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THESIS

«IMPORTS OF US LNG IN THE EU: A GAME – CHANGER FACTOR TOWARDS THE SECURITY OF SUPPLY»

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This dissertation is dedicated to my family.

For their endless love, support and encouragement.

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CHAPTER 1: Introduction

The Aim

The aim of this thesis is to consider the U.S LNG imports into the EU as a factor determining the rules for secure supply. Europe is facing certain challenges as it is called upon to meet its future energy needs. These challenges include the rapid rise in world demand, the competition emerging from the supply of energy by emerging economies such as China and India, the current volatility in energy-producing regions such as the Middle East, the divided internal European energy market, and the current need to change fuels to cope with changes in the environment. The result is that security of energy supply is a key priority for the European nations and the European Union (EU).

The Methodology

To carry out the comparative work and to achieve the stated objective we follow the methodology of literature review related to US LNG imports into the EU and its importance for both the EU and the US. A. reflecting the current situation concerning the EU gas supply, as well as the future gas supply planning.

The Structure

The second chapter of the thesis discusses certain basic introductory terms, such as energy security, U.S perspectives, various oil crises, future energy-related challenges, and population and consumption. The third chapter discusses various points of view related to LNG trade between the EU and the US, EU Energy Policy as well as Extra-EU imports of natural gas & LNG by source and how to quantify the EU's dependence on imported Natural Gas and how to measure the EU's dependence on Natural Gas imports - Independence indices. Next, we analyze the potential sources of alternative supplies and various pipeline designs that can supply gas throughout Europe. Finally, this paper examines the U.S's LNG Strategies and the U.S Perspectives for the supply of LNG to the European market.

The Contribution

In the EU, there are recent laws to promote renewable energy sources such as wind, solar, hydroelectric, geothermal, biomass and biofuels which are alternatives to fossil fuels and aid to reduce greenhouse gas and greenhouse gas emissions. In doing so, Europeans appear to be stepping up efforts to reduce the EU's dependence on external oil and gas suppliers

while safeguarding the natural environment. Each Member State is required to draw up comprehensive national plans to achieve this objective (Rogers, 2015).

However, Europe's energy demands are high and renewables are a long-term energy plan. Gas is an important and cost-effective solution to Europe's needs, with Russia being part of the largest supplier. Concerns over Europe's heavy dependence on Russian gas have mobilized America, which has increased its LNG exports to Europe, while eastern Mediterranean gas fields are another factor that will play an important role in Europe's energy supply in the coming years (Siddi, 2018).

CHAPTER 2: Europe's Energy Needs

2.1. Introduction

Russia is a major energy supplier for Europe, so designing a policy to address Russia's (military, political, commercial) concerns endangers energy imports.Russia's confidence in America, in the energy sector, and external relations has led it to intimidate its trading partners, including the EU. In 2012, gas production in the US was over 29 trillion cubic feet (Joskow, 2013). Horizontal drilling and hydraulic fracturing, or "fracking", has helped American workers release natural gas from shale deposits which was previously unprofitable. While the implications for the fracking environment are being discussed, gas production is booming

In the US, gas production has increased by 23% between 2005 and 2012, resulting in a 46% drop in prices, while switching from carbon to natural gas has had a positive impact on the environment. If the U.S. allies are helped to do the same the aim to achieve a global reduction in the emission of greenhouse gases may be achieved. The natural gas industry hopes to export LNG but there is a requirement for export licenses to countries that do not have a free trade agreement with the United States. Exporting liquefied natural gas (LNG) to US allies can make them more energy-efficient, reduce the contracts with the oil market in Asia, and reduce the impact of unfriendly countries using energy as a tool for their policy (Rogers, 2015).

2.2. Energy Security

According to the International Energy Agency (IEA), energy security is defined as the uninterrupted availability of energy sources at affordable prices (Kruyt et al., 2009). Energy security is multidimensional. In the long run, energy security has to do with the problem of proper investment in energy supply following economic developments and sustainable environmental needs. In the short term, energy security aims to make the energy system capable of responding immediately to sudden changes in the balance between supply and demand. The lack of energy security is causing several economic and social problems, such as the natural shortage of energy prices that either become uncompetitive or become overly volatile and also harms society because countries use energy as a political and military weapon (Barten, 2005).

Many issues raise concerns about security of supply. Concerns about the security of supplies are mainly caused by the financial loss from extreme price peaks. Concerns about the lack of supply are more present in energy markets where the transmission system needs to be balanced, such as electricity and to some extent gas. Energy security is an important area of national security and relates to accessing and receiving energy in the required quantity and quality at reasonable prices. In a narrower context of energy security, the military security sector is needed to ensure that the military of a crisis state fulfills its responsibilities in the event of a national emergency, military attack or natural disaster.

In summary, the definitions of energy security for countries importing energy materials mainly consist of (Chow et al., 2003):

1. Access to a sufficient amount of energy resources.
2. At an adequate price.
3. In appropriate form.

Many factors affect energy security. The depletion of stocks or the disruption of supply lines affects the country's decisions and its energy choices. The second factor is environmental perspectives and protests for environmental changes from the exploitation of energy resources. Also, sharp increases in energy costs require additional energy imports at a higher price, and finally there is the geopolitical factor, as energy security affects the political instability of energy-producing areas.

In conclusion, a country's energy security is measured using the Energy Security Index (ESI): This is based on (Chow et al., 2003):

1. Availability: The domestic supply of oil and gas in a country and the level it depends on imported resources.
2. Diversity: The range of energy resources used.
3. Tension: The extent of a country's economic dependence on oil and gas.

2.3. The U.S Perspective

Gas was not a cause for concern in shaping US fo reign policy. From last year, US imports came mainly from Canada, and the country was an importer of clean gas, with little concern for geopolitical or energy security. In the 2000s, the United States was concerned that they could depend on liquefied natural gas (LNG) imports, but that

did not last long. The US took the opportunity to become a LNG producer. For the past ten years, the US gas industry has planned to build infrastructure to import liquefied natural gas (LNG), and when gas production declines, the country will take one of the top three LNG exports in the world. This will have a major impact on the geopolitical relations between the countries. Besides, the growth in the use of shale oil and gas enables these exports to change the US energy situation. Also, European countries must change their energy supplies without using Russian gas, creating the start of US gas exports to Europe.

Geopolitics of shale gas and U.S. LNG exports to Europe (Medlock , 2012):

1. Europe is the second-largest gas consumer after the US
2. The rapid decline in domestic gas production
3. Increase in gas imports (currently 70% of demand) shifts imports to improve the security of supply
4. EU has well-developed LNG import infrastructure (26% utilization rate)
5. Additional LNG terminals in progress, some with EU support.

LNG exports from the U.S. to Europe and the development of shale gas use have a positive impact on EU energy security. Europe is thus changing the countries of energy supply and supports the use of alternative energy goods. Also, the most important is the reduction of European dependence on Russian energy imports. Russia is the largest producer of gas and oil in recent years. Gas exports to Europe support Russia's economy. Russia is thus using gas distribution as a means to punish states such as Poland, Romania and other European countries (Medlock et al., 2014).

The development of shale gas use and US gas exports and, of course, EU legislation on climate change and environmental protection to reduce energy dependence on Russia has altered geopolitical balances and caused conflicts and new "friendships" between countries. In the first place, the Ukrainian crisis halts EU co-operation in the construction of the South Stream project, Russia's gas program to supply gas to southern Europe that does not cross Ukraine and aims to bypass Ukraine. This is leading to a new crisis and a major conflict between Ukraine and Russia, which may revitalize European interest in shale gas and LNG and smooth this conflict (Schubert et al., 2014).

Increase in US gas production and US gas exports to the EU in 2016 improved security of gas supply in Europe and worldwide. The LNG is an important part of the EU's diversification strategy. The EU is the second largest single gas market in the world after the US, and is an advantageous choice for the US. US LNGs, if competitively available, can play an important role in delivering gas to the EU, enhancing its diversification and energy security (Medlock et al., 2014). From an economic standpoint, there is no indication today that the US LNG will be able to reduce the importance of the short- and long-term marginal costs of the Russian gas pipeline to the European market. The US LNG remains too expensive to be competitive.

2.4. Future Challenges

Firstly, the lack of investment and research in 2015-2017 will probably lead to a shortage of new supplies that will occur in the short term. While prices are recovering, companies are still paying off debt, so be careful about increasing investment in the near future. Secondly, global warming, and the inevitable reaction to greenhouse gas emissions, will force the change in the amount of oil consumption and favor the use of lower greenhouse gas fuels. The pressures of global warming and the development of economically competitive new technologies will lead to peak oil demand in the near future. Each of the above three points will lead to the production of light hydrocarbons as opposed to heavier hydrocarbons, leading to an imbalance that will cause the industry to have trouble supplying the necessary petroleum products (Simshauser & Nelson, 2012).

The increase in energy consumption is related to two important phenomena: population growth and increase in per capita consumption. Europe is the second-largest energy consumer after the US, however the imbalance between energy demand and energy supply in Europe has a negative impact on its energy industry and therefore promotes alternative sources of energy, such as renewable energy. Thus, producers of alternative energy sources, change its energy goods and thus achieve its energy security (Okyay et al., 2014).

2.5. Renewable Energy Sources

Renewable sources of energy (wind, solar, hydro, ocean energy, geothermal, biomass and biofuels) are substitutes or alternatives to fossil fuels and aid to reduce the greenhouse gas emissions and to diversify greenhouse gas emissions. Lessening reliance on

problematic and insecure fossil fuel markets, specifically oil and gas. In the EU, recently there are legislations to promote renewable energies. While the future policy framework for the post-2030 period is under discourse.

EU energy approach intends to advance the improvement of new and sustainable energy sources to more readily adjust and incorporate climate change destinations into a new market plan. The current Renewable Energy Directive, embraced under the co-decision procedure on 23 April 2009 (Directive 2009/28 / EC, repealing Directives 2001/77 / EC and 2003/30 / EC) expresses that the required offer 20% of EU energy utilization should, by 2020, be secured by RES. Simultaneously, all Member States must cover 10% of their transport fuels from RES by 2020. The Directive likewise indicates different systems that Member States can actualize to accomplish their targets (support schemes, guarantees of origin, joint projects, cooperation between the Member States and third countries), including the sustainability criteria for biofuels. The Directive sets out the national renewable energy targets for every nation, considering the beginning stage and the general potential for sustainable energy. These range from 10% in Malta to 49% in Sweden (Iniyan et al., 2020). EU countries are characterizing how they expect to accomplish these targets and the general guide for their sustainable energy approach in their national sustainable energy activity plans. Progress towards accomplishing national targets is estimated at regular intervals when EU countries distribute national advancement covers sustainable energy.

2.6. Energy Efficiency

By utilizing energy all the more efficiently and by bringing down costs, Europeans can lessen the cash they spent through on effort and decrease the EU's reliance on outer oil and gas providers while securing the natural environment. Energy efficiency should be improved all through the energy production chain to accomplish the above advantages. Simultaneously, the advantages of energy investment funds must exceed the expenses, for instance, those after renovations. In this way, EU estimates center around territories where the potential for reserve funds is most noteworthy, for example, structures or where a planned methodology is required (Kumar et al., 2017).

In 2012, as per Directive 2012/27/EU on energy productivity, the EU set a 20% energy reserve funds to focus by 2020 (contrasted with anticipated energy use in 2020). Specifically, this implies lessening the EU's last energy utilization to close to 1.086

million tons of oil equivalent (Mtoe) and primary energy consumption to a limit of 1,483 Mtoe. This is proportional to shutting down 400 force stations (Ozcan & Ozturk, 2019). To accomplish this, EU countries were required to set their very own demonstrative national energy efficiency focuses by distributing 3-year National Energy Efficiency Plans (ESIAs) and yearly advancement reports. In December 2018, the reexamined Energy Efficiency Directive and changed the EU Directive (2018/2002), by updating some particular arrangements and presenting new components in arrangements. It came into power with a provision for conceivable upward modification by 2023 The 32.5% objective for 2030 means a final energy consumption of 956 Mtoe and/or primary energy consumption of 1,273 Mtoe in the EU-28.

