the scientific breakthroughs in new technologies and helps to coordinate research and financing, sometimes in partnership with several private actors. Although the original strategy of the Energy Union did not include a heading which outlined the external dimension, the latest update report from 2019 recognizes the need for a strong

external dimension. This report states that the EU, as an important global actor, was one of the first to identify the need for appropriate climate policy and over the years has successfully engaged with climate diplomacy (EC, 2019). According to the Commission, the EU is working closely together with the G7 and G20 partners to promote the climate change agenda. The transition to cleaner energies has more facets than just climate change and environmental causes. Climate change acts as a so-called threat multiplier, meaning that it has a broader nature. More specifically, this means that 'it has the potential to exacerbate other drivers of insecurity' (Werrell & Femia, p. 42, 2016). The Commission points to threats such as contributing to global instability and large-scale migration flows as seemingly the most important drivers for the EU.

EU-Russia Dialogue

The relationship between the EU and Russia is one of mutual dependency. Russia's biggest client is the EU on the energy market, and the EU's main energy supplier is Russia. And since both economies are so heavily dependent on each other, the EU-Russia Dialogue was set up in 2000. In this joint declaration, the leaders of the EU and the Russian Federation reaffirmed the importance that is attached to this strategic partnership. 'The primary objective of this cooperation, which is entering into a new phase, will be to support the institutional, economic and social reforms, with a view to strengthening the rule of law and meeting the democratic requirements of a modern economy and society.' (EC, 2011). Furthermore, through this dialogue, the EU and Russia seek to improve investment opportunities, secure infrastructure, increase the use of environmentally friendly technologies, and exchange information on legislative initiatives.

In order to facilitate this, thematic groups were brought into existence which consist of experts, businesses, academia, and representatives from the EC and the Ministry of Energy of the Russian Federation. The first of these groups is concerned with energy strategies, forecasts and scenarios. This group was established to shine a light on these matters from the EU and Russian perspective to bring more coherence to policies affecting scenarios until 2030. Furthermore, this group 'contributes to the development of bilateral data exchange and monitoring systems in order to enhance transparency and mutual confidence in energy matters and identifies and jointly analyses potential mid- and long-term issues.' (EC, 2018). The second thematic group established is the market developments group. Like the first group, it aims to build transparency and exchange information on regulations and policy developments. Next to this, it also oversees market developments that may occur in the energy sector of both

the EU and the Russian Federation and works on improving the investments made in climate friendly technologies and energies. The third group is concerned with energy efficiency. It provides a platform to exchange information on these matters and cooperates on energy efficiency projects.

Next to the thematic groups, a special Gas Advisory Council was included in the EU-Russia Dialogue. This council has basically the same functions as the thematic groups do for the overall energy sector, except this council is specifically for the gas market. The council consists of representatives from the most important Russian and EU gas companies and academic research organizations.

Early Warning Mechanism

Another important arrangement between the EU and Russia is the Early Warning Mechanism. This mechanism was set up in November 2009. Following the gas dispute of 2009, which left numerous European countries without a reliable gas supply, the demand for such measures grew. The instrument was set in place to prevent what happened during those days and ensures the 'rapid communication to prevent further supply interruptions in the field of gas, oil or electricity.' (European External Action Service, 2019). It includes relevant contact persons on both sides from the government and energy companies involved as well as independent energy experts.

The state of arrangements

With regard to the state of the arrangements made between the EU and Russia there seem to be different accounts and opinions. From official releases from several EU institutions it seems that the plans from the Energy Union strategy are mostly on track. On 9 April 2019, a document was released by the EC. This document is the fourth update on the state of the Energy Union and gives a comprehensive summary of all the element included in the strategy.

In terms of a more secure energy market, new rules on gas supply and electricity risk preparedness have strengthened the overall energy security of the EU. The diversification of energy sources has also been on the agenda of the strategy and here the EU continues to invest in policy that aim to do this. For example, since 2016 the Commission has been looking into making the EU a more attractive client for LNG. The United States have become a major partner in this sector and 'since the meeting between President Juncker and President Trump in July 2018, the LNG trade relation has intensified, with a total of almost 9 billion cubic meters as of end of March 2019 imported.' (EC, 2019). Moreover, the report states that efforts

to diversify the gas supply for Member States is delivering some solid results. The efforts made are putting an end to single-supplier-energy dependency and as of 9 April 2019, all but one Member State 'have access to two independent sources of gas.' (EC, p. 14, 2019). 'And if all ongoing projects are implemented on schedule, all Member States except for Malta and Cyprus will have access to three sources of gas by 2022, and 23 Member States will have access to the global LNG market.' (EC, p. 14, 2019).

Good progress is also being made towards a more integrated European energy market. Antitrust decisions, which contribute to the flow of energy both in terms of electricity and gas, have given the consumers in Central and Eastern Europe a tool to ensure the access to more competitive gas prices. An example of such an antitrust decision is Case AT.39816, where Gazprom charged excessive prices to certain CEE (Central Eastern European) countries. Furthermore, the Commission reached the conclusion that Gazprom kept a strategy of fragmenting and isolating the CEE markets and was restricting the free flow of gas (EC, 2018a). Gazprom in return stated in the decision that it would refrain from these activities, including several specific commitments towards the CEE countries. The decision was legally binding; thus, Gazprom would have to follow up on its words. The Commission was satisfied in the extent that no further action was deemed necessary and that the case should therefore be put to an end.

On the topic of energy efficiency, it can be read that the emission of greenhouse gas has decreased and that the progress made is promising. Although more investments are needed in order to reach the climate goals. After a gradual decrease between 2007 and 2014, emission have since slightly risen, likely due to variations in weather conditions and increased economic activity combined with relatively low oil prices in the EU (EC, 2019). For the transport sector, it seems that the once effective energy efficiency policies are not effective anymore. Levels are back to those of 2005, likely due to increased transport activity and low capacity utilization in road-freight transport (EC, 2019). An interesting statistic is that as of the release of the report, roughly 900.000 jobs are related to energy efficiency activities in the EU.

In order to decarbonize the economy of the EU, the Commission plans to invest a lot in research and innovation programs that support this goal. Through the Horizon 2020 research and innovation program around €2.5 billion will be committed to decarbonize the EU building stock (EC, 2019). Since technologies in new areas start to emerge, such as space and hydrogen, the Commission continues to invest in these innovations as they 'can support the decarbonization of gas infrastructure, transport, and energy intensive industries.' (EC, p. 19,

2019). Furthermore, the full implementation of the circular economy shall help to reduce the emissions and materials needed for these highly intensive industries, while at the same time maintaining their competitiveness (EC, 2019).

As for the investments in research and innovation, the public investments (meaning from both the EU and individual Member States) have been roughly stable throughout the years 2014 to 2017 with an average of around €5.3 billion annually (EC, 2019). Investments have been key to the goals stated in the Energy Union, and it is important to keep investing in research and innovation and keeping a consistent agenda.

The update report mentions the Russian Federation when it comes to the trilateral talks between the EU, Ukraine and Russia. Here, the EU has facilitated several meetings with the aforementioned states with the aim to secure the gas flows from Russia to and via Ukraine. Any further mentions in the document remain absent, which can be attributed to the sanctions that are placed on Russia as of the 2014 annexation of the Crimea. More on this will be said in the section below, where the relation between the EU and Russia is further discussed.

The EU-Russia Dialogue, that started out as promising, has been on hold as of 2014, 'pending positive developments in the resolution of the Ukraine crisis and implementation of the Minsk Agreements. Only the technical work-stream on internal market issues under the previous EU-Russia Gas Council remains operational.' (EC, 2020). Furthermore, several restrictive measures in response to this crisis have been put in effect, although these seem to be mostly focused on economic sanctions, and not so much on restrictions concerning energy supply. Nevertheless, between the gas disputes, annexation, and these sanctions have deteriorated the relationship between the EU and Russia significantly. The formerly mentioned investigations have damaged Gazprom's reputation and the level of trust between Gazprom and European energy companies, and the EU and Russia in a broader sense (Maltby & Sharples, 2016). Maltby and Sharples (2016) further note that these events have triggered rhetorical commitments from both sides to further reduce the mutual dependency and seek alternative partners in order to increase the energy security. This is also evident from the energy strategy that the EU adopted in 2015, where diversification of energy sources and decreased dependency are prominently featured on the agenda. The Early Warning Mechanism has already proven its effectiveness according to the EEAS (2019). In what way or when is not made clear and remains obscure, as no further sources either acknowledge or deny the effectiveness of this mechanism. For now, the single statement made by the EEAS (2019) is the only source.

As the completion of the Nord Stream 2 pipeline draws near, the media has also caught up to speed with regard to the ambiguous energy relationship between the EU and Russia. The Dutch newspaper, NRC Handelsblad published a number of articles recently where the status quo is described. Where the leaders of both the EU and Russia posed happily for a picture at the beginning of the pipeline's construction, 7 years later the mood had gone down. 'Many do not see the 'gas partner' that Russia once was. This image has been replaced by one of an aggressor that annexes land, wages proxy wars, uses spies (the assassination on alleged spy Sergej Skripal in the UK made this aware), influences elections, and uses gas to destabilize democracies.' (Cukier, 2018). Further criticism comes forwards about the relationship between the EU and Russia from an international ambassadors meeting in Brussels where Renée Jones-Bos, former ambassador in Moscow, said 'at this moment there is no EU-Russia dialogue. Europe needs to think harder about its relationship with Russia.' (Cukier, 2019).

Energy experts have also expressed their concerns on the Russian promise that the gas pipelines running through the Ukraine will remain intact and active. Russian-American expert Mikhail Korchemkin wrote in Foreign Policy that 'some European politicians have faith in the promises of the Kremlin that Nord Stream 2 would not harm Ukrainian interest. They shouldn't have. The Russian President Vladimir Putin has used Gazprom-pipelines before to damage Europe and Ukraine and will probably do so again.' (Korchemkin, 2019). The German gas expert Frank Umbach mentions that promises made to Ukraine are worthless. He further goes on to mention that 'Germany should have shut down the construction of Nord Stream until the Ukrainian matters were resolved. But it did not do that.' (Cukier, 2019a).