Under the new administration rules, every Member State is required to set a ten-year Integrated National Energy and Climate Plan (NECP) for 2021-2030, sketching out how it means to accomplish its 2030 energy objectives. efficiency and sustainable energy. Submitting NECPs in mid 2019, the Commission distributed a point by point assessment of these draft designs in June 2019 with nation proposals. As indicated by the guideline, Member States ought to finish their particular NECPs before the end of 2019.

To orchestrate and harmonize the EU's internal energy market, measures on market access, transparency and regulation, customer insurance, interconnection support and satisfactory degrees of supply have been embraced since 1996. The point of these measures is to construct an increasingly aggressive, client-driven, adaptable and non- unfair EU power showcase with advertise based stock costs. In doing as such, they fortify and expand the privileges of individual clients and networks, address energy destitution, explain the jobs and obligations of market players and controllers, and address the issue of security of power supply, naturally gas and oil, and the issue of creating trans-European power and gas transmission systems (Ozcan & Ozturk, 2019).

In the energy division, the finish of the EU inward market requires the removal of numerous barriers and obstructions to exchange; tax assessment, pricing policies and standards; and environmental legislation and security. The goal is to guarantee a working business sector with reasonable market get to and an elevated level of purchaser security, just as sufficient degrees of interconnection and production limit (Kumar et al., 2017).

By permitting free movement and development of electricity where required, society will progressively profit by rivalry and cross-border exchange. They will coordinate the ventures required for security of supply while lessening carbon in the European energy system.

Moreover, the consumer is at the core of the progress to clean energy, and the new principles take into consideration the dynamic interest of consumers while making a solid structure for consumer assurance. The Directive on basic standards for the inward market in electricity (EU) 2019/944 supplanting the electricity order (2009/72/EC) and the new guideline on the interior market in electricity (EU) 2019/943, (Regulation EC/714/2009), present another edge for power plants qualified for endowments as tonnage systems (affirming the eliminating of appropriations for limit producing 550gr CO2/kWh or more) (Boscán, 2020).

The new guidelines help accomplish the EU's objective of being the world chief in sustainable energy production, enabling more noteworthy adaptability to oblige a developing portion of sustainable energy on the lattice. The progress to sustainable energy and the expansion in electricity supply are imperative to accomplishing carbon lack of bias by 2050. The upgrade of the electricity market will likewise help make employments and development (Sencar et al., 2014).

2.7. Conclusion

European energy security, once the EU imports energy, depends on access to a sufficient amount of energy resources, its price advantage, and its proper form. For each country, energy security is measured using the ESI which is dependent on the availability of diversity and the economy's dependence on oil and/or gas. Europe is the second-largest consumer of natural gas after the US, with a rapid decline in domestic gas production. Increasing physical imports is shifting imports to improve the security of supply. In general, the EU has well-developed LNG import infrastructures. and in the world in general, leads to increased energy consumption. Oil and gas supplies have been increasing in recent years to meet the needs of citizens and states. As a result, the depletion of these energy resources will at some point end. Western society has experienced a frenetic development over the last two centuries, thanks to its support of the necessary amounts of energy.

CHAPTER 3: Literature review of energy security

3.1. Introduction

Europeans need safe, sustainable and affordable energy sources. Our lifestyles make energy vital for the necessary daily activities and without it we and our businesses cannot function. We need energy for lighting, heating, transport and industrial production. In addition to our basic needs, we also need energy for washing machines, computers, televisions, and other products that we now use without thinking. However, securing the energy required, at an affordable price, both now and in the future, is not so easy.

The European Union's dependence on energy imports - in particular oil and, more recently, natural gas - is the basis on which security of energy supplies are based. Many electricity networks and gas pipelines have been built for national purposes and do not have a good cross-border connection. Electricity and gas should be able to flow seamlessly through networks across Europe. Energy should also be transported, often by ocean or underwater, to the place to be used. This requires a network of power plants that can generate uninterrupted electricity for many decades. This requires enormous technological, logistical and financial resources. However, the lack of access to a pan-European market prevents investors from investing in energy infrastructure. This has the effect of delaying investment in new power plants to replace the old and outdated ones (Birchfield & Duffield, 2011).

The proposed US LNG export programs will make the United States the largest LNG exporter. In recent decades, the US has been producing LNG and this is the opportunity to change Europe's energy policy. Any volume of LNG from the United States will benefit the market, including Europe, by offering a new supplier to consumers. The key or advantage of the US LNG is the price. The United States is one of the few countries that does not link the price of gas to the price of oil and, therefore, can push for the decoupling of these two commodities.

This thesis looks at primary energy production within the EU and, as a result of production lag behind consumption, the EU's growing dependence on third country energy imports. This chapter will discuss EU gas needs, as well as gas imports mainly from the US and Russia (Medlock et al, 2014).

3.2. Energy Security and Sources Distribution

The International Energy Service defines energy security as the smooth availability of energy at acceptable prices. “In the international energy market, the natural total inability to find energy products has been virtually eliminated. Therefore, the main practical dimension of the term concerns the possibility that, when prices are so heavily influenced by unwanted changes in the international system (wars, natural disasters, economic crises), the state continues to feed without serious economic, social consequences and at competitive prices” (Jacoby, 2009: 345-346). “Energy security is more versatile than many policy makers or even students can realize. In addition, security may have an objective and subjective dimension. While the objective dimension may include factors that can be measured by external criteria, the subjective dimension can be defined as the individual's perception of what is safe. EU energy security policy deals with both internal threats (eg bad infrastructure and inadequate markets) and external threats (eg dependence on unreliable imports)” (Bengt, 2013: 64).

“Language and writing create good practices and policies. Security is never inherent, but rather a phenomenal discourse created and supported by ideologies, power and politics. The concept of energy security is not a given, but rather an evolving social perception shaped by the tactics used by actors who use linguistic and rhetorical schemes to express social vulnerabilities” (Fischhendler & Nathan, 2014: 153).

Another interesting concept for energy and timeliness is the policy of protecting critical infrastructure which is often used within its civil protection policy area. Energy is often promoted as one of the vital functions of society and critical infrastructure along with health protection, the payment system, etc. (Johansson, 2013).

Energy diversification refers to the use by a state of multiple sources of energy to feed the national economy, public services and the needs of individual consumers of the state. Energy diversification aims to reduce the state's dependence on its energy suppliers, optimize the economic supply of energy products, develop the competitiveness of its economy, as well as its own national independence and ensure its political status. Energy diversification has been associated, since the oil crisis of the 1970s, with investments in the extraction, transportation and supply of energy products, the development of both domestic production and the search for different suppliers of the same product, as well as the development of alternative renewable energy sources and nuclear energy.

Seamless timing, quality, quantity and prices of energy products are the main competitive tool a national economy must have in order to be competitive and consequently viable in the 21st century. The diversification of energy sources thus becomes a tool not only of economic necessity but also of geopolitical and strategic importance within a global energy market.11 World energy trade is the sum of all net exports for each, globally traded fuel or carrier (Jewell et al., 2014).

By applying the best and most established practices in the international energy sector, the Union is striving to enhance its energy security (Keating, 2012). In the EU blueprint for a unified European energy network, "diversification of suppliers and routes, especially for gas and oil, is seen as key to increasing competition and enhancing security of supply. Diversification of sources and routes , is part of a broader energy strategy where energy efficiency, renewables, smart electricity grids have a role to play. reducing uncertainty, in particular, securing a defined level of security by diversifying supply and production activities (Babonneau et al., 2012).

Chester describes the concept of energy security as grand and slippery, referring to its ability to symbolize many different dimensions at the same time (Mansson et al., 2014). Cherp and Jewell will identify energy security as the low vulnerability of critical energy systems (Cherp & Jewell 2014). Sovacool talks about this multidimensional phenomenon involving interlinked energy reserves and a mixture of fuel consumption, diversification and justice, price stability and predictability, technological innovations and the environment, military security and diplomacy, global economy and transport, global economy and electricity, global transport and electricity, governance and investment, etc. A mix of terms unique to each country and commensurate with the individual characteristics of each state (Sovacool & Mukherjee, 2011). Energy security analysis extends to emerging issues including energy efficiency, the provision of affordable energy services, and enhancing the viability of energy technologies. Research and development of new and innovative energy systems, ensuring equal access to energy services, and improving transparency and participation in energy decision-making are all key elements of energy security (Sovacool & Mukherjee, 2011).

The timing of energy security also determines the impossibility of a clear and clear definition. The concept of energy security differs in the short, medium and long term, because the existence, the probability and consequences of the various risks or threats to energy supply vary over time. Thus, they will never reach a final state of energy security as such. A similar situation is the competition process.

Businesses are constantly striving to create and maintain the best conditions for their profitability.

To do this, businesses will constantly strive to take advantage of advances in technology, production, distribution, access to information and consumption. It is a never ending process. Similarly, policy makers and governments are taking action as they seek to tackle short and long- term obstacles and have a corresponding impact on energy security. But the factors affecting energy security, however, are constantly changing. As a result, the final state of energy security will not be achieved because its nature is constantly evolving.

Energy security, both as a condition and as a condition, is the dynamically evolving mix of factors that emerge from the daily developments in the political, economic and social context of the modern energy regime (Cherp & Jewell, 2014). As energy plays an important role in state security and the sustainability of the economy of any organization or state, energy security becomes a necessity that must be promoted not only by economic, legal, political and institutional measures, but also by educational measures such as environmental awareness and social alertness (Thiengkamol, 2011).

Energy security is a phenomenon saturated with the socio-economic and cultural system. Energy security concepts, as we are told by Knox-Hayes, Brown, Sovacool and Yu Wang (Knox-Hayes et al., 2013), are shaped by socio-demographic and local characteristics. These perceptions form a set of subjective perceptions of the subject which in turn determine the political response to the issue. Given the complexity, the political nature of energy security, the emerging risks to energy security and differentiated socio-economic perceptions, it is important to have a complete picture of the social and environmental factors that determine energy security perceptions at a given time and a given time place.

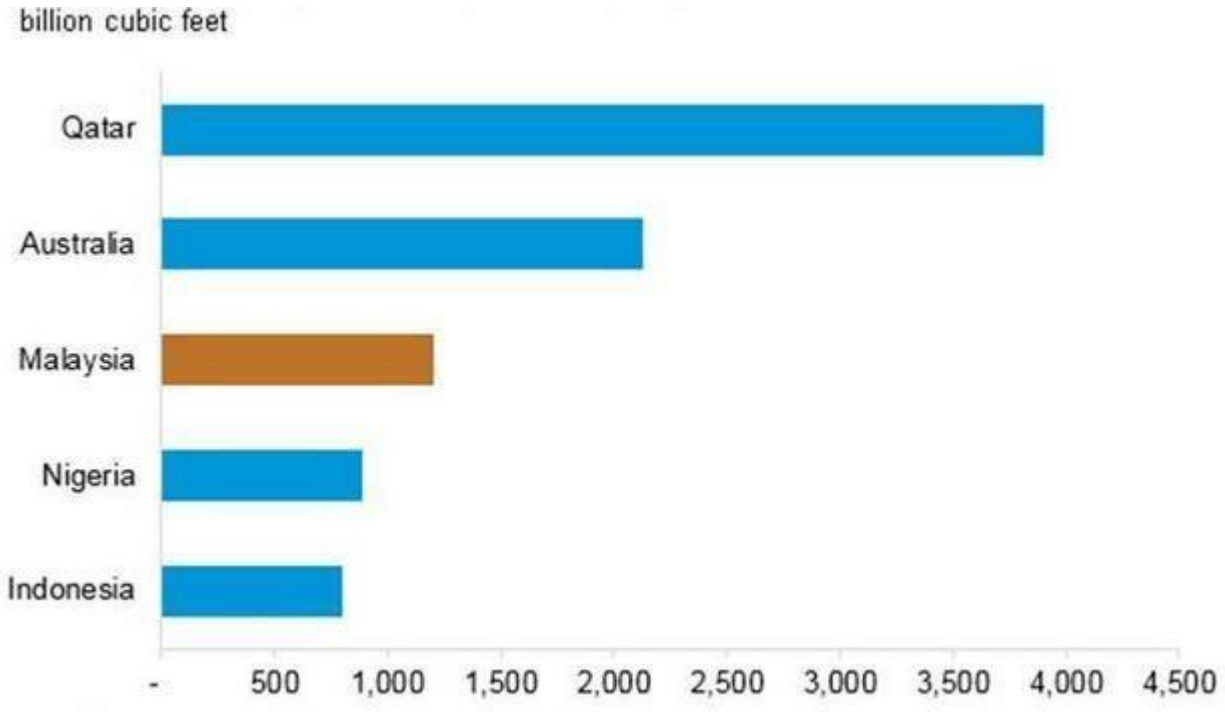
3.3. The role of LNG in European energy security

In recent years, and especially after 2014, the Global Liquefied Natural Gas (LNG) Market has evolved, and can now be described as a 'mature' global market. With many sources of LNG exporting countries emerging and predicted to come in the coming years, such as the US, Australia and Russia, there is a growing trend of competition among these countries for who will gain the largest market share. Of course, let's not forget Qatar's dominant position as the largest exporter in the liquefied natural gas (LNG) market.

The global market for natural gas in 2016 was 706 billion cubic meters, of which 39% was LNG, ie 282.4 billion cubic meters of gas was shipped in LNG form. It is also predicted that the world market for gas trading in 2040 will be 1,230 billion cubic meters or 1,230 trillion cubic meters, of which 59% will be marketed in LNG form.

Worldwide liquefied natural gas (LNG) trade will play an important role in the future energy security of Europe and Southeast Asia.

Figure 1. The first countries to export Liquefied Natural Gas (LNG) for 2016.

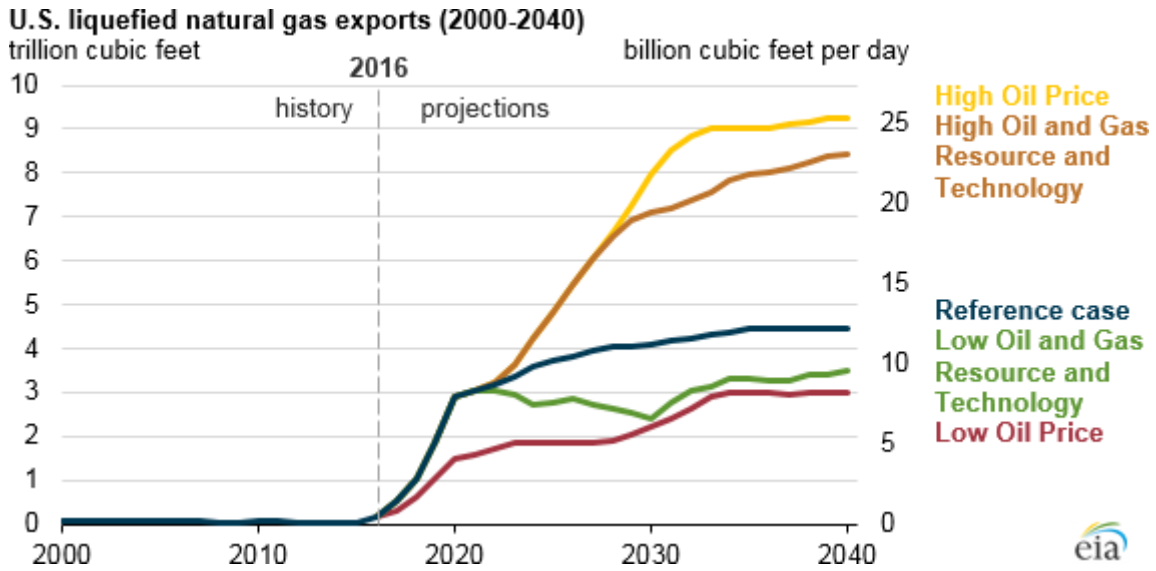


Source: (Atabani et al., 2011)

Figure 1 above shows the countries with the most LNG export quantities for 2016: Qatar, Australia, Malaysia, Nigeria and Indonesia. As shown in the diagram above, Qatar was far more likely to export LNG, compared to other countries (Atabani et al., 2011).The Liquefied Natural Gas market is a complex market that will bring many geopolitical upheavals over the next fifteen years to the global energy geopolitical ecosystem.

Projecting the US global geopolitical hegemony not only militarily through aircraft carriers but also financially / energetically through LNG export ships, which will deliver shale gas from the US to the rest of the world. Of course, in this section we should emphasize that maintaining and increasing US gas production would have to spend tens of billions of dollars on exploration and production of conventional and unconventional gas fields. Shale gas production is a difficult process, and keeping production high and commercially high will be one of the major challenges for the American oil industry for the next decade. Mining costs will play an important role in the final sale price of US LNG on world markets and in whether it will be competitive.

Figure 2. US Liquefied Natural Gas (LNG) Exports from 2000 with Forecast to 2040.



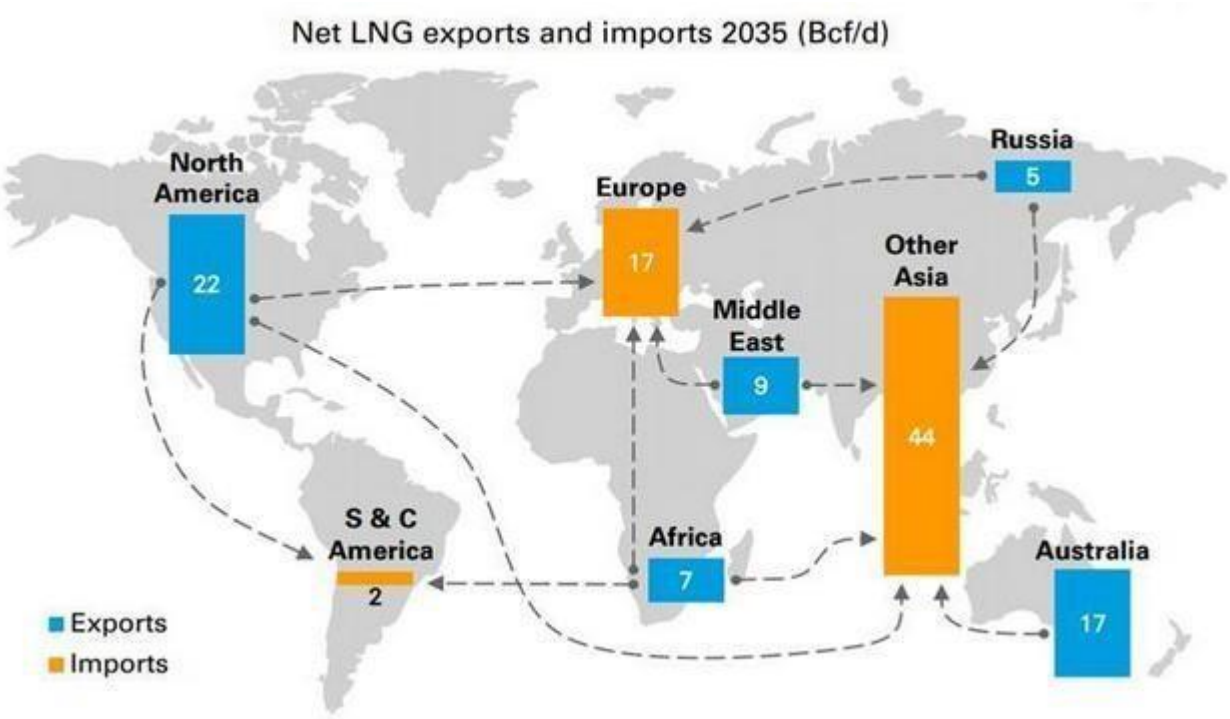
Source: (Conti et al., 2016)

There is currently only one active LNG export station, Sabine Pass, in Louisiana by the well-known Cheniere Energy Company. Another 5 new LNG export stations / terminals are yet to start operating by 2020. According to the US Energy Information Administration (EIA, US Energy Agency), the US will become the world's third largest LNG exporter in 2020, after Qatar and Australia, after the construction of the above stations / terminals.

US LNG, compared to other suppliers, has the advantage of domestic direct prices that are less sensitive to world oil prices. If we reverse the conditions and put a low-oil scenario worldwide or more pessimistic assumptions about gas and oil technology and resources in general, LNG exports, though still remain below the benchmark levels by 2040, continue to grow (Figure 2) (Conti et al., 2016).

The largest LNG importers by 2040 will be Europe and Asia: In particular, China and India are expected to cover most of the future demand for LNG. One of the key principles governing the future foreign policy of China, India, and Europe will be energy security and the uninterrupted flow of energy goods, which will focus heavily on gas and secondary oil. Essentially, one of the most important principles of US foreign policy for the last 70 years, the uninterrupted flow of oil / energy to their country, will be adopted by all major energy importers by 2030 (Figure 3). Countries such as China, India, Japan and Great Britain already have or will receive new aircraft carriers in the coming years, which will not only be used to promote military power but also as a deterrent to disrupting the free flow of energy and trade to these countries (Dudley, 2018).

Figure 3. Worldwide Liquefied Natural Gas (LNG) Market Forecast for 2035 according to BP.



Source: (Dudley, 2018)

Russia is already participating in the global LNG market as an exporter, and its participation will increase in the coming years, which plays an important role in Eurasia's geopolitical chessboard. Russia has also announced several future LNG export stations / terminals that are expected to be built in the next 15 years.

Replacing coal / lignite with natural gas as the main fuel for electricity production worldwide will further boost global gas demand, and is an unpredictable factor that can also increase global demand for LNG. This trend will also increase because of the recent increase in LNG storage space. The storage tanks will in the future be placed on power plants using gas as the main fuel in all modern ports and train refueling stations, since LNG will be used as future fuel by modern trains and ships.

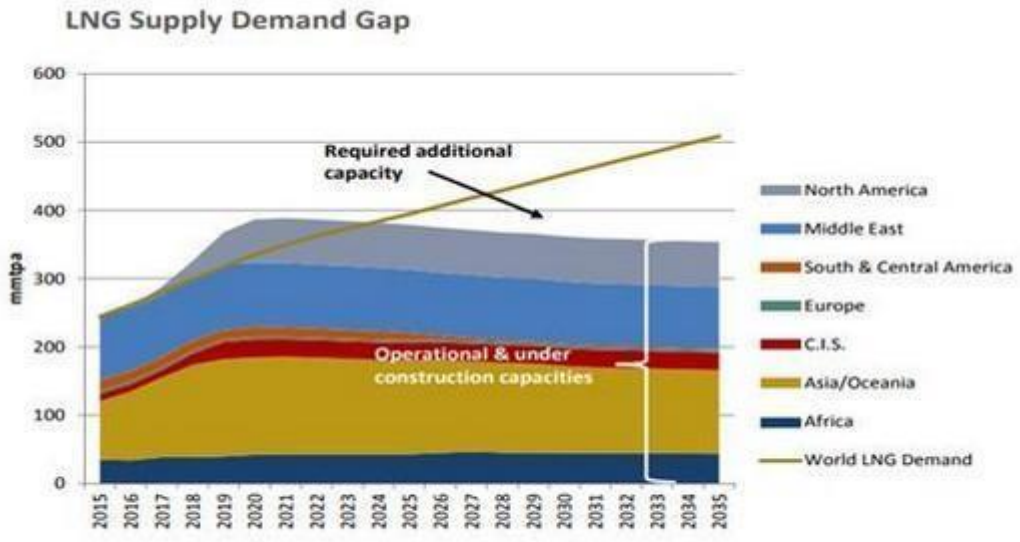
Major upheavals in the global gas market, due to the large development of the global LNG market. These rearrangements, according to the International Energy Agency (IEA), will be the global competition between Russia, Australia, the US, and Qatar for which country will have the largest market share in the global LNG market.