In conclusion, the set-up of the Energy Union helps to increase the energy security of the EU and protects the individual Member States from malpractices by energy providers from third countries, such as the antitrust decision. The EU-Russia Dialogue has been on hold since 2014 with no plans to reinstate that in the near future. The Early Warning Mechanism in place since 2009 is supposed to prevent gas disputes, but it is unclear whether this is an effective tool. The developments of the Nord Stream-project are met with much criticism from diplomats and energy experts and is framed as a threat to both Europe and the Ukraine over a period of 7 years.

Alternative energy sources for the EU

New technologies and innovations for greener energy sources are around the corner. In the beginning of 2019, the EC launched a plan to further the investments in low carbon technologies with over €10 billion. The investment program is set to cover multiple sectors to boost the global competitiveness. Green technologies and the R&D-process that is involved are priorities on the Energy Union agenda, as can be read in the previous chapter. The ambitious goals set for 2020, 2030 and 2050 can be seen as the driving force behind the investments. But what are the other options that the EU has in terms of decreasing the dependency on, sometimes unstable and undesirable, third countries for energy supplies? In this chapter of the thesis, the alternative energy sources that the EU has access to are laid out. For example, Norway already plays a role in the gas supply to the EU. Can this role be expanded in general, or in the absence of reliable Russian connections? And what about other suppliers? As can be read in the previous chapter, the EU has intensified its trade dialogue with the US in order to scale up the LNG trade. Finding other energy partners is crucial to increase the diversification of energy sources. The EU should look at North African regions, Caspian Sea regions, and Central Asia for this. Furthermore, renewable energy sources can be a viable option, provided that the scale needed is not too complex to meet the energy needs of the EU. In the 1970s, the indigenous gas production of the EU covered most of the demand for the region. But over the years, gas production in the EU has staggered and with growing rates of economic activity and overall demand, the EU gas supply could only support 57% of the demand by 2013 (Dickel et al., 2014). The production is falling everywhere around Europe, except for Norway. As a result, the EU will rely much more on the import of sources, provided that nothing is being done about the situation. So, there are other options available to the EU.

One of the options is to look to the indigenous gas supply of the EU to be less dependent on Russia gas. Within the EU there are a few Member States that could add to the supply. The top 3 of these countries consists of Norway, The Netherlands, and the UK. From reports of 2013, it can be read that the annual gas production is 109 billion cubic meters (bcm), 86 bcm, and 38 bcm respectively, with the first two countries being responsible for 70% of the total indigenous gas production. As already mentioned in previous text, the gas production around the EU is falling. The Netherlands is scaling down its gas production, with the result of eventually stopping the production. (Ministerie van Algemene Zaken, 2020). Since the UK is

set on leaving the EU, the future of this source is uncertain as trade agreements might have to be made, making it a possibly lengthy process.

Norway

In 2013, Norway was the largest exporter of gas in the world, after Russia and Qatar (Dickel et al., 2014). Most of this gas was exported to the European market, but figures from the Ministry of Petroleum in Norway show that the gas production in the coming years is set to decrease with annual production amounts falling from 100-125 bcm in 2020, to 75-115 bcm in 2025. Increases in the production are thus not expected, but this could be reversed if new sources are discovered in the Barents Sea, as these activities are still at an early stage of development (Dickel et al., 2014). However, these activities and new discoveries are costly events. Moreover, in order to transport the gas from these sources, new infrastructure is needed, which might not be an investment that Norway is willing to make.

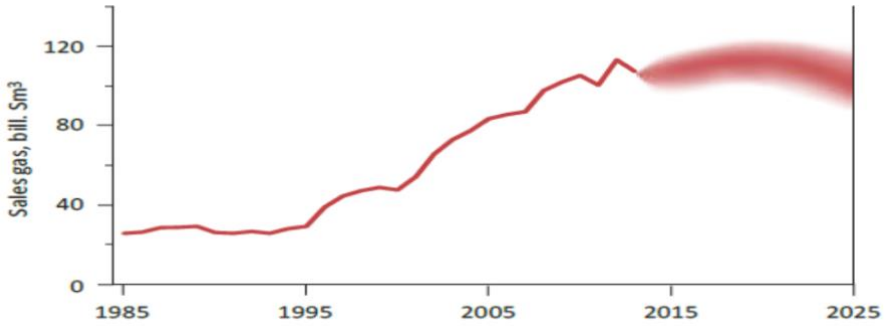


Figure 2. gas sales from Norway 1985-2025 (Dickel et al., 2014)

The Netherlands

After Norway, the Netherlands were the largest gas exporter of Europe. The production declined marginally beginning in the early 2010s. The gas field near Slochteren is one of the largest in the world, with a production of nearly 54 bcm in 2013. In the last few years, the discussion surrounding the side effects caused by the production has been a hot topic on the national political agenda. Firstly, limits were set on the amount allowed to produce for 2014, 2015, and 2016 at 42.5, 42.5, and 40 bcm per year respectively. However, fears of increased tremors and ground cave-ins became too much and according to the latest plans, the production is expected to cease in 2022 (Ministerie van Algemene Zaken, 2020).

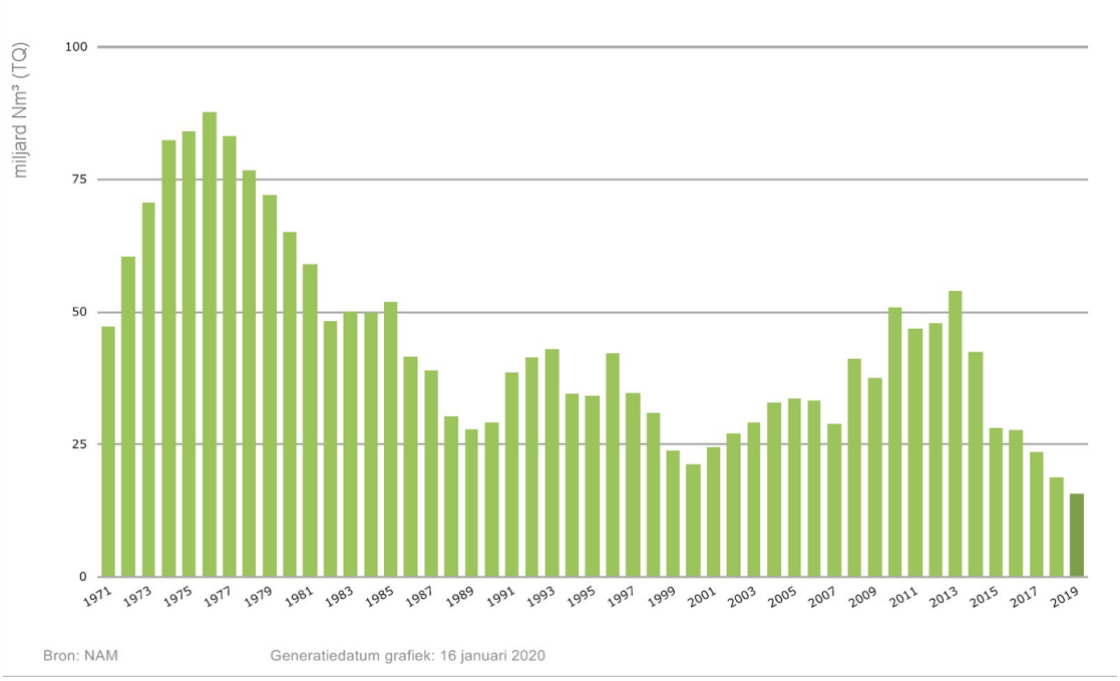


Figure 3. gas production from Groningen gas field 1971-2019 (NAM, n.d.)

United Kingdom

Most of the produced gas in the UK comes from offshore gas fields in the North Sea and the Irish Sea. Estimates displayed in the Oxford energy institute report state that the decline of gas production will likely hit around 20 bcm in the 2020s to 2030s. As with the formerly mentioned countries (Norway and the Netherlands), the gas production in the UK is declining. The production of gas in 2019 decreased by 2,2%, which seems to follow the long-term trend of a declining gas production since the production peak in the year 2000 according to the government gas statistics (Clark & Pearce, 2020).

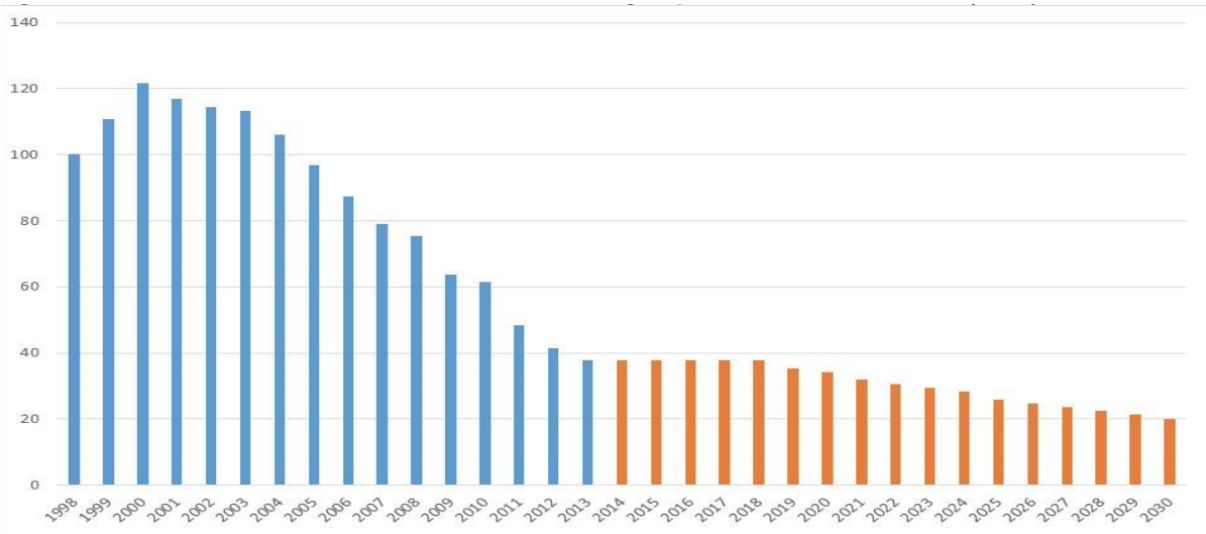


Figure 4. historical and estimated gas production 1998-2030 UK (OIES, 2014)

Non-European options: North Africa and the Caspian Sea region

North Africa is frequently cited as being an alternative to Russian gas by other energy authorities (Dickel et al., 2014; Ratner, Belkin, Nichol, & Woehrel, 2013). The region has been a supply partner to Europe for a long time. And according to the OIES, it could hold to key to Europe's gas supply for the long term. However, 'while all these attributes render the region a potential key source of incremental European gas supplies in the long term, the short- and medium-term outlook for an increased North African gas export to Europe looks increasingly bleak.' (Dickel et al., p. 17, 2014). The challenges of finding enough investment – a task which is complicated by the region's declining investment climate following the Arab Spring – and the increased gas demand for domestic use will determine the export potential of the region for the coming years.

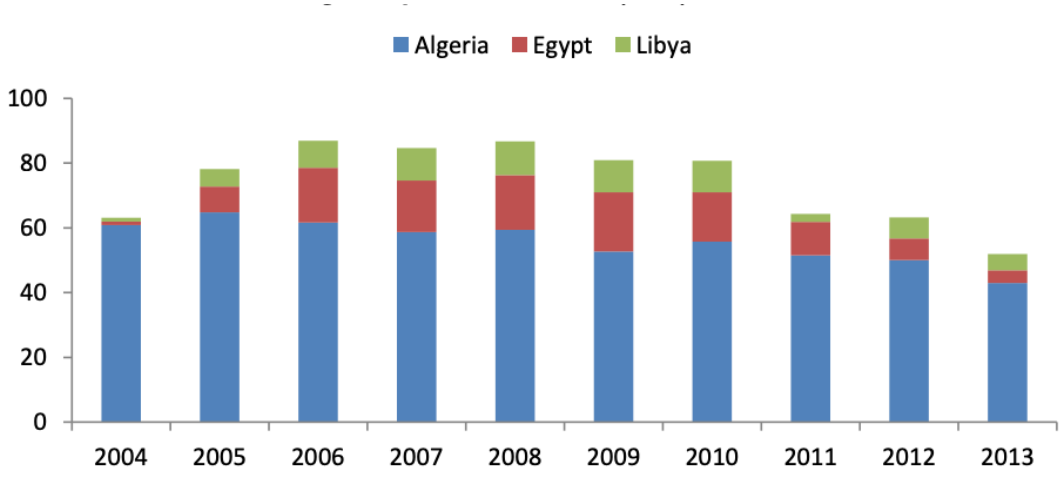


Figure 5. North African gas exports (Dickel et al., 2014)

The situation in Libya seems to be troublesome after years of domestic conflicts. Several militias are fighting over key resources of the country including cities, infrastructure, and important gas and oil fields. And in 2011, the gas exports from the country were suspended completely for almost 8 months as a result from the ongoing civil war at the time and the UN-sanctions against the Gadhafi regime until the fall of the regime in October 2011. The near future for this region in terms of gas export seems to be uncertain. While the potential is very promising looking at the amount of material that is available, a history of project delays over the past years suggest potential for similar delays in the future. To add to this, the stability '…is also far from having recovered politically from the disruptive effects of the Arab Spring'. (Dickel et al., p. 19, 2014).

According to a report from the Congressional Research Service in 2013, the proven estimated gas supply of Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan are around 1000 tcf (trillion cubic feet). Moreover, the IEA estimates that over 7% of the world's gas supply is located in this region, with the possibility of this being upscaled if more reserves are discovered. Nevertheless, these markets remain somewhat unused due to their isolated locations and building pipelines would be a costly, politically risky, investment. These pipelines would then in turn pass through either the Caspian Sea, 'where the littoral states continue to argue over its legal status' (Ratner et al., p. 18, 2014), or the routes would pass through Russia or Iran which are arguably not the best states to be dependable upon in light of recent developments.

The Southern Gas Corridor is one of the projects that fit the strategy of the Energy Union with regard to the diversification of energy sources. Since many CEE countries are dependent on a single supplier for most of their gas supply, the Commission supported the concept of a pipeline that would expand the existing infrastructure. In 2002 the first talks started between companies from the Nabucco pipeline, a project that aimed to build a pipe from Turkmenistan, through Azerbaijan and Turkey to South Eastern Europe. The goal is to reduce the dependency of those countries that are dependent on a single supplier and for most of those countries that means Russia. 'Initially, around 10 bcm of gas will flow along this route when it opens in 2019-2020. Given the potential supplies from the Caspian region, the Middle East and the East Mediterranean, however, the EU aims to increase this to 80-100 bcm of gas per year in the future.' (EC, 2020a). Part of this project are other pipelines such as the Trans Anatolia Gas Pipeline (TANAP) and the Trans Adriatic Pipeline (TAP). These pipelines would carry gas from Greece to Italy through Albania and the Adriatic Sea.

The production amount in 2014 of Azerbaijan from the Shah Deniz phase 1 field was around 16-17 bcm. The produced gas was mainly used for the domestic use and for the export to Russia, Georgia, Turkey, and Iran. This is set to remain the same for the most of 2020s. Export numbers to other countries might differentiate slightly over the years but no significant numbers would be made available for the export of gas to Europe. The Shah Deniz phase 2, set up by BP and several other partners started production in June 2018. The 28-billion-dollar project is the first subsea development in the Caspian Sea, according to BP (n.d.). The field is expected to produce around 16 bcm annually. 10 bcm is planned to be exported to Europe and 6 bcm is destined for Turkey. It is the starting point of the Southern Gas Corridor series of pipelines that will deliver gas to the European markets from 2020 and in the years to follow.

SOCAR (the gas authority of Azerbaijan) officials stated that the gas production is expected to increase by 50 to 55 bcm per year by the year 2025 (The Business Year, 2012). However, the OIES expectations are that only around 8 bcm of gas per year maximum would be made available to the European market.

The gas supply of Turkmenistan is quite large. The government presents impressive figures and the estimated amount of reserves sit at 50.4 tcm. International authorities are more conservative and estimate it around 19.5 tcm of gas. The gas that Turkmenistan produces is mostly used to meet the trade commitments made with China. In 2013, Turkmenistan produced roughly 50 to 55 bcm of gas of which 20 bcm went to the Chinese market. The country is planning on upscaling the production levels to China to 65 bcm annually and it wants to increase the production levels to around 100 bcm per year, which are quite ambitious goals. The most recent numbers show a different picture as the production is around 60 to 70 bcm (Turkmenistan Natural Gas Production, 2020; Karagianni, 2019). Moreover, it is difficult to bring gas from Turkmen fields to Europe. Routes would lead through Russia or Iran, which are not favorable countries. The gas export policy that Turkmenistan handles is an obstruction, which demands that in order to sell gas at the border, the purchaser takes all the transit risks. ‘Given Turkmenistan’s small population and revenue requirements, there is no reason to think this policy will be changed in the foreseeable future.’ (Ratner et al., p. 25, 2014).

Uzbekistan and Kazakhstan are also major gas producers with around 50 to 60 bcm annually. Most of this gas is consumed domestically with only 9.4 bcm being exported (Central Intelligence Agency, 2020). The main trading partner of both countries are Russia and China. New pipeline projects are built on behalf of China to increase the gas flow and are expected to begin operations in 2020. In order to make Europe available to Uzbek and Kazakh gas, the completion of the Southern Gas Corridor is crucial. Other transit options would all run through Russia, which is not something that would be favorable in terms of European energy security.

Renewable energies

In the strategy of the Energy Union, one of the priorities is to decarbonize the economy. One of the ways of doing this is to increase the use of renewable energies. According to statistics by Eurostat (n.d.-b), the share of renewable energies in the total energy consumption increased from 9.6% to 18.9% between 2004-2018. The 2020 target is 20% and the 2030 target is set for 32% of renewable energy consumption. Between the Member States in the EU there are sometimes large gaps of renewable energy consumption. For example, as seen in figure 8 below, Sweden had the highest share of 54.5%, followed by Finland (41%) and Latvia (39%). Among the lowest in the ranking are Luxembourg with 6.4%, the Netherlands (6.6%), and Malta (7.2%). The main reason for success rate of renewable energy share is the variations of natural environments that are favorable for the production of large amounts of renewable energy.

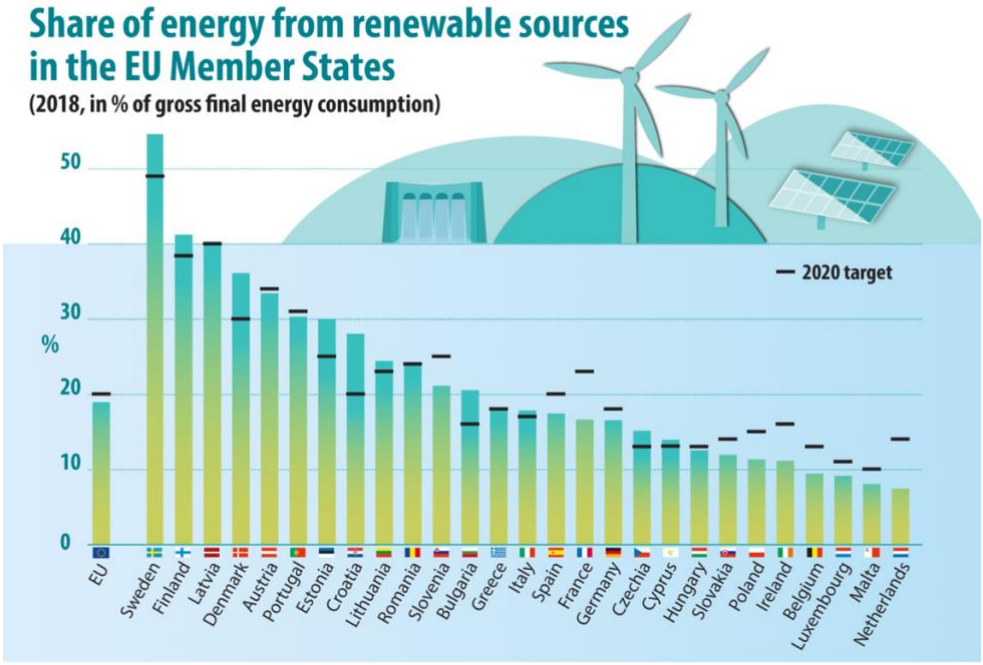


Figure 6. Share of energy from renewable sources in the EU Member States. (Eurostat, 2020)

To claim that renewable energy sources would replace fossil fuels and gas as the main source of energy is a far-fetched scenario. However, there are ambitions within the EU to achieve this goal. A study done in 2016 by Connolly et al., researches a potential 100% renewable energy scenario or pathway for the EU by 2050. Their proposed scenario is based on the Smart Energy System-concept. This concept involves creating new flexibilities in the existing energy system, mostly by incorporating all of the sectors with one another (Connelly et al.,

2016). This would mean a significant transition for the current energy system in place in many EU countries in terms of policies, technologies, and institutions.