Figure 4. Global Liquefied Natural Gas (LNG) Prices, October 2011 - December 2017.

Source: (Winter et al., 2018)

As we can see from the graph above (Figure 4), Global Liquefied Natural Gas (LNG) prices have changed quite a bit in recent years. Specifically from an average price of $ 15-17 / mmBTU in October 2013 it dropped to an average price of $ 7 -10 / mmBTU in October 2017. Of course, global surveys and studies report that the forecast for global liquefied natural gas prices (LNG) are optimistic for countries with large gas imports and pessimistic for countries with large gas exports (Winter et al., 2018).

Figure 5. Prospects for the Global LNG Market.

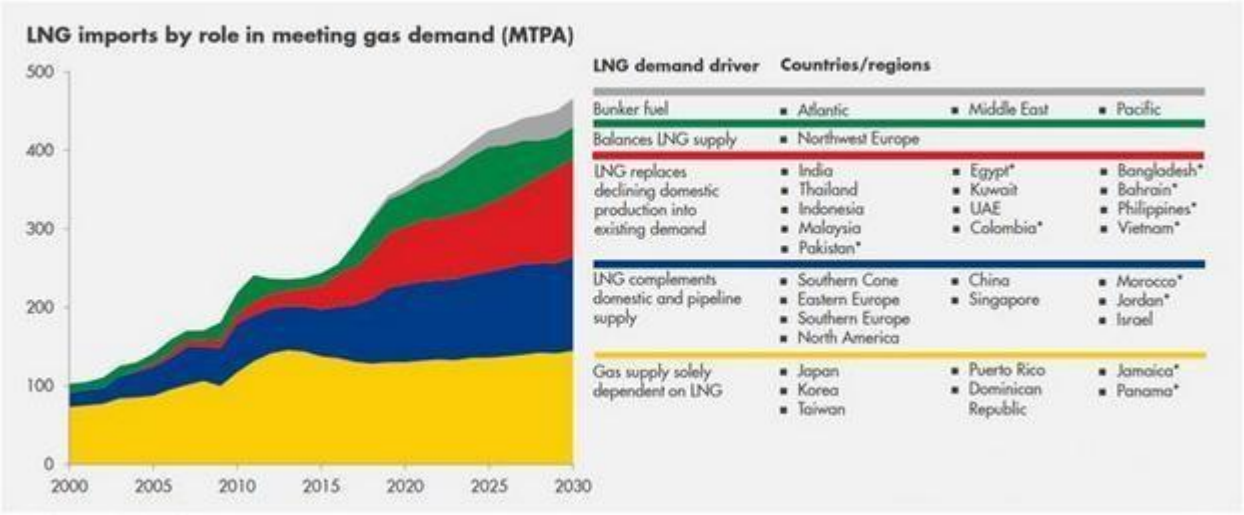


Source: (Sandalow et al., 2018)

According to CEDIGAZ (the International Association for Natural Gas, previous chart at Figure 5), the oversupply on the world LNG market will last until 2023-2025, with global liquefied natural gas (LNG) prices fluctuating below $ 10 / mmBTU. At these prices, many liquefied natural gas export terminals are either non-competitive or have low profit margins and in some extreme cases do not even cover their export costs. It is also predicted by CEDIGAZ that supply shortages may occur after 2025, which could not meet world demand for LNG, a situation that will push global LNG prices above $ 15 / mmBTU. This situation may benefit future LNG exporters who plan to start exporting after 2025, these LNG exporting countries / countries are Cyprus, Israel, Mozambique and partly Greece, if the expected natural gas fields are confirmed our country (Sandalow et al., 2018).

As expected, LNG prices are rising in the winter due to higher demand for natural gas for electricity production and domestic heating due to lower temperatures. Developed economies that cover much of their energy needs with gas will pay higher prices than other countries. Such countries are Italy, Germany, South Korea and Japan.

Figure 6. Global LNG Demand by 2030.



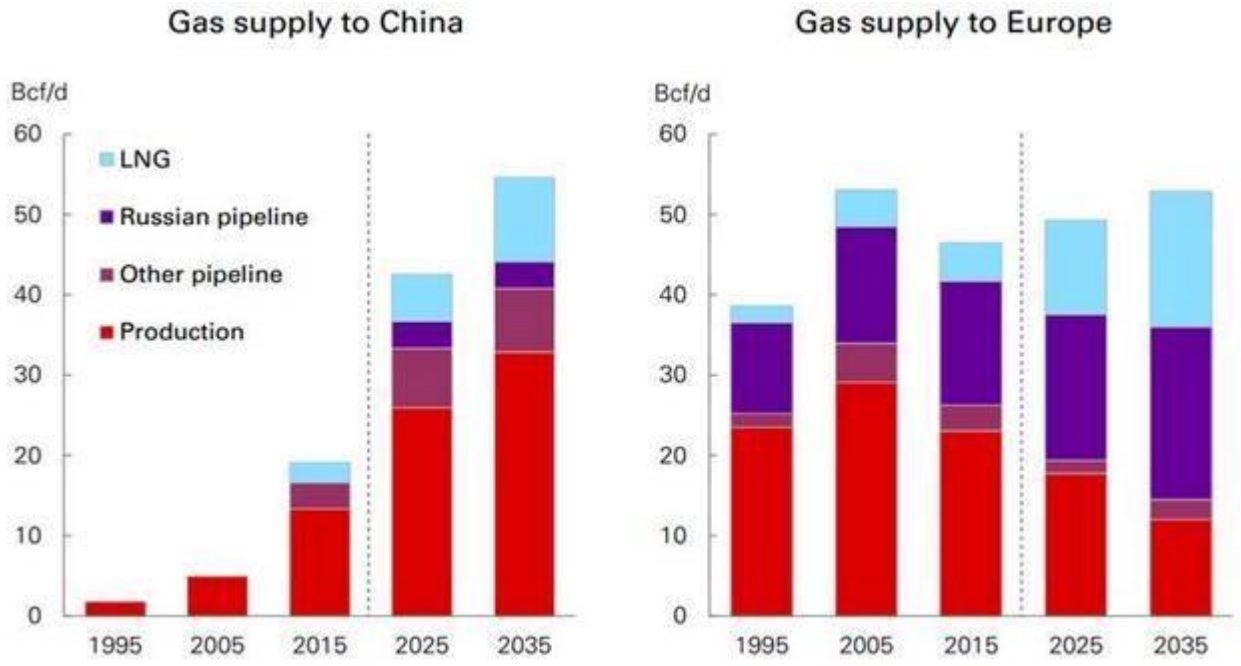
Source: (Omoregie, 2019)

Future global LNG demand will be based on 4 categories which are the using of LNG as fuel for ships, replacing oil in areas such as the Middle East, the Atlantic and the Pacific Ocean and replacing reduced domestic gas production with LNG imports from countries such as India, northwestern Europe and Vietnam (Figure 6). Also, supply of domestic gas demand with LNG imports but also with pipeline imports from countries such as Southern and Eastern Europe, China and Jordan and living domestic demand only from LNG imports from countries such as South Korea, India and Taiwan (Omoregie, 2019). As shown in Figure 7, according to Dudley (2018), gas demand

in China will continue to increase, while LNG needs will also show an upward trend by 2035, both for China and for Europe.

Finally, let's mention that the following factors may affect future global LNG prices as well as global LNG demand and supply. The future utilization of their own methane hydride fields at competitive mining prices to cover their internal gas market from countries such as India, China, Japan or even Greece. Also, a future global recession due to the creation of a global bubble / artificial prosperity due to the over-supply of money by all the central banks of the planet, a future crisis / recession of the Chinese economy due to the bubble in real estate or the stock market and a new energy discovery, such as a new form of cheap energy or the rapid reduction of energy storage costs and renewable energy. An energy policy change, such as the closure of all of Japan's nuclear power plants after the Fukushima accident. At this point, let's emphasize that Japan plans to start producing more power from its nuclear power plants by 2025, which will reduce the demand for LNG imports. As of September 2017, Japan had started production from 5 of the country's 54 total stations with only 4 being destroyed in the Fukushima accident and the rest being inactive (Silverstein, 2017). Finully, development of new liquefied natural gas export technologies, which reduce the export cost by $ / mmBTU and reduce the initial capital of the plant. These are the technologies of Small-Scale LNG and Floating LNG Unit (floating liquefaction terminals)

Figure 7. China and Europe's demand for natural gas by 1995 is forecast to reach 2035.



Source: (Dudley, 2018)

3.4. EU Energy Policy for the Future

The EU has voted for energy policies to reduce its energy dependency and increase its energy efficiency and security. Also, the EU has set policies and objectives for reducing environmental risk and climate change. Thus, policy measures, including the Energy Union framework, resulted in the creation of the Energy Union strategy in 2015 to ensure that the EU's energy supply is secure, accessible and sustainable. One aspect of the Energy Union includes the objective of reducing dependence on energy imports and diversifying energy supplies to reduce the risk of geopolitical risks. The Energy Union aims to improve energy efficiency (by at least 27% by 2030), reduce carbon in the economy (achieve a 40% reduction target by 2040) and become a world leader in clean energy technologies. Then there is the EU energy security strategy, where the European Commission launched its energy security strategy in May 2014. The strategy aims to ensure a stable and abundant supply of energy for European citizens and the economy. In the short term: Under this strategy, 38 European countries, including all EU countries, conducted energy security simulation tests in 2014 (Scarlat et al., 2015). Two power outage scenarios were examined for a period of one or six months. Complete cessation of Russian gas imports into the EU and cessation of Russian gas imports through Ukraine's transit route. Long-term measures: The strategy also addresses the long-term problems of security of supply. Measures are proposed in five key areas. First of all, increasing energy efficiency and meeting the proposed energy and climate goals of 2030. Priorities in this area focus on buildings and industry, which account for 40% and 25% of total energy in the EU respectively. Consumers should also reduce energy consumption, for example with clear billing information and smart energy meters. Subsequently, energy production in the EU increases and supplier countries and routes change. This includes the further development of renewable energy sources, the sustainable production of fossil fuels and the safe nuclear energy where this option is selected. It also leads to effective negotiations with today's major energy partners, such as Russia, Norway and Saudi Arabia, as well as with new partners such as the Caspian countries (Polzin et al., 2015). With the completion of the internal energy market and the creation of missing infrastructure links there may be an adequate response to supply disruptions and energy can be redirected across the EU where needed. Then, with unanimous decisions on foreign energy policy, including the confirmation that EU countries will inform the European Commission early on of planned agreements with

third countries that may affect EU security of supply. Finally, by strengthening the emergency mechanisms need and solidarity and critical infrastructure protection This includes greater coordination between EU countries on the use of existing storage facilities, the development of reverse flows, the conduct of risk assessments and the implementation of supply security plans at regional and EU level (Scarlat et al., 2015).

3.4.1. 2050 Long-term Strategy

On 28 November 2018, the Commission presented its strategic long-term plan for a prosperous, modern, competitive and climate-neutral economy by 2050 - a clean planet for all. The long-term strategy shows how Europe can lead climate neutrality by investing in realistic technology solutions, empowering citizens and coordinating actions in areas such as industrial policy, financing or research, while at the same time ensuring social justice. This is based on the new energy policy framework established under the "Clean Energy for All Europeans" package. Following invitations from the European Parliament and the European Council, the Commission's vision of a climate- neutral future is in line with almost all EU policies and is in line with the objective of the Paris Agreement to keep global warming at a much lower level of 2 ° C and strive to maintain it at 1.5 ° C.

The strategy promotes joint action in seven areas, energy efficiency, the development of a renewable, clean, secure and connected mobility competitive industry and cyclical economy, infrastructure and interconnections, bioeconomy and natural carbon sinks, carbon capture and storage to cope with remaining emission target (Mont et al ., 2014).

3.4.2. Clean Energy for all Europeans package

The EU updated its energy policy framework to enable the transition from fossil fuels to cleaner energy use and to cope with EU projections for reducing greenhouse gas emissions based on its proposals. Based on Commission proposals published in November 2016, the Clean Energy for All package consists of eight legislative acts. Following political agreement by the Council and the European Parliament in 2018 and early 2019, allowing all new rules to enter into force by mid-2019, EU countries have 1-2 years to put the new directives in their national law (Ringel & Knodt, 2018).

Energy Efficiency in Buildings through Renewable Energy contains energy efficiency, governance, electricity market planning, electricity guidelines, risk preparation, ACER. Overall, EU energy policies, including energy as a source of employment and growth in Europe: completing the European internal market for electricity and gas (European network, availability interconnection, investment in capacity, same conditions: activity, increasing the competitiveness of European industry). Also addressing competitiveness and security of supply: increasing the sustainability and diversity of the energy mix, solidarity between the Member States: the path towards internal European energy supply policy (increasing security of supply in the internal market, reviewing access of the EU in emergency oil and gas reserves and preventing disruptions). Also, tackling climate change (more for less: Europe as the most energy-efficient region, expanding the use of renewable energy, carbon capture and geological storage), encouraging innovation for the European Strategic Plan energy technologies towards a solid foreign energy policy; dependence on imports mainly on oil and gas; a clear policy of diversification of gas supplies; KON dialogues about partnerships in the energy sector, an effective response to emergencies, the establishment of pan-European energy networks, the integration of energy into other external policies, energy to promote the development) (Ringel & Knodt, 2018).

3.4.3. Consumption & Demand

Natural gas accounts for about a quarter of the EU's total energy consumption. About 26% of this gas is used in the electricity generation sector (including cogeneration plants) and about 23% in industry. Most of the rest is used in housing and services, mainly for heating buildings. EU gas demand is about 480 billion cubic meters (centimeters) and, under current policies, is expected to remain relatively stable in the coming years. Domestic gas production is expected to decline, which may have an impact on gas imports. However, along with other policies aimed at meeting the energy and climate objectives of 2030 - in particular those included in the Clean Energy for All Europeans, improvements in efficiency in heating and industry - a decrease in overall gas usage is likely to occur throughout the EU (Pirlogea & Cicea, 2012). Table 1 shows the total proved reserves in the EU in bcm and Table 2 shows the evolution of the Greek energy system during the period 2015-2050.

Table 1. Natural Gas Demand in Europe (bcm) –scenario)

2016	2030	2040
587	611	592

(Source: IEA)

Table 2. Evolution of the Greek energy system during the period 2015-2050.

Final Energy Consumption (ktoe) of natural gas

2015	2020	2025	2030	2035	2040	2045	2050
1018	1029	996	939	1033	1142	1190	1173

(Source: EU28: Reference Scenario (REF2016), Summary Report PRIMES ver. 4 Energy Model)

3.5. Conclusion

The EU has designed a strategic plan for a prosperous, modern, competitive and climate-neutral economy by 2050. This is based on the new energy policy framework established under the "Clean Energy for All Europeans" package. The EU's vision is in line with the Paris Agreement's goal of global warming and maintaining its temperature at 1.5 ° C. EU gas demand is about 480 billion cubic meters (cm) and, according to with current policies, it is expected to remain relatively stable in the coming years. Domestic gas production is expected to decline, which could have an impact on gas imports. However, along with other policies aimed at meeting the energy and climate objectives of 2030 - in particular those included in the European Clean Energy for All, improvements in the efficiency of heating and industry - there may be a reduction in the overall use of gas across the EU.

However, evidence to date shows that demand is increasingly increasing with the EU co- financing or committing to co-financing natural gas infrastructure projects in excess of € 638 million. These could be in line with US liquefied natural gas imports if market conditions are right and prices are competitive. According to the International Energy Agency (IEA), Europe's liquefied natural gas imports are expected to increase by about 20% by 2040 compared to 2016 levels (56.5 billion). In 2017, Europe accounted for more than 10% of total liquefied natural gas exports to the US, from 5% in 2016.

CHAPTER 4: The Development of LNG in US

4.1. Introduction

In recent years, and especially after 2014, the global market for liquefied natural gas (LNG) has evolved and can now be described as a 'mature' global market. With many LNG export sources emerging and predicted to come in the coming years, such as the US, Australia, and Russia, there is a growing trend of competition between these countries for those who will gain the largest market share. Of course, do not forget Qatar's dominant position as the largest exporter in the LNG market. Four new liquefaction trains - the common term for a shipping facility - have entered service in the United States this year. The US is well on its way to becoming the world's largest LNG exporter by 2024.

LNG is considered as an alternative to countries based on coal-fired power plants. LNG exports have increased in recent years from Qatar, Australia and the United States, the three largest exporters of super fuel. The volatile nature of the market was evident at the end of this year when a warm night in Asia reduced demand for heating and prompted Asian importers to divert shipments to Europe. In this paper, we will look at the US prospects for LNG exports to the EU, the planning to achieve this goal, and a number of other factors involved, such as Russia and other major exporting countries.

4.2. U.S LNG strategy

The shale gas revolution profoundly changes the U.S gas scene and the competitiveness of gas on the U.S market. The abundant resources and sharp rise in production have resulted in surplus production and have driven the U.S gas prices down. In 2020, the United States could become the third (3rd) largest exporter in the world after Australia and Qatar. The U.S LNG exports will revolutionize international trade in LNG. Their contract structure (linked to the U.S gas spot price, no destination clauses and tolling agreement and the projected volumes will enable) greater flexibility in the international LNG market and facilitate price convergence between regional markets. At the current level of gas prices on the European market, which is particularly low, LNG is not however guaranteed to arrive in large quantities, as higher margins can be made in other markets (Latin America, the Middle East, and India). The European market is a “last resort” market for LNG surpluses which are likely to increase from 2018 (Ritz, 2019).

Traditional exporters to Europe particularly Russia are preparing for this new competition in a market where demand has fallen by a fifty since 2010, although it increased in 2015. The fall in Russian gas prices which are correlated to fluctuations in the crude oil price with a six-to-nine –monthly lag, removes the short term threat of this new competition. However, the rise (even modest) in oil prices will change the situation. The price of Russian gas will increase as Russian contracts are partly linked to the oil price. This situation is likely to trigger a price war between Gazprom, the main supplier to the European gas market and U.S exporters. Gazprom could adjust its prices downwards to defend its market share depending on the cost of U.S gas delivered to Europe, making this uncompetitive for European buyers. So, the U.S LNG has many advantages for European buyers in terms of security of supply and competitiveness and this weather the LNG arrives in Europe or not. As a result, the United States, due to its abundant reserves and the low cost of its LNG exporter and it well placed to meet Europe's growing import needs, provided that Europe remains an alternative market for LNG imports (Schulte & Weiser, 2019).

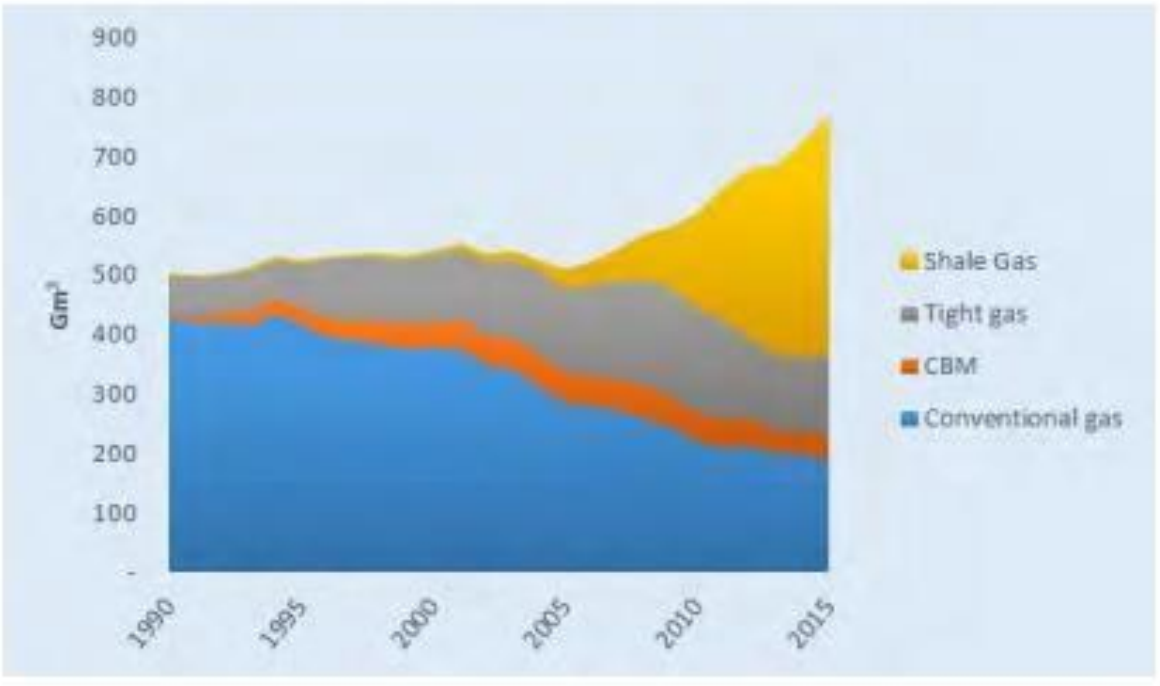
4.2.1. Shale gas represents half of U.S production

The main advantage of U.S shale gas production is the use of horizontal drilling and hydraulic fracturing (fracking). The use of this technology and the U.S strong economy to invest on the industrialization of these technologies, have helped to considerably increase shale gas production in the United States, which now accounts for 53% of marketed gas production, with more than 400 billion cubic meters (bcm) produced in 2015. In the following graph we can notice the marketed gas production in the United States (Staub & Lead, 2015).

Due to this huge increase, the United States has become the world's largest gas producer, overtaking Russia from 2009. As a result, the country is set to become one of the three largest LNG exporters in the world and the start of whereas that had built infrastructure to import LNG in anticipation of a fall in production is the North American gas industry. These changes in the U.S shale gas industry create new balances in the gas market. The shale gas revolution has driven gas prices down on the U.S market. The natural gas spot price at Henry Hub in Louisiana, the national benchmark price, dropped to 2.63$ per million British Thermal Unit (MBtu) on average in 2015, its lowest level since 1999. Firstly, the fall in gas prices resulted in the

refocusing of activities to oil or wet gas basins, providing better returns. In late April 2016, the number of gas wells being drilled was no more than 87, as opposed to about 900 at the beginning of 2011, before the fall in prices[1] (Chang et al., 2019). Figure 8 shows the marketed gas production in the U.S.A., where the upward trend of shale gas is clear (Henderson, 2017).

Figure 8. Marketed gas production in the U.S.A.