The initial results of the study give insight in the scenario where the EU would rely for 100% on renewable energy by the year 2050. What is interesting is that to reach the target of 80% less CO2 emissions in 2050 compared to 1990 levels, the total annual costs of the EU energy system would be about 3% higher than the fossil fuel alternative. To reach 100%, this percentage would be 12%. However, the researchers also have to acknowledge that this study is speculative as there are too many uncertainties surrounding the cost assumptions for 2050 and could be considered negligible. Furthermore, in the scenario used for the study, there are no fossil fuels, energy imports, and no CO2 emissions (at least less than 1%). The key technologies to achieve this goal are in wind energy, solar energy, electric vehicles, fuel storage, and smart buildings with heat saving technologies. The technologies needed are for the most part at a mature enough level to be implemented at the scale that is needed for the scenario making the solution seemingly closer than at first sight. 'The results in this study suggest that the progress towards a 100% renewable energy system will most likely be defined by political desire and society's ability to implement suitable technologies, rather than the availability of cost-effective solutions.' (Connolly et al., p. 1650, 2016).

With the energy transition in the future, other dangers might lure in the dark. There are studies that suggest the rise of renewable energy sources might lead to an increase in the emissions of the gas 'Sulfur hexafluoride' or SF6. The gas is being used for industrial applications as it helps prevent fires by displacing air. This comes in helpful with the growing energy grid where high voltage switches and circuit breakers become more of a fire risk. So, the increased use of renewable energy sources, also increases the use of SF6. A study from the UK found that this causes the use of SF6 to increase by 30 to 40 metric tons every year, and worldwide the expectations are that the gas is used 75% more by 2030 (Widger & Haddad, 2018).

This is problematic. SF6 is a fluorinated gas, meaning that it is a greenhouse gas with high global warming potentials and even among this group, SF6 is the most potent of them all. It has 23500 times more warming potential than carbon dioxide. Furthermore, SF6 does not break down in the environment, lasting for 3200 years in the atmosphere. And while we are not intentionally adding this gas to the atmosphere, it does leak from installations that provide us with renewable energy. But it is hard to notice as the gas is odorless and colorless. The emissions in Europe for 2017 were equivalent to adding 1.3 million cars to the roads.

Should the EU be alarmed about this development? Regulators have tried to ban the use of the gas to no avail. ‘In the end, the electrical industry lobby was too strong, and we had to give in to them’, said Dutch Green MEP Bas Eickhout, who was responsible for the attempt to regulate F-gasses in a BCC interview (McGrath, 2019). However, it seems that no immediate action is needed for now. In the UK, the emissions accounted for only 0.11% of the total greenhouse gas emissions. Some companies seem to be more willing to cooperate. Scottish Power Renewables has installed a new wind farm where a system of vacuums and clean air replace the use of SF6. And Siemens is developing high voltage switchgear that is SF6 free as well (Davidson, 2019). The study done by Widger & Haddad (2018) concludes that industry-led projects should come up with better leak-containment solutions. For example, ‘a demonstration site at Sillindge substation in Kent, UK has been commissioned to install a 400-kV substation that is insulated by a new green gas for grid (g3) as an alternative to SF6.’ (Widger & Haddad, p. 9, 2018).

LNG imports and storage

The possibilities of Liquified Natural Gas (LNG) ‘are frequently regarded as the most promising alternative source of non-Russian gas supplies to Europe.’ (Dickel et al., p. 29, 2014). The gas would be imported through so-called LNG terminals and is an important source of diversification that contributes to the competition in the gas market and adds to the security of supply, according to the Commission (EC, 2020a). In the previous chapter it can be read that the trade dialogue and investments surrounding LNG-partners and hubs are already well on their way. The IEA expects the LNG imports to Europe to increase by almost 20% by 2040 in comparison to the import levels of 2016.

In February 2016, the EC presented an EU-strategy for LNG and gas storage as part of the Energy Union strategy to ensure the attractive destination of LNG for the EU. The USA have proven to be a major partner in the exchange of policy information. ‘Both the United States and the EU have taken concrete steps to increase imports of competitively priced United States LNG to the EU.’ (Dickel et al., p. 23, 2019). In fact, over the whole of 2018 Europe was responsible for almost 11% of the total US LNG exports. When taking the time into account since the start of the strategy in 2016, this percentage rises to 26%. ‘New LNG supplies from North America, Australia, Qatar, and East Africa are increasing the size of the global LNG market, and some of these volumes have already reached the European market.’ (EC, 2020a). The increase of LNG usage is also beneficial to the achievement of the Energy Union goals.

Analysis done by the EC have already proven that projects of interests (PCIs) will remove or at the very least soften the main vulnerabilities that were indicated by the gas stress test done in 2014. And it is vital that the infrastructure and new liquid gas hubs in the Mediterranean, Baltic, and CEE region are rapidly constructed (EC, 2016).

In conclusion, the indigenous gas market from the EU is not a viable option as gas production is being scaled down on a large basis. The North African region's political instability makes it impossible to be a trustworthy gas supplier in the future. The Caspian Sea region can become a big supplier of gas, provided that the Southern Gas Corridor project is completed in full. As for renewable energy sources, the EU is taking steps to further increase the implementation of these sources. However, not all Member States possess the favorable environmental attributes needed for the most effective utilization. Finally, according to the OIES, LNG is the most promising option as non-Russian energy source.

Risks related to the energy supply from Russia

In this section, I shall try to put the risks that are attached to the energy supply provided by Russia in a clearer perspective. Already mentioned, is of course the Russo-Ukrainian gas dispute that happened in 2009. Firstly, following the energy security assessment framework laid out by Cherp & Jewell (2013), some background information of the main energy systems or routes through which energy flows from the Russian Federation towards Europe is provided. For the supply of natural gas, pipelines run through Ukraine, Belarus, Poland, and the Nord Stream-pipelines. Some of these lines have existed since Soviet times, beginning in the early 1970s. The newer connections are those running through the Baltic Sea, namely the Nord Stream-projects.

In the following section, a number of the risks that are present or, sometimes, perceived by the EU and Member States is discussed. According to statistics from Eurostat, around 60% of the EU's total energy import come from Russia, whereas 39% of all the natural gas imports came from Russia.

The Russo-Ukraine gas dispute

There were some minor conflicts that happened over the course of the 1990s, but more serious disputes erupted in the years 2005 and 2009. The Russo-Ukraine gas conflict in 2009 is one of the most serious disputes that had significant impact on not just Ukraine, but also Russia and the EU. Austvik (2015) mentions that as much as 18 European countries lost their Russian supplies due to this conflict. Not long after, the OIES came out with a report on what had happened and provided initial conclusions in a comprehensive assessment.

Starting on the 1st of January, the conflict had little impact on the European gas supply and delivery but on the same day, Gazprom cut-off all supplies for Ukrainian usage. The conflict started by a claim from Gazprom that Ukraine had 'stolen' 65.3 million cubic meters (mmcm) of gas during the first four days of 2009 and that they should make up for this by supplying from its own reserves. Ukraine responded by saying that it had rights to this 'technical' (fuel) gas in the absence of a supply and transit contract and had to use it for the operation of the network where it would be used to run the compressor stations. For Europe, one of the key moments was the night of January 5th. Here, during a (rather obviously staged) televised interview President Putin and Gazprom CEO Miller discussed the Russian problems with Ukraine and came to the conclusion that they both agreed on a gas flow reduction, and that Gazprom would inform its European partners about the reasoning for the action set in motion.

Following from this, on January 7th, the conflict entered a more serious phase as gas was cut off completely to countries in South Eastern Europe which are for 100% dependent on Russian imports, and partially to other countries for 13 days (Pirani et al., 2009). The CEO of Gazprom, Aleksei Miller, stated that it had stopped delivering to the system because Ukraine had closed it down. Naftogaz, Ukraine's state-owned oil and gas company responded by saying that it had closed the system because Gazprom had stopped delivering gas. Neither of the two countries seemed to be interested in resolving the matters in an orderly and hasty fashion, as they mostly blamed each other for being the cause of the disruption. What is important to mention in this conflict is the scale and overall unprecedented nature. Something serious like this had never really happened before and it is one of the first times that Russia showed its true power on the energy grid. In the end, the gas supplies were not truly cut, at least, those to Europe. But Ukraine diverted a lot of the gas volumes destined for the European market to its internal grid. A comprehensive summary of events can be found in Figure 7.

Thus, while the blockage was eventually lifted, and gas started flowing again to where it was supposed to flow, the aftermath contained serious consequences for Gazprom. The conflict damaged the reputation and the reliability of the company (and indirectly also Russia) came under scrutiny. The damage was done and perhaps so irreparably. Not just because of the existing distrust against Gazprom as a stable supplier, but more so because many were not interested who was to blame for the conflict, something that both Russia and Ukraine seemed to be focused on. Early statements from the Prime Minister of the Czech Republic seem to reflect this rationale and shows the need for a solution to be made in the near future. 'The main lesson learned from this crisis is that Russia and Ukraine aren't reliable suppliers. Europe must think about alternative sources and pipelines' (EP, 2009).