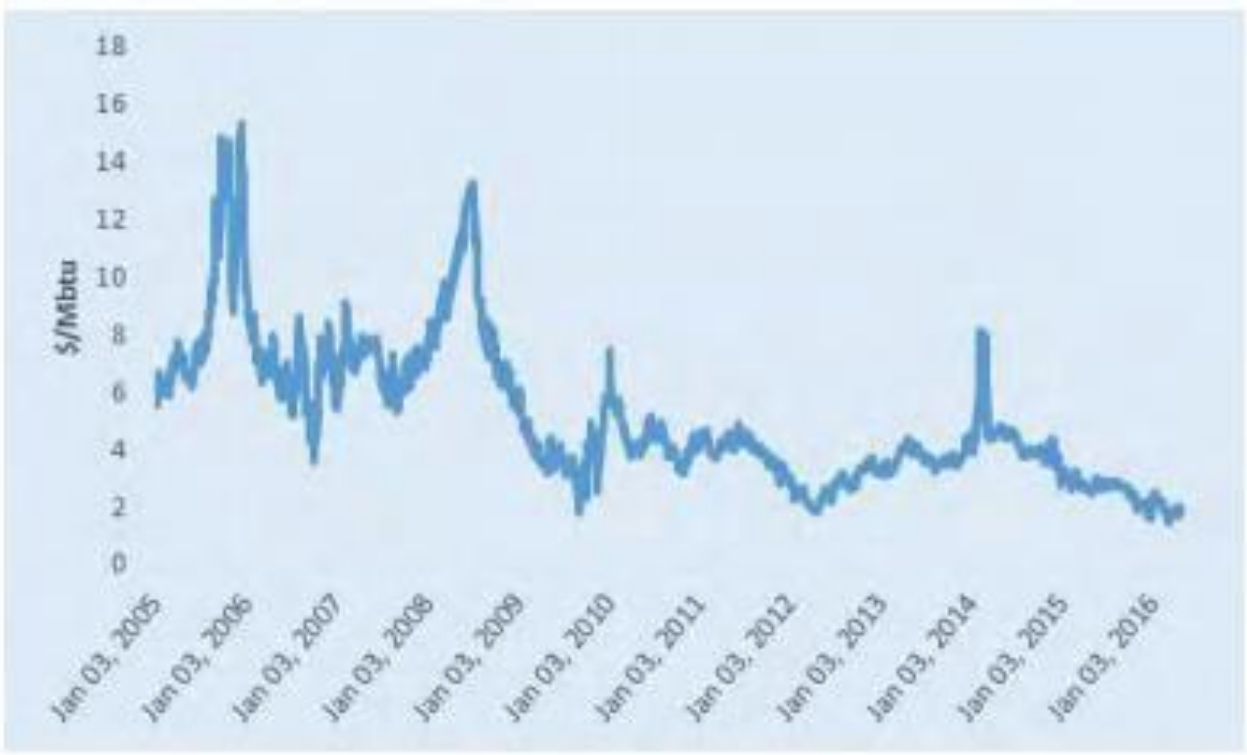
Source: (Henderson, 2017)

Due to this huge increase, the United States has become the world's largest gas producer, overtaking Russia from 2009. As a result, the country is set to become one of the three largest LNG exporters in the world and the start of whereas that had built infrastructure to import LNG in anticipation of a fall in production is the North American gas industry. These changes in the U.S shale gas industry create new balances in the gas market. The shale gas revolution has driven gas prices down on the U.S market. The natural gas spot price at Henry Hub in Louisiana, the national benchmark price, dropped to 2.63$ per million British Thermal Unit (MBtu) on average in 2015, its lowest level since 1999. Firstly, the fall in gas prices resulted in the refocusing of activities to oil or wet gas basins, providing better returns. In late April

[1] H. Baker, north America Rig Count (Jan. 2000- Current), http://phx.corporate-ir,net

2016, the number of gas wells being drilled was no more than 87, as opposed to about 900 at the beginning of 2011, before the fall in prices[2]. Figure 9 shows the changes in the U.S. spot price (Henry Hub) for the period between 2005 – 2016 and Figure 9 shows the natural gas production projections by source by 2040 (Mason & Roberts, 2018).

Figure 9. Changes in the U.S. spot price (Henry Hub)



Source: (Mason & Roberts, 2018)

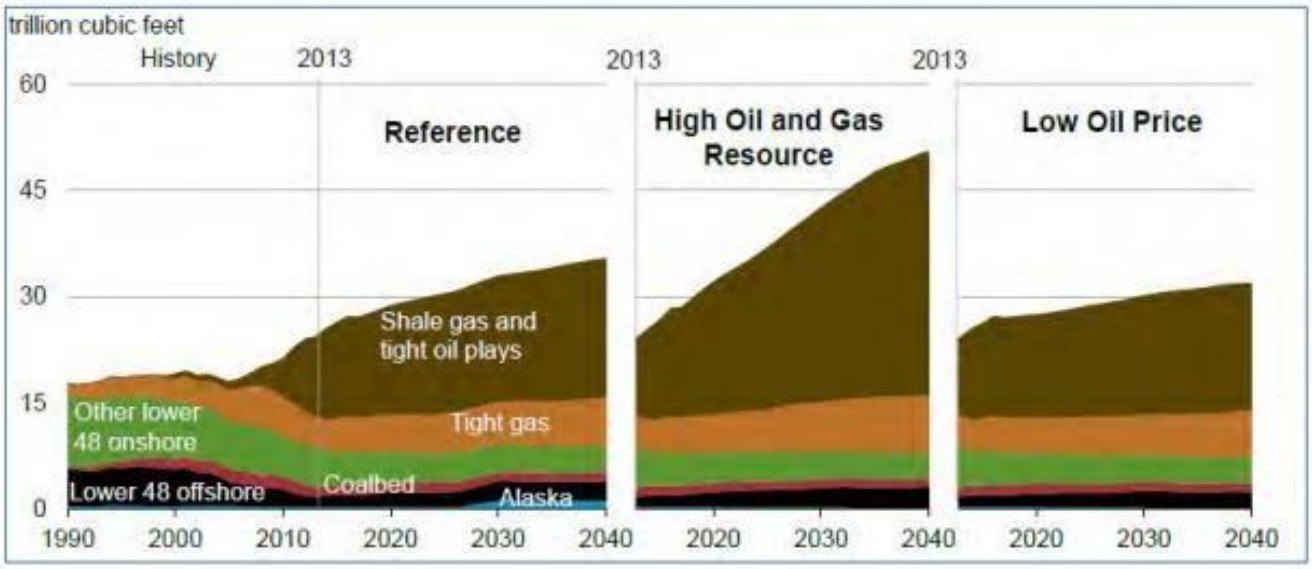
However, it should be emphasized that shale gas production has started to decline since March 2016. In the short-term, this fall is expected to continue and result in stagnation in total gas production in the United States. Also, the EIA projects, in 2017 increase of 2.2% in production in response to higher prices (at 3$/ MBtu), due to a tighter supply situation with rising domestic demand LNG exports. In the long- term, gas production is expected to grow significantly. The proven gas reserves in the United States were estimated at 11,000 bcm by the EIA in December 2014[3]. Despite increasing gas production in recent years, the proven reserves have continued to increase, mainly due to a better understanding of the shale gas potential and its

[2] H. Baker, north America Rig Count (Jan. 2000- Current), http://phx.corporate-ir,net

[3] EIA, "Shale Oil And Natural Gas Proved Reserves." 23 November 2015, www.eia.gov

extraction methods (Figure 10) (Harris et al., 2018). To conclude, future natural gas production mainly depends on the level and cost of the shale gas-tight gas[4] resources, technical improvements, domestic demand and oil and gas prices (Chang et al., 2019).

Figure 10.Natural gas production projections by source by 2040.



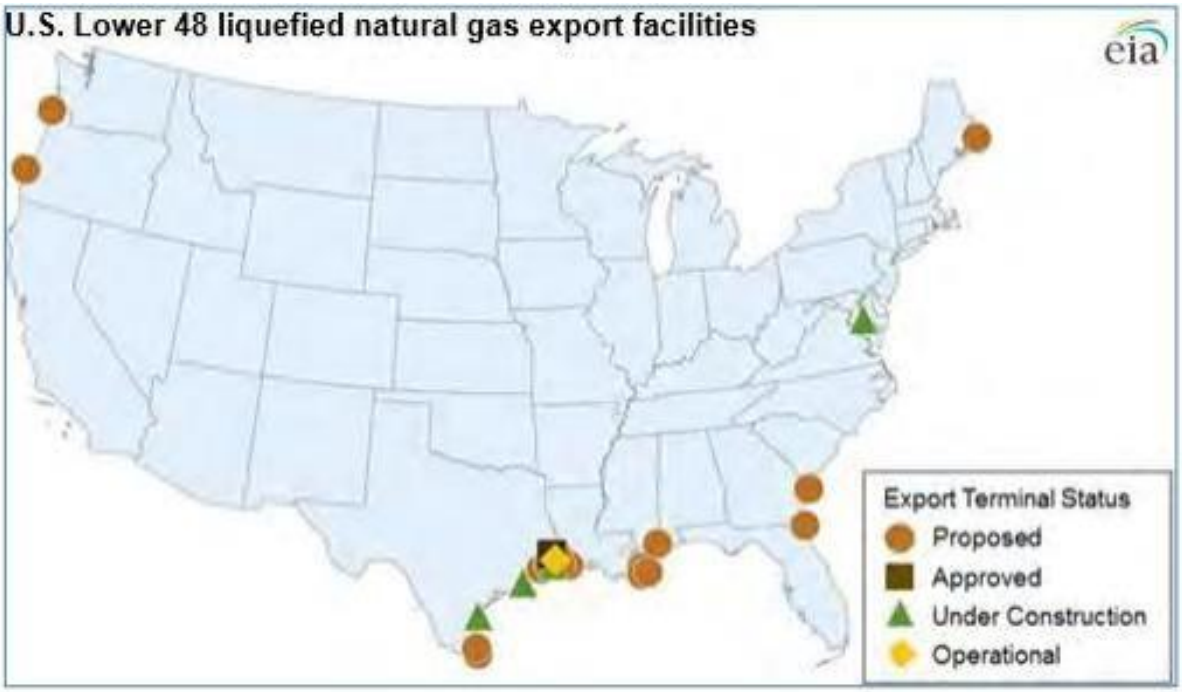
Source: (Harris et al., 2018)

3.3. U.S. LNG export projects

The increase in shale gas production prompted U.S producers to turn to LNG exports. In the United States, LNG exports are subject to authorization by the Department of Energy (DOE) and the Federal Energy Regulatory Commission (FERC). Seven projects have received authorization from FERC. With these authorizations, the regulatory obstacle which prevented the United States from becoming a significant exporter on the LNG market was raised (Smead, 2019). Figure 11 shows the LNG export projects in the U.S., with the majority of facilities located or planned to be established in the Gulf of Mexico (Swenson, 2017).

[4] The reinforcement of environmental standards by the EPA (the elimination of gas flaring among others) will impact on future production costs.

Figure 11. LNG export projects in the U.S.