The report by the OIES (2009) was released the month after the incident happened and the authors are thus quite limited in their knowledge for the foreseeable future. While they believe the incident to be a 'landmark event' in the gas relationship between Russia and European countries, they conclude that the use of an economic or political weapon in such a manner is not likely to happen. The profits for the Russian Gazprom are for a large portion dependent on the delivery to the European market and the dependency on Russian gas is too high for Europe at this point in time. On the other hand, the decision from the Russian government to cut back on the deliveries was an 'unnecessarily risky and commercially irrational action at that stage of the dispute' (Pirani et al., 2009, p. 60). This decision might have reflected the anger and emotions of Prime Minister Putin leading to a point of irrational behavior. Thus, although the use of this energy weapon might seem unlikely, the order of magnitude that emotions played a role in this decision, makes for an unpredictable future.

This conflict also had another consequence in that it showed Ukraine to no longer be a viable transit country for the European market. And now that the conflict between Russia and Ukraine has escalated to the point of the annexation of the Crimea in 2014, other transit options have to be considered. In order to show that the Ukraine is not needed as a transit country to the rest of Europe, Gazprom has invested in the build of other pipelines, such as the Nord Stream-project.

- 1 January: Gazprom cuts all supplies for Ukrainian consumption, while supplies to Europe continue
- 5 January: Gazprom alleges that 65.3 mmcm of gas has been 'stolen' during the first four days of the year; Ukraine responds that in the absence of a supply and transit contract it is entitled to take this 'technical' (fuel) gas
- 6 January: deliveries to Europe drastically reduced
- 7 January: deliveries to Europe completely cut off
- 11 January: EU monitors deployed
- 13–17 January: Gazprom cites daily attempts to resume flows 'blocked by Ukraine'
- 14 January: letter from Naftogaz to Gazprom cites lack of a 'technical agreement' preventing resumption of flows
- 19 January: ten year supply and transit contracts signed
- 20 January: gas flows to Ukraine and Europe restart
- 22 January: gas flows to all European customers returning to normal levels

Figure 7. Russo-Ukraine gas dispute (Pirani et al., 2009, p. 19)

Nord Stream-projects

Before diving into the details of the Nord Stream-project, it should be mentioned that this topic is politicized. Many different opinions are not always free of bias. Finding such literature and extracting solid information is therefore also a difficult task. This study is done with this in mind and the statements made in this thesis are done so with the transparency and objectivity that is required.

What exactly is this Nord Stream 2 project? First of all, it is the second stage of the Nord Stream-project, formerly known as the North European Gas Pipeline, that was constructed in the early 2010s. However, the original idea of the pipeline came into existence in 1997, when the Finnish company Neste and the Russian Gazprom formed the company North Transgas Oy, 'to examine alternative gas pipeline routes from Russia to Germany through the Baltic Sea' (Whist, 2008, p. 5). Later on, German companies E.ON Ruhrgas and BASF/Wintershall became involved. In 2005, these companies, together with Gazprom, agreed to construct the North European Gas Pipeline. What followed was the formation of the company Nord Stream AG, incorporated in Zug (Switzerland), with Gazprom being the majority shareholder (51% in 2005) and the two German companies with a stake of 24.5% each (Whist, 2008).

In more technical terms, the Nord Stream-project is the construction of a set of offshore natural gas pipelines laid parallel to each other. The lines run from Vyborg, located in the Russian Federation, to Greifswald in Germany. The first of these pipelines was constructed in May of 2011 and inaugurated on 8 November 2011. The second line was finished and inaugurated almost a year later on 8 October 2012. The pipeline has an annual carrying capacity of 55 billion cubic meters of gas. The capacity is expected to be doubled (110 billion cubic meters) by the construction of two additional pipelines.

In 2011, the Nord Stream company started to explore the possibilities of an expansion to increase the gas flow. On 5 September 2015, Gazprom and its Western partner companies signed the shareholder agreement on Nord Stream 2 at the Eastern Economic Forum in Vladivostok (Goldthau, 2016). Nearly a year later, the CEO of Gazprom, Aleksei Miller, at the St. Petersburg Economic Summit proclaimed the completion of the first tenders of the pipeline. At its current length of over 1200 kilometers, it is the longest sub-sea pipeline in the world, and it will operate without any compressor stations along the way. Figure 8 highlights the route of the existing and the Nord Stream 2 lines.

The project has faced opposition from the USA as well as numerous Western and Eastern European countries, fearing that this project would increase Russia's influence in the region. Sources of concern with the Nord Stream pipeline project have existed ever since the beginning of project. A report made by the Fridtjof Nansens Institute from 2008 concerning the political debates surrounding the Nord Stream-project, indicates a few initial concerns that are worrisome. First of all, the consortium of Nord Stream AG chose to have its base in Switzerland, famous (or infamous) for its strict banking laws and the secrecy that surrounds them. Making the project less transparent would it have been based in any other EU country. Secondly, the Russian energy sector is lacking transparency. For example, the reputation of Gazprom being a shady company comes forward in Larsson (p. 9, 2008), saying that the Russian energy company has "a tradition of being related to rather dubious companies … (and that) Gazprom and Nord Stream could use shady subcontractors, intermediaries or subsidiaries (that might be registered offshore) and thereby dodge environmental or other responsibilities." One of the more obvious consequences is that this pipeline would keep the dependency of Europe, and especially those countries that are for a significant portion reliant on Russian gas. 'The main backdrop of the region playing a prominent role in the discussion on Nord Stream 2 is that it is highly dependent on Russian gas in overall gas imports' (Goldthau, 2016). The stress test deployed in 2014 revealed that countries such as Poland

would be hit hard in the case of a long-term supply disruption, as well as several South-Eastern member states like Hungary, Bulgaria and Romania. Other observers (Goldthau, 2016; Loskot-Strachota, 2015) have noted that the expansion of the Nord Stream pipeline would strengthen Gazprom's grip on the European market and give Russian the chance to cut some Eastern European countries off supplies without harming any Western EU countries, such as Germany. Revenue loss for those Eastern European countries also seems to lurk on the horizon, as transit countries (Ukraine, most of all) would miss the transit fees that normally apply.

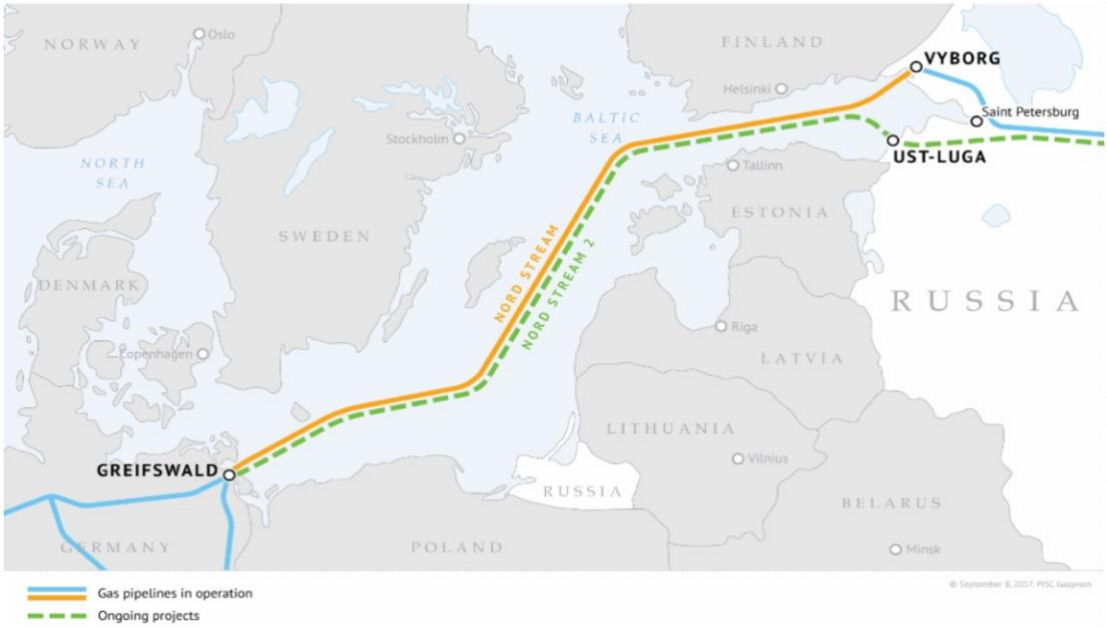


Figure 8. Nord Stream pipeline routes in the Baltic Sea. (Gazprom, n.d.)

The then President of the European Council, Donald Tusk, mentioned that the Nord Stream 2 project is against the EU's interests. 'In my perspective, Nord Stream (2) does not help diversification, nor would it reduce our energy dependency.' He further added: 'The EC has assessed that if Nord Stream 2 would be constructed, it would increase Europe's dependence on one supplier and concentrate 80% of Russian gas imports on one route' (Teffer, 2015). Also, from outside of the EU there are fears of the perceived damage and threat that the pipeline would bring to the energy security of the EU. The then United States Secretary of State, Rex Tillerson, mentioned at a joint press conference during a visit to Poland that the construction of the Nord Stream 2 pipeline would undermine Europe's stability and energy security (Goettig & Kelly, 2018). Military security aspects also come into play here, as Sweden has stated that the pipeline causes a security problem.

These concerns grew when Vladimir Putin said that the ecological safety of the pipeline would be ensured by the Baltic Fleet of the Russian Navy.

Environmental associations and charities have argued that the dangers of the project pose a threat to the environment which makes it illegal under European climate and environmental laws and should be canceled (Baker, 2018). These groups go further to question the investment of the Nord Stream 2 pipeline as being a sensible one. Director of Greenpeace Poland said: 'Nord Stream 2 is a useless and harmful investment by companies that want to force dependency on fossil fuels at any cost'… 'Law has been amended at the behest of these companies and a blind eye has been turned to the reliability of the Environmental Impact Assessment. That's why we are demanding a full assessment of the social and environmental costs of the Nord Stream 2 natural gas pipeline' (Baker, 2018). Additional concerns were raised, as Nord Stream AG planned to use a chemical solution called glutaraldehyde to clean the pipeline, which would then be dumped into the Baltic Sea after.

Critics have also mentioned the ethical issues that surround the Nord Stream AG company. Both Gerhard Schröder, former Chancellor of Germany, and Vladimir Putin were in favor of the construction during the negotiation phase. On 24 October 2005, a few weeks before Schröder planned to step down, the Germany authorities granted a guarantee of €1 billion (the largest ever by the German government) where Germany would step in should Gazprom default on a loan aimed at financing part of the Nord Stream-project. Schröder, now being the head of the shareholder committee of Nord Stream AG, was accused of having conflicting interests as it was only days since he left his post of Chancellor of Germany.

Russian officials responded to all these claims by saying that 'attempts to halt implementation of the Nord Stream 2 project will continue but they will not prevent its development', according to Russia's permanent representative to the EU, Vladimir Chizhov (TASS, 2018). He further added; 'Politicizing around this process will continue and there is no way around its opponents. However, these feeble efforts are unable to stop the project. I am confident that the Nord Stream 2 will take place' (TASS, 2018). The most recent news reports state that even though the Nord Stream 2 project suffered from delays due to US sanctions, it will still be completed. Vladimir Putin announced that during a meeting with businessmen, according to the Russian newspaper Kommersant (NOS, 2019).

In Conclusion, The Russo-Ukraine conflict caused the EU to take more action on the security of gas supply. However, future developments remain uncertain. The Nord Stream-projects are causes for concern to the Western world, as it presumably would give Russia more control over the supply of energy sources. The expansion of this pipeline has not only nations, but also environmental groups on the edge of their seat. Furthermore, ethical concerns are raised over the loans given to the company of Nord Stream AG. Overall it seems that the developments of the Nord Stream 2 are not in the best interests of the EU, but then it is odd that so little action is taken to put an end to the project all together.

5. Conclusion and discussion

As the world becomes more aware of its fragile existence, topics such as climate change, resource security and energy security are becoming increasingly important. For the EU, one of the biggest factors here is the energy dependency on third countries and the stability of these energy relationships. The stress test of 2014 showed the need for action if the EU wishes to get rid of this dependency. As mentioned in the theoretical framework, it is hard to quantify the energy security of a nation, let alone of the entire EU. It depends on different factors and has different meanings depending on the context of the situation.

In this research, to answer the main question, three sub-questions are formulated;

1. What are the existing arrangements between the EU and Russia on gas?

The answer to this question seems straightforward. There are a number of arrangements between the EU and Russia when it comes to the gas relationship. First of all, the arrangements are made within the framework of the Energy Union. Secondly, the 'EU-Russia Dialogue' serves (among other goals) to safeguard the supply of gas towards the EU. The relationship between the EU and Russia is one of mutual dependency where both economies heavily depend on each other. Lastly, the Early Warning Mechanism is supposed to prevent the supply disruptions that happened in the past.

2. What are the alternatives for the gas supply of the EU?

The first option for the supply of gas is to look to the indigenous gas supply of the Member States within the EU in order to become less dependent. The top three most viable candidates are Norway, the Netherlands, and the UK. These countries make up 70% of the total indigenous gas production. Another option is to look to reliable suppliers outside of the EU.

Specifically, the North African and Caspian Sea regions seem to possess the gas needed, albeit not always easily obtainable. Furthermore, another alternative for the gas supply of the EU are renewable energy sources. In 2050, the EU plans to be fully dependent on renewable sources for all its energy needs. Finally, LNG imports and storage are discussed as alternative. The Oxford Energy Institute (2014) sees this as the most promising alternative as non-Russian gas supply to Europe.

3. What are the current risks related to gas supply from Russia to the EU?

In the past, there have been a number of gas disputes which threatened the supply of gas towards Europe. The nature of some of these conflicts make for an uncertain future. Furthermore, the Nord Stream-projects had a negative impact on the security of the steady gas supply. Multiple EU Member States and energy experts have expressed their concerns surrounding the pipeline expansion, as it would give Russia more control over the supply of gas and also increase the dependency.

In conclusion, how resilient is the EU towards a cut-off from Russian gas?

The answer to the main question can be divided into short term solutions and long term solutions. Firstly, the short-term solutions focus more on the indigenous gas production within the EU and the gas projects currently available for the supply of gas. The indigenous gas production of several states could temporarily and partly solve a cut-off from Russia. However, these are deemed unviable for longer sustained gas supply as the production capacity is already being scaled down. So, the solutions on the short term are difficult and unwanted.

On the long term, the gas supply to the EU could be sorted by countries in the North African and Caspian Sea regions. The estimated reserves in these countries seem adequate in order to sustain a longer cut-off from Russia. Provided that the political stability of some of these countries improves and they evolve in reliable trade partners. The other long-term solution is to keep investing in renewable energy sources in order to cut most of the gas out the energy system. This would radically reduce the dependency on Russia while working towards the goal of 100% renewable energy in 2050 in the EU.

Furthermore, another advice is for Europe to have its own voice. More specifically, Europe needs to intensify its efforts in promoting and supporting political stability in those regions that are possible candidates for alternative gas suppliers. In light of the challenges in these regions (political stability) and the political will, the EU should introduce a special envoy on international energy affairs.

Findings show that the EU is making the proper steps to strengthen the energy independence over the coming years and increasing overall resilience. However, despite of political vilifying statements from EU states, economic and pragmatic solutions outweigh the political interest.

This study looked into the energy security of the EU. In order to do this, a document study of the most important threats, the existing agreements and the alternative solutions was done. The documents and literature used for this study were selected from multiple sources and viewing angles to make it as inclusive as possible and to have reliable and valid information. Furthermore, this approach resulted in the broadening of not only the view of the reader, but also of the author. The framework provided by Cherp & Jewell (2013) was the inspiration for the structure of this thesis but was not followed to the dot.

For some topics it became clear that the truth is harder to distill than one would think. Many stakeholders are sometimes involved all wanting a different result or having a different political agenda. The overall politicization surrounding the matters of energy security in the EU should be regarded as a troublesome development which in the long run will not prove to be beneficial to the parties involved. Here, both parties involved should be more interested in the mutual dependency that still exists today and recognize each other vital energy partners. It is however uncertain if the relationship could be salvaged at this point in time or in the near future. The Crimea crisis is still left unresolved and hostilities towards each other continue even in the shadow of economic sanctions. The build of the Nord Stream 2 and the history of gas disputes seems to be a recipe for disaster. How future events will unfold is uncertain, but these activities are clearly an obstacle in the path of reliable energy security for the EU.

Promises of other options that would provide the EU with the amounts of gas needed to replace Russian gas are not just fantasies. The indigenous gas supply of the EU would be insufficient and unwanted in terms of the headed direction for the energy system of the future. Foreign gas markets would be able to add to the supply and diversification has an important role in the Energy Union strategy, but it turns out that these resources are not always easily obtained. What seems to be more promising is the use of LNG. The benefits of LNG are numerous, and it would decrease the dependency on unstable gas suppliers. The EU is already investing in the infrastructure to support the growth of LNG use to ensure the increased diversification in the near future.

Renewable energy sources prove to be dependent on the geographical attributes that individual Member States have. The countries with the highest share of renewable energy

sources are making cleverly use of this fact. If more renewable energy sources are to be used the current energy grid would have to be changed significantly to a more physically integrated network. These sources could be volatile which causes fluctuations in the supply of electricity. ‘To handle the technical challenges an improved cross-border management and increased investment in power transmission infrastructure is needed.’ (Pacesila et al., p. 167, 2016).

The reader should be made aware that this study is unable to encompass the whole concept of energy security as this may include other economic, social, and political factors. This study tried to find a middle road. At the hand of the sub-questions, this study gave more insight in the threats, the existing arrangements and the alternatives in terms of gas relationships with Russia. However, it is not uncommon for energy security studies to be characterized as either being too broad, lacking precision and coherence, or too narrow in that they tell us little about comprehensive energy challenges (Sovacool & Brown, 2010). Another limitation is that this thesis focused on the gas relationship with Russia, as this is the most prominent energy source that the EU is dependent on from Russia. To give a more complete picture of the energy relationship between the two parties, more energy sources could be included.

References

Austvik, O. G. (2015). *The EU Energy Union, Energy Security and Russian Gas.* Consulted from https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/Austvik_FNL.pdf

Azzuni, A., & Breyer, C. (2017). Definitions and dimensions of energy security: a literature review. *Wiley Interdisciplinary Reviews: Energy and Environment*, *7*(1).

Baker, E. (2018, 5 February). *Nord Stream 2 "useless and illegal", say environment experts*. Consulted from https://www.clientearth.org/nord-stream-2-useless-and-illegal/

BP (n.d.). *Shah Deniz Stage 2, Azerbaijan.* Consulted from https://www.bp.com/en/global/corporate/investors/upstream-major-projects/major-projects-2018/shah-deniz-stage-2.html

Central Intelligence Agency. (2020, 16 April). *Central Asia :: Uzbekistan — The World Factbook - Central Intelligence Agency.* Consulted from https://www.cia.gov/library/publications/the-world-factbook/geos/uz.html

Cherp, A., Adenikinju, A., Goldthau, A., Hernandez, F., Hughes, L., Jansen, J., Jewell, J., Vakulenko, S. (2012). *Global Energy Assessment – Toward a Sustainable Future.* Cambridge, United Kingdom: Cambridge University Press.

Cherp, A., & Jewell, J. (2011). The three perspectives on energy security: intellectual history, disciplinary roots and the potential for integration. *Current Opinion in Environmental Sustainability*, *3*(4), 202–212. https://doi.org/10.1016/j.cosust.2011.07.001

Cherp, A., & Jewell, J. (2013). Measuring energy security: From universal indicators to contextualized framework. *International Handbook of Energy Security*. Cheltenham, United Kingdom: Edward Elgar Publishing.