Source: (Swenson, 2017)

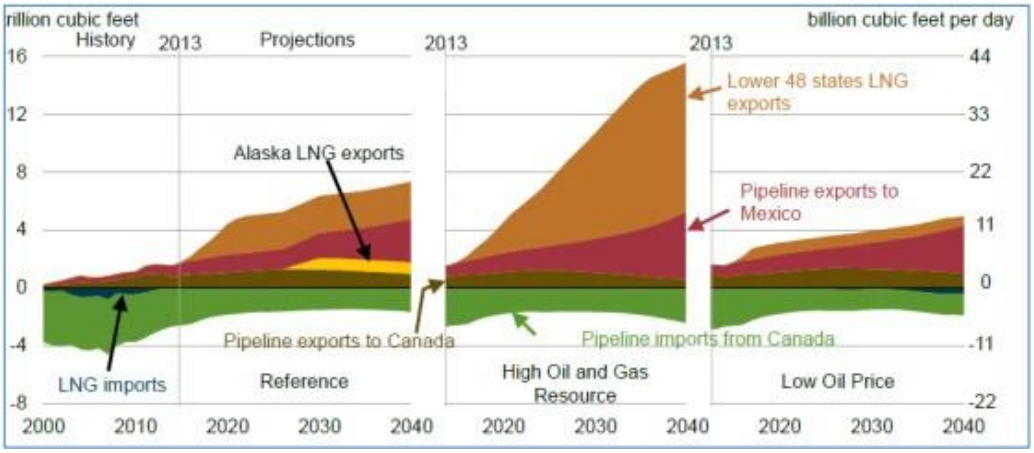
4.3.1. The Key Features of U.S LNG Exports Projects

The U.S exports will lead to a change in the marketing and pricing of LNG. Indeed, the U.S. export contracts are structured very differently from traditional LNG supply contracts.

4.3.2. Prices indexed to the U.S. spot price

One of the advantage of the U.S LNG exports in the indexing of their price to the U.S. Henry Hub gas spot price. This indexing allows buyers to diversify prices from oil- indexed contracts (most of the LNG contracts, with notable exceptions, like the contracts between Qatar and British buyers). Last but not least, the U.S export terminals currently under construction benefit from lower costs than those of new liquefaction projects in the United States and in the rest of the world (Ritz, 2019). Figure 12 shows the export projections for natural gas and LNG by 2040, according to Burnham et al., (2018).

Figure 12. Export projections for natural gas and LNG by by 2040, according to the AEO 2015



Source: (Burnham et al., 2018)

4.4. Conclusion

US LNG exports create unbalance in energy industry and especially in EU's energy market. The increasing competition that comes from US LNG exports on the European market have influence Gazprom's exports and Russia's strong geopolitics situation. The EU'S gas consumption (427 bcm in 2015) is lower by more than 100 bcm to that of 2010, although it increased again in 2015 (+4, 5%). This is happen, due to the decline the drop in consumption in the electricity sector, between 2010 and 2014, in the face of weak demand for European electricity, competition with coal and the rise of Renewable Energies. A series of wilder winters than normal has also limited demand from the residential commercial sectors.

Russia is the main supplier to the EU and the US LNG is potentially a threat for Russia and Gazprom. The capacity of European hubs to absorb surplus LNG is indeed mainly determined by the LNG capacity to replace the flexible volumes of long-term contracts, in particular from Russia whose contracts include significant.

As we can see, in the short term, the fall in gas prices on the global market is making difficult to develop a new US LNG project. However, the increase in the medium term in oil prices with link to stability of US gas prices (AEO 2016 scenario), give many opportunities on the economies of US projects. As a result, in the short term, preventing LNG imports from existing terminals or terminals under construction. So, Gazprom could follow "price's strategy", like setting prices lower than those required by the US LNG exporters (short-run marginal cost).In the medium term, discouraging the

construction of new LNG projects and this scenario require volatile price to deter investment decisions. In the long term, US LNG is more attractive for European buyers due to lower Hub prices (Henderson & Yermakov, 2019).

Europe is an important market for LNG suppliers worldwide. Continuous growth in global liquefaction capacity is projected to continue to grow at a rapid pace, with liquidation capacity of 188 billion cubic meters per year being built around the world in early 2016. Competition between suppliers for European markets is likely to limit LNG's share of European supply and in particular the UK's LNG. The traditional supplier strategy for Europe and the Gazprom strategy, in particular, are a decisive factor in the share that LNG could take in Europe (Henderson & Yermakov, 2019).

LNG exports to the US create an imbalance in the energy industry, and in particular in the EU energy market. The increased competition stemming from US gas exports to the European market has affected Gazprom's exports and Russia's strong geopolitical situation. Gas consumption in the EU is lower than more than 100 billion cubic meters in 2010, although it increased again in 2015. This is due to the decline in electricity consumption between 2010 and 2014, given the low demand for European electricity, competition with coal and the rise of renewable energy sources.

Russia is the EU's major supplier, with US LNG a threat to Russia and Gazprom. The ability of European nodes to absorb the LNG surplus is mainly determined by the ability of the LNG to replace flexible volumes of long-term contracts, in particular, Russia, whose contracts include significant contracts (Boussena et al., 2019).

CHAPTER 5: LNG and European Union

5.1. Introduction

Whereas during the period 2011-2014, global LNG supply was restricted by insufficient liquefaction capacities to meet the high Asian demand which followed the Fukushima disaster, from mid-2014 the situation reserved. New liquefaction plants came into production, while supply slowed down. So, Europe was the main driver of the increase in international LNG trade which reached 323 bcm in 2015. After falling by 50% between 2011, and 2014, European imports increased by 12% in 2015 to 50 bcm (Ritz,
2019).

Europe is in competition with buyers around the world. The quantities of LNG imported into Europe in the first quarter of 2016 fell slightly in relation to the same period in 2015, and the inflow of Russian and Norwegian gas at low prices likely to prolong this situation.

The global liquefaction capacity (417 bcm per year in late 2015) will continue to grow rapidly: at the start of 2016 a liquefaction capacity of 188 bcm per year is under construction around the world. Additionally, the new situation and the European policy for LNG (Box 1), will help to significantly increase LNG imports in Europe. Furthermore, competition between European market suppliers is likely to restrict the share of LNG in the European supply, and that of U.S LNG in particular. The strategy of traditional suppliers to Europe and that of Gazprom in particular, is a deciding factor in the share that U.S LNG could take in Europe.

In February 2016, the European Commission released its sustainable energy package with a certain number of measures intended to increase the Unions energy security. This package includes an LNG strategy, which aims to make Europe, often described as a “last resort” market for LNG exports, an attractive region. The Commission is putting forward the favorable economic situation in the global LNG market which provides the EU with a unique opportunity to enhance its security of supply and competitiveness, as suppliers. It also states that the emergence of FSRU (Floating Storage Regasification Units) technology changes the dynamics of investment in import capacities. The Commission is referring to the Klaipeda FSRU terminal in Lithuania as an example, which has helped the country to increase the diversity of its supply and

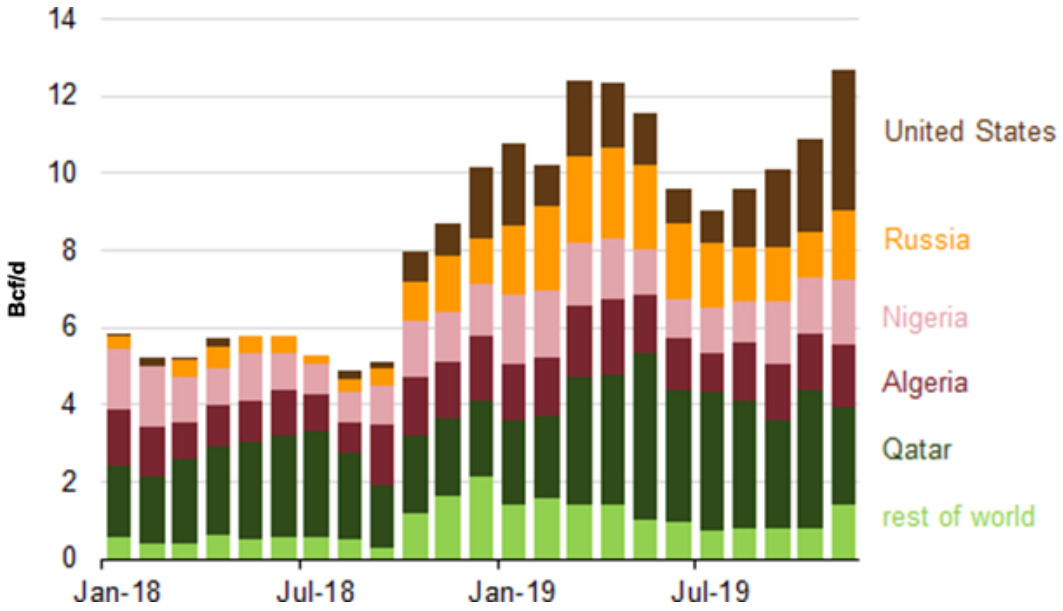
competitiveness (Henderson & Yermakov, 2019). Access to the global LNG market has reduced the gas price on the Lithuanian market. The terminal played a role in negotiating a 23% reduction in the price of Russian gas imported to Lithuanian.

To improve the access of all Member States to LNG as an alternative gas source, the LNG strategy identifies three key actions that the EU must implement. First of all, to build the infrastructure necessary to complete the internal market, so that all Member States may access international LNG markets, either directly or through the other Member States. The Commission recognizes that in northwestern Europe, the markets are competitive, well connected and have access to various sources of gas, including terminals providing substantial LNG import capacities. However, the gas markets are less developed in the Baltic Sea, central European, south-eastern European and south- western European regions. Based on the list of major infrastructure projects so that all Member States have access to LNG. After that, to complete the internals market so that it sends the right price signals, attack LNG where it is needed and thus, facilitate the necessary investments in infrastructure. Finally, to cooperate closely with international partners to promote global LNG markets which are free, liquid and transparent. This implies a dialogue with current and future suppliers and with the other major consumer countries so that LNG can be freely marketed on global markets, both under market conditions and in the event of external shocks (Henderson & Yermakov, 2019).

5.2. Europe LNG Imports and Exports

Figure 13 shows the LNG imports into the European Union countries, from the largest LNG exporting countries for January 2018 to November 2019. The chart shows the US constant, where for In November 2019, there was an import record, with US LNG imported. exceeding 12Bcf/d, which was also observed in March and April 2018. The other countries - EU LNG suppliers report much lower sales throughout the period described with Russia being the next largest LNG supplier. for the European Union. The largest Russian LNG imports occurred in March and April 2018. What is noteworthy is the fact that for the period between January 2018 and October 2018, LNG imports into the European Union from the US, Russia and Nigeria had similar prices, with this picture changing after November 2018, with US and Russian LNG at the top of imports for the European Union (Figure 14) (Hasanov et al., 2020).

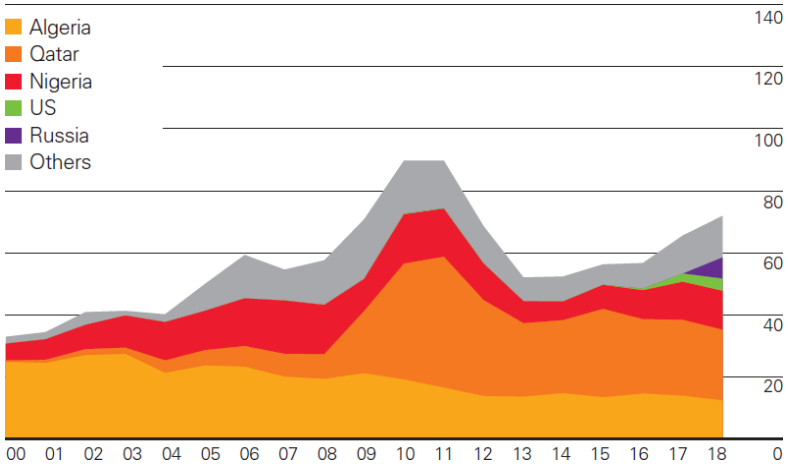
Figure 13. LNG imports into the European Union between January 2018 and November 2019, by country of LNG export.