Chester, L. (2010). Conceptualising energy security and making explicit its polysemic nature. *Energy Policy, 38*(2), 887–895. https://doi.org/10.1016/j.enpol.2009.10.039

Clark, Z., & Pearce, A. (2013). *Energy Trends: UK gas*. Consulted from https://www.gov.uk/government/statistics/gas-section-4-energy-trends

Connolly, D., Lund, H., & Mathiesen, B. V. (2016). Smart Energy Europe: The technical and economic impact of one potential 100% renewable energy scenario for the European Union. *Renewable and Sustainable Energy Reviews, 60,* 1634–1653. https://doi.org/10.1016/j.rser.2016.02.025

Cukier, E. (2018, 16 November). Nord Stream 2, splijtzwam in Europa. *NRC Handelsblad*. Consulted from https://www.nrc.nl

Cukier, E. (2019a, 21 November). Nord Stream 2 is bijna klaar, debat over Russisch gas nog niet. *NRC Handelsblad*. Consulted from https://www.nrc.nl

Cukier, E. (2019b, 23 December). 'Dialoog met Rusland is enorm verschraald'. *NRC Handelsblad*. Consulted from https://www.nrc.nl

Davidson, J. (2019, 18 December). *Green Energy Has a Greenhouse Gas Emissions Problem, but Solutions Are Near.* Consulted from https://www.ecowatch.com/electrical-industry-greenhouse-gases-2640380385.html?rebelltitem=1#rebelltitem1

Dickel, R., Hassanzadeh, E., Henderson, J., Honoré, A., El-Katari, L., Pirani, S., Rogers, H., Stern, J., & Yafimava, K. (2014). *Reducring European Dependence on Russian Gas: distinguishing natural gas security from geopolitics.* Consulted from https://ora.ox.ac.uk/objects/uuid:f5ecc8e9-4fe9-49d8-8fda-7ff31da7081c/download_file?file_format=pdf&safe_filename=NG-92.pdf&type_of_work=Working+paper

European Commission. (n.d.) *2020 climate & energy package.* Consulted from https://ec.europa.eu/clima/policies/strategies/2020_en

European Commission. (2011). *EU-Russia Energy Dialogue.* Consulted from https://ec.europa.eu/energy/sites/ener/files/documents/2011_eu-russia_energy_relations.pdf

European Commission. (2015). *Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*. Consulted from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0080

European Commission. (2016). *On an EU strategy for liquefied natural gas and gas storage*. Consulted from https://ec.europa.eu/energy/sites/ener/files/documents/1_EN_ACT_part1_v10-1.pdf

European Commission. (2018a). *Upstream Gas Supplies in Central and Eastern Europe.* Consulted from https://ec.europa.eu/competition/antitrust/cases/dec_docs/39816/39816_10148_3.pdf

European Commission. (2018b). *EU-Russia energy dialogue - Energy European Commission.* Consulted from https://ec.europa.eu/energy/topics/international-cooperation/key-partner-countries-and-regions/russia/eu-russia-energy-dialogue_en?redir=1

European Commission. (2019). *Fourth report on the State of the Energy Union.* Consulted from https://ec.europa.eu/commission/sites/beta-political/files/fourth-report-state-of-energy-union-April2019_en_0.pdf

European Commission. (2020a). *Diversification of gas supply sources and routes - Energy European Commission*. Consulted from https://ec.europa.eu/energy/topics/energy-security/diversification-of-gas-supply-sources-and-routes_en?redir=1

European Commission. (2020b). *Energy prices and costs in Europe - European Commission*. Consulted from https://ec.europa.eu/energy/data-analysis/energy-prices-and-costs_en

European Commission. (2020c). *Russia - Energy European Commission*. Consulted from https://ec.europa.eu/energy/topics/international-cooperation/key-partner-countries-and-regions/russia_en?redir=1

European Parliament. (2009). *Czech Presidency faces up to Gaza and gas dispute*. Consulted from https://www.europarl.europa.eu/sides/getDoc.do?type=IM-PRESS&reference=20090119IPR46568&format=XML&language=EN

Eurostat. (n.d.-a). *What are the European Green Deal and the Energy Union all about?*. Consulted on 20th January, from https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-1.html

Eurostat. (n.d.-b). *What is the share of renewable energy in the EU*. Consulted on 20th January, from https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-4c.html

Eurostat. (n.d.-c). *From where do we import energy and how dependent are we?*. Consulted on 20th january 2020, from https://ec.europa.eu/eurostat/cache/infographs/energy/bloc-2c.html

Femia, F., & Werrell, C. (2016). The climate and security imperative. *Handbook of Transitions to Energy and Climate Security,* 41–57. https://doi.org/10.4324/9781315723617-3

Gazprom. (n.d.). *Nord Stream pipeline routes in the Baltic Sea*. Consulted from https://www.gazprom.com/projects/nord-stream2/

Goettig, M., & Kelly, L. (2018, 27 January). *U.S. Says Planned Russian Pipeline Would Threaten European Energy Security.* Consulted from https://money.usnews.com/investing/news/articles/2018-01-27/uss-tillerson-says-nord-stream-2-pipeline-would-undermine-europes-energy-security

Goldthau, A. (2008). Rhetoric versus reality: Russian threats to European energy supply. *Energy Policy, 36*(2), 686–692. https://doi.org/10.1016/j.enpol.2007.10.012

Golthau, A. (2016). *Assessing Nord Stream 2: regulation, geopolitics & energy security in the EU, Central Eastern Europe & the UK*. Consulted from https://www.researchgate.net/profile/Andreas_Goldthau/publication/306013591_Assessing_Nord_Stream_2_regulation_geopolitics_energy_security_in_the_EU_Central_E

astern_Europe_and_the_UK/links/57aa492908ae42ba52ac32c2/Assessing-Nord-Stream-2-regulation-geopolitics-energy-security-in-the-EU-Central-Eastern-Europe-and-the-UK.pdf

Gracceva, F., & Zeniewski, P. (2014). A systemic approach to assessing energy security in a low-carbon EU energy system. *Applied Energy, 123*, 335–348. https://doi.org/10.1016/j.apenergy.2013.12.018

International Energy Agency. (n.d.). *Energy Security: Reliable, affordable to all fuels and energy* sources. Consulted from https://www.iea.org/topics/energy-security

Jansen, J. C., & Seebregts, A. J. (2010). Long-term energy services security: What is it and how can it be measured and valued? *Energy Policy, 38*(4), 1654–1664. https://doi.org/10.1016/j.enpol.2009.02.047

Johansson, B. (2013). A broadened typology on energy and security. *Energy, 53*, 199–205. https://doi.org/10.1016/j.energy.2013.03.012

Judge, A., Maltby, T., & Sharples, J. D. (2016). Challenging Reductionism in Analyses of EU-Russia Energy Relations. *Geopolitics, 21*(4), 751–762. https://doi.org/10.1080/14650045.2016.1222520

Karagianni, M. (2019, 20 February). *Turkmenistan looks to gas expansion*. Consulted from https://www.petroleum-economist.com/articles/politics-economics/middle-east/2019/turkmenistan-looks-to-gas-expansion

Keppler, J. H. (2007*). International relations and security of energy supply: risks to continuity and geopolitical risks*. Consulted from https://www.europarl.europa.eu/thinktank/en/document.html?reference=EXPO-AFET_ET(2007)348615

Korchemkin, M. (2019, 7 October). *With Gazprom's Nord Stream 2, Putin Is Getting Ready to Cut Off Natural Gas Supplies to Europe*. Consulted from https://foreignpolicy.com/2019/10/07/gazproms-nord-stream-2-will-help-putin-cut-off-natural-gas-supplies-to-europe/

Kruyt, B., van Vuuren, D. P., de Vries, H. J. M., & Groenenberg, H. (2009). Indicators for energy security. *Energy Policy, 37*(6), 2166–2181. https://doi.org/10.1016/j.enpol.2009.02.006

Larsson, R. L., & European Parliament. (2008). *Security Implications of the Nord Stream-project.* Consulted from https://www.europarl.europa.eu/meetdocs/2004_2009/documents/dv/afet_01042008_security/afet_01042008_securityen.pdf

Loskot-Strachota, A. (2015, 24 November). *The case against Nord Stream 2*. Consulted from https://energypost.eu/case-nord-stream-2/

Månsson, A., Johansson, B., & Nilsson, L. J. (2014). Assessing energy security: An overview of commonly used methodologies. *Energy, 73*, 1–14. https://doi.org/10.1016/j.energy.2014.06.073

McGrath, M. (2019, 13 September). *"Dirty secret" gas boosts climate warming*. Consulted from https://www.bbc.com/news/science-environment-49567197?fbclid=IwAR0k_JbnVsgK6hTBhtShgBvq2nmxSRFF1pAY75sR2ZNktzkQD6JX7plPS_0

Ministerie van Algemene Zaken. (2020, 21 February). *Groninger gaswinning gaat dit jaar nog verder onder het veiligheidsadvies van toezichthouder SodM*. Consulted from https://www.rijksoverheid.nl/onderwerpen/gaswinning-in-groningen/nieuws/2020/02/21/groninger-gaswinning-gaat-dit-jaar-nog-verder-onder-het-veiligheidsadvies-van-toezichthouder-sodm

NAM. (n.d.). Totaal uit Groningen-gasveld gewonnen gas. Consulted from https://www.nam.nl/feiten-en-cijfers/gaswinning.html#iframe=L2VtYmVkL2NvbXBvbmVudC8_aWQ9Z2Fzd2lubmluZyN0YWItdGFiLWRvd25sb2Fkcy1iMTQzNDlkMzA3MzA0MDFiOTcwNWIzNDI0ZjczYTYyOQ

Norsk Petroleum (2020). *Exports of Norwegian oil and gas.* Consulted on 21th January, from https://www.norskpetroleum.no/en/production-and-exports/exports-of-oil-and-gas/

NOS. (2019, 26 December). *"Rusland bouwt met eigen schip verder aan gaspijpleiding Nord Stream 2"*. Consulted from https://nos.nl/artikel/2316244-rusland-bouwt-met-eigen-schip-verder-aan-gaspijpleiding-nord-stream-2.html

Pacesila, M., Burcea, S. G., & Colesca, S. E. (2016). Analysis of renewable energies in European Union. *Renewable and Sustainable Energy Reviews, 56*, 156–170. https://doi.org/10.1016/j.rser.2015.10.152

Pirani, S., Stern, J., & Yafimava, K. (2009). *The Russo-Ukrainian gas dispute of January 2009: a comprehensive assessment*. Consulted from https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/NG27-TheRussoUkrainianGasDisputeofJanuary2009AComprehensiveAssessment-JonathanSternSimonPiraniKatjaYafimava-2009.pdf

Ratner, M., Belkin, P., Nichol, J., & Woehrel, S. (2013). *Europe's energy security: Options and challenges to natural gas supply diversification*. Consulted from

https://www.researchgate.net/publication/292562359_Europe's_energy_security_Options_and_challenges_to_natural_gas_supply_diversification

Sovacool, B. K., & Brown, M. A. (2010). Competing Dimensions of Energy Security: An International Perspective. *Annual Review of Environment and Resources, 35*(1), 77–108. https://doi.org/10.1146/annurev-environ-042509-143035

TASS. (2018, 24 May). *Nord Stream 2 opponents unable to stop project implementation, says Russian envoy.* Consulted from https://tass.com/economy/1006064

Teffer, P. (2015, 18 December). *Tusk: Nord Stream II doesn't help*. Consulted from https://euobserver.com/energy/131605

The Business Year. (2012, 23 augustus). Scalability as drawn. Consulted from https://www.thebusinessyear.com/azerbaijan-2012/scalability-as-drawn/interview

The European Union and the Russian Federation. (n.d.). Consulted from https://eeas.europa.eu/topics/energy-diplomacy/35939/european-union-and-russian-federation_en

von Hippel, D., Suzuki, T., Williams, J. H., Savage, T., & Hayes, P. (2011). Energy security and sustainability in Northeast Asia. *Energy Policy, 39*(11), 6719–6730. https://doi.org/10.1016/j.enpol.2009.07.001

Whist, B. S., (2008). *Nord Stream: Not Just a Pipeline*. Consulted from https://www.osti.gov/etdeweb/servlets/purl/950539

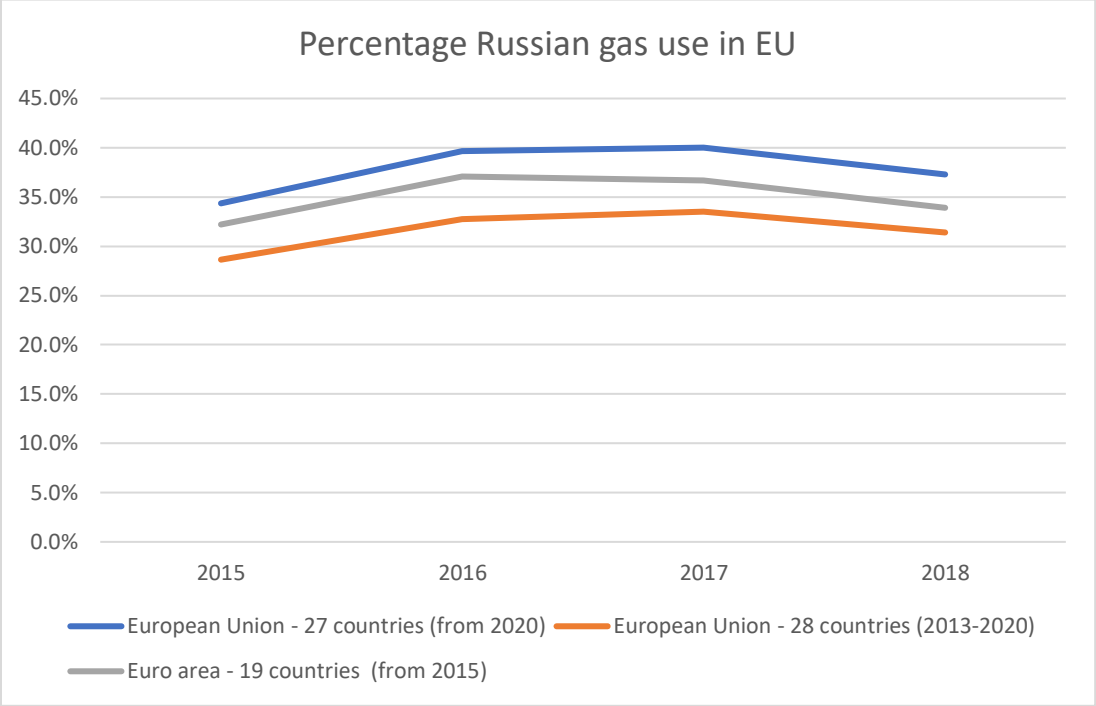
Widger, P., & Haddad, A. (2018). Evaluation of SF6 Leakage from Gas Insulated Equipment on Electricity Networks in Great Britain. *Energies, 11*(8), 2037. https://doi.org/10.3390/en1108203

Ycharts (n.d.). *Turkmenistan Natural Gas Production*. Consulted from https://ycharts.com/indicators/turkmenistan_natural_gas_production

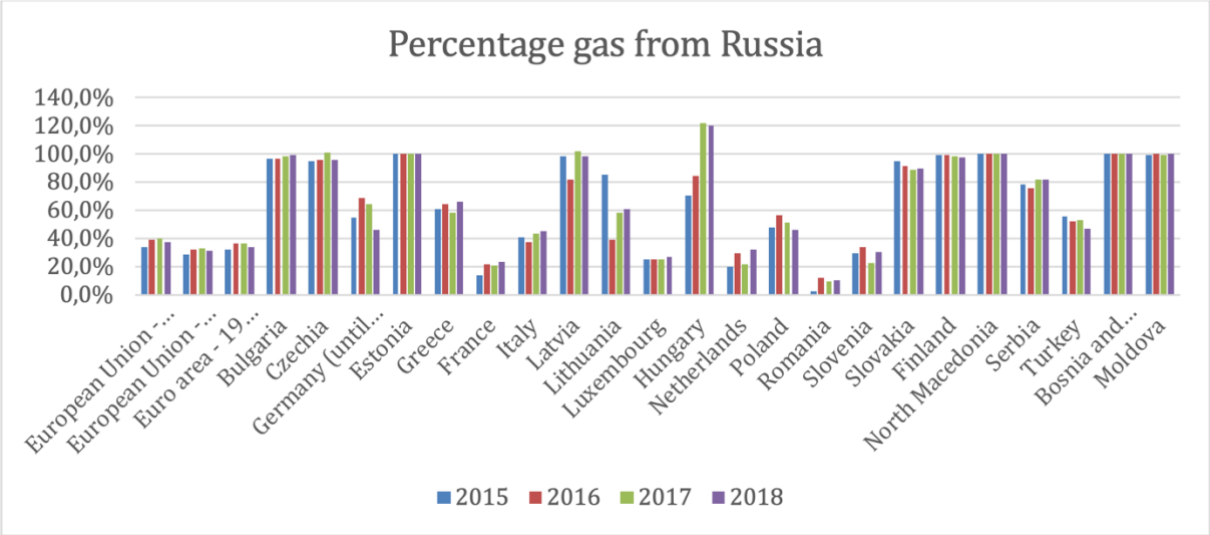
Appendix A

GEO/TIME	2015	2016	2017	2018
European Union - 27 countries (from 2020)	34,4%	39,7%	40,0%	37,3%
European Union - 28 countries (2013-2020)	28,6%	32,7%	33,5%	31,4%
Euro area - 19 countries (from 2015)	32,2%	37,1%	36,7%	33,9%
Belgium				0,5%
Bulgaria	96,9%	96,5%	98,6%	99,1%
Czechia	94,8%	95,6%	101,0%	96,4%
Denmark				
Germany (until 1990 former territory of the FRG)	55,3%	68,9%	65,1%	46,4%
Estonia	100,0%	100,0%	100,0%	100,0%
Ireland				
Greece	61,5%	64,3%	58,4%	66,4%
Spain				2,8%
France	14,4%	21,7%	20,9%	23,6%
Croatia				
Italy	41,0%	37,8%	44,0%	45,2%
Latvia	98,6%	82,0%	102,0%	98,8%
Lithuania	85,6%	39,5%	58,1%	61,0%
Luxembourg	25,1%	25,1%	25,1%	27,0%
Hungary	70,5%	84,2%	122,4%	120,2%
Malta				
Netherlands	20,0%	30,0%	21,6%	32,7%
Austria				
Poland	48,0%	57,0%	51,2%	46,4%
Portugal				
Romania	1,6%	12,8%	9,9%	11,0%
Slovenia	29,9%	33,8%	22,9%	31,1%
Slovakia	95,0%	91,7%	89,4%	89,5%
Finland	99,7%	99,6%	98,7%	97,5%
Sweden				
United Kingdom			0,1%	1,9%
Liechtenstein				
Norway				
North Macedonia	100,0%	100,0%	100,0%	100,0%
Serbia	78,8%	75,6%	82,1%	82,1%
Turkey	56,0%	52,8%	53,4%	47,5%
Bosnia and Herzegovina	100,0%	100,0%	100,0%	100,0%
Moldova	99,7%	100,1%	99,9%	100,2%
Ukraine	18,2%			
Georgia				

Appendix B


Percentage Russian gas use in EU
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
2015
2016
2017
2018
European Union - 27 countries (from 2020)
European Union - 28 countries (2013-2020)
Euro area - 19 countries (from 2015)

Appendix C


Percentage gas from Russia
140,0%
120,0%
100,0%
80,0%
60,0%
40,0%
20,0%
0,0%
European Union -...
European Union -...
Euro area - 19...
Bulgaria
Czechia
Germany (until...
Estonia
Greece
France
Italy
Latvia
Lithuania
Luxembourg
Hungary
Netherlands
Poland
Romania
Slovenia
Slovakia
Finland
North Macedonia
Serbia
Turkey
Bosnia and...
Moldova
2015
2016
2017
2018