Source: (Hasanov et al., 2020)

The Figure 14 diagram illustrates LNG imports from Europe, one of its largest suppliers, between 2000 and 2018. This chart shows that LNG fixed gas suppliers are Algeria, Qatar and Nigeria, while imports from Russia and the US occupy a prominent position in 2017 and 2018. As the diagram shows, LNG imports from Russia exceed those of the US, while for those 18 years the largest imports are from other countries (Dudley, 2018).

Figure 14. LNG imports into Europe, from its largest suppliers, between 2000 and 2018.



Source: (Dudley, 2018)

Table 3 shows the formation of LNG, Natural Gas and Crude oil prices for the 20 years between 1988 and 2018. The table shows prices for all three products showing a steady increase after 2000, with This increase is expected to peak in 2013, where for the case of Japan CIF LNG the observed increase is more than 500% compared to the 1988 price. However, prices have fallen after 2013, reaching levels of 2008 and 2009 (Dudley, 2018).

Table 3. The formation of LNG, Natural Gas and Crude oil prices for the 20 years between 1988 and 2018.

Prices

	LNG		Natural gas					Crude oil
US dollars per million Btu	Japan CIF[1]	Japan Korea Marker (JKM)[2]	Average German Import Price[3]	UK (Heren NBP Index)[4]	Netherlands TTF (DA Heren Index)[4]	US Henry Hub[5]	Canada (Alberta)[5]	OECD countries CIF[6]
1988	3.34	–	2.22	–	–	–	–	2.56
1989	3.28	–	2.00	–	–	1.70	–	3.01
1990	3.64	–	2.78	–	–	1.64	1.05	3.82
1991	3.99	–	3.23	–	–	1.49	0.89	3.33
1992	3.62	–	2.70	–	–	1.77	0.98	3.19
1993	3.52	–	2.51	–	–	2.12	1.69	2.82
1994	3.18	–	2.35	–	–	1.92	1.45	2.70
1995	3.46	–	2.43	–	–	1.69	0.89	2.96
1996	3.66	–	2.50	1.87	–	2.76	1.12	3.54
1997	3.91	–	2.66	1.96	–	2.53	1.36	3.29
1998	3.05	–	2.33	1.86	–	2.08	1.42	2.16
1999	3.14	–	1.86	1.58	–	2.27	2.00	2.98
2000	4.72	–	2.91	2.71	–	4.23	3.75	4.83
2001	4.64	–	3.67	3.17	–	4.07	3.61	4.08
2002	4.27	–	3.21	2.37	–	3.33	2.57	4.17
2003	4.77	–	4.06	3.33	–	5.63	4.83	4.89
2004	5.18	–	4.30	4.46	–	5.85	5.03	6.27
2005	6.05	–	5.83	7.38	6.07	8.79	7.25	8.74
2006	7.14	–	7.87	7.87	7.46	6.76	5.83	10.66
2007	7.73	–	7.99	6.01	5.93	6.95	6.17	11.95
2008	12.55	–	11.60	10.79	10.66	8.85	7.99	16.76
2009	9.06	5.28	8.53	4.85	4.96	3.89	3.38	10.41
2010	10.91	7.72	8.03	6.56	6.77	4.39	3.69	13.47
2011	14.73	14.02	10.49	9.04	9.26	4.01	3.47	18.56
2012	16.75	15.12	10.93	9.46	9.45	2.76	2.27	18.82
2013	16.17	16.56	10.73	10.64	9.75	3.71	2.93	18.25
2014	16.33	13.86	9.11	8.25	8.14	4.35	3.87	16.80
2015	10.31	7.45	6.72	6.53	6.44	2.60	2.01	8.77
2016	6.94	5.72	4.93	4.69	4.54	2.46	1.55	7.04
2017	8.10	7.13	5.62	5.80	5.72	2.96	1.60	8.97
2018	10.05	9.76	6.62	8.06	7.90	3.13	1.12	11.69

[1]Source: EDMC Energy Trend.
[2]Source: S&P Global Platts ©2019, S&P Global Inc.
[3]Source: 1988-1990 German Federal Statistical Office, 1991-2018 German Federal Office of Economics and Export Control (BAFA).
[4]Source: ICIS Heren Energy Ltd.
[5]Source: Energy Intelligence Group, Natural Gas Week.
[6]Source: ©OECD/IEA 2019, Oil, Gas, Coal and Electricity, Quarterly Statistics *www.iea.org/statistics*.

Source: (Dudley, 2018)

Table 4 shows worldwide LNG imports in Billion cubic meters between 2008 and 2018. As shown in the table, focusing on European Union countries, Spain is the country for which consistently higher LNG imports are observed. Especially for the period between 2008 and 2010, imports of LNG to Spain are more than twice as large as the next country to imports of LNG from France. However, Spanish imports are steadily declining in the coming years and in 2018 they are half of those of 2008, but still maintaining the leading position among the European Union countries in LNG imports. Other countries in or near the European Union, with high LNG imports exceeding 10 Billion cubic meters, are France, Turkey and the United Kingdom.

Table 4. Natural gas LNG imports for the period between 2008 and 2018.

Natural gas: LNG imports

Billion cubic metres	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Growth rate per annum 2018	Growth rate per annum 2007-17	Share 2018
Canada	–	1.0	2.0	3.2	1.6	1.0	0.5	0.6	0.3	0.4	**0.6**	56.1%	n/a	0.1%
Mexico	3.8	3.7	6.1	3.8	4.9	7.8	9.3	6.8	5.6	6.6	**6.9**	4.2%	11.3%	1.6%
US	9.7	12.6	12.1	9.9	4.9	2.7	1.7	2.5	2.4	2.2	**2.1**	-2.0%	-20.5%	0.5%
Total North America	13.5	17.3	20.2	16.8	11.4	11.4	11.5	10.0	8.3	9.2	**9.6**	5.0%	-9.1%	2.2%
Argentina	0.4	1.0	1.9	3.7	4.7	6.3	6.2	5.6	5.1	4.6	**3.6**	-21.9%	n/a	0.8%
Brazil	–	0.4	2.8	0.7	3.5	5.2	7.1	6.8	2.6	1.7	**2.9**	67.8%	n/a	0.7%
Chile	–	0.7	3.1	3.7	4.0	3.8	3.5	3.7	4.5	4.4	**4.3**	-1.2%	n/a	1.0%
Other S. & Cent. America	1.3	1.4	1.4	1.9	2.4	2.8	2.8	2.8	3.0	2.8	**3.7**	32.9%	9.3%	0.9%
Total S. & Cent. America	1.8	3.5	9.2	9.9	14.6	18.1	19.6	18.9	15.2	13.5	**14.5**	7.6%	27.9%	3.4%
Belgium	3.0	6.8	6.5	6.3	4.1	3.1	2.9	3.6	2.4	1.3	**3.7**	185.2%	-7.4%	0.9%
France	12.8	13.3	14.7	14.4	9.8	8.3	6.9	6.4	9.1	10.9	**13.1**	20.8%	-1.9%	3.1%
Italy	1.6	3.0	9.3	9.1	7.1	5.8	4.5	5.9	5.9	8.2	**8.0**	-1.8%	12.4%	1.9%
Spain	29.8	27.5	28.2	23.9	21.4	15.7	16.2	13.7	13.8	16.6	**15.0**	-9.2%	-4.1%	3.5%
Turkey	5.6	6.0	7.8	5.9	7.6	5.9	7.1	7.5	7.6	10.9	**11.5**	6.1%	6.8%	2.7%
United Kingdom	0.8	10.1	18.8	24.7	13.9	9.2	11.2	13.7	10.8	7.2	**7.3**	1.5%	18.3%	1.7%
Other EU	3.7	3.7	3.9	4.9	4.4	3.7	3.3	5.2	6.9	10.2	**12.8**	25.3%	10.8%	3.0%
Rest of Europe	–	–	†	–	†	–	†	–	†	0.1	**†**	-97.9%	n/a	◆
Total Europe	57.4	70.5	89.1	89.2	68.2	51.8	52.1	56.0	56.5	65.3	**71.5**	9.6%	1.8%	16.6%
Egypt	–	–	–	–	–	–	–	3.9	10.7	8.3	**3.2**	-61.9%	n/a	0.7%
Kuwait	–	0.9	2.8	3.0	2.8	2.3	3.6	4.3	4.7	4.8	**4.3**	-10.0%	n/a	1.0%
United Arab Emirates	–	–	0.2	1.4	1.4	1.6	1.6	2.9	4.2	3.0	**1.0**	-65.2%	n/a	0.2%
Other Middle East & Africa	–	–	–	–	–	0.5	0.1	2.7	4.8	5.3	**4.0**	-23.6%	n/a	0.9%
Total Middle East & Africa	–	0.9	3.0	4.4	4.2	4.3	5.3	13.7	24.5	21.4	**12.5**	-41.3%	n/a	2.9%
China	4.6	8.0	13.0	16.9	20.1	25.1	27.3	27.0	36.8	52.9	**73.5**	38.8%	29.3%	17.0%
India	11.3	13.0	11.5	17.4	18.4	18.0	19.1	20.0	24.3	26.1	**30.6**	17.0%	9.6%	7.1%
Japan	95.4	88.9	96.4	108.6	119.8	120.4	121.8	115.9	113.6	113.9	**113.0**	-0.9%	2.2%	26.2%
Malaysia	–	–	–	–	–	2.0	2.2	2.2	1.5	2.0	**1.8**	-11.1%	n/a	0.4%
Pakistan	–	–	–	–	–	–	–	1.5	4.0	6.1	**9.4**	54.2%	n/a	2.2%
Singapore	–	–	–	–	–	1.3	2.6	3.0	3.2	4.1	**4.5**	8.6%	n/a	1.0%
South Korea	38.3	35.3	45.0	47.7	49.7	55.3	51.8	45.8	46.3	51.4	**60.2**	17.1%	3.6%	14.0%
Taiwan	12.6	12.4	15.0	16.3	17.1	17.2	18.6	19.6	20.4	22.7	**22.8**	0.5%	7.1%	5.3%
Thailand	–	–	–	1.1	1.4	2.0	1.9	3.6	3.9	5.2	**6.2**	19.1%	n/a	1.4%
Other Asia Pacific	–	–	–	–	0.1	–	–	–	–	–	**0.8**	n/a	n/a	0.2%
Total Asia Pacific	162.2	157.5	180.9	207.9	226.6	241.2	245.2	238.5	253.9	284.6	**322.8**	13.4%	6.3%	74.9%
Total LNG imports	**234.9**	**249.7**	**302.4**	**328.3**	**324.9**	**326.8**	**333.6**	**337.1**	**358.3**	**393.9**	**431.0**	**9.4%**	**5.4%**	**100.0%**

Gross LNG trade
†Less than 0.05.
◆Less than 0.05%.
n/a not available.

Source: (Dudley, 2018)

A comparison of global gas imports and exports between 2008 and 2018 is shown in Table 5. Looking again at Europe, we see the huge difference between exports and imports, where exports are 2740% higher from exports. Another important observation is that 100% of gas exports are in the form of LNG, while in terms of imports, 22% is in the form of LNG and the remaining 78% through pipelines (Dudley, 2018).

Table 5. Inter-regional trade of Natural Gas for the period between 2008 and 2018. Source: (Dudley, 2018)

Natural gas: Inter-regional trade

Billion cubic metres	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Growth rate per annum 2018	Growth rate per annum 2007-17	Share 2018
US														
Pipeline imports	99.0	89.9	90.2	85.0	80.8	75.9	71.8	71.6	79.5	80.8	**77.3**	-4.3%	-2.5%	8.2%
LNG imports	9.7	12.6	12.1	9.9	4.9	2.7	1.7	2.5	2.4	2.2	**2.1**	-2.0%	-20.5%	0.2%
Total imports	108.7	102.5	102.3	94.9	85.6	78.6	73.5	74.1	82.0	83.0	**79.5**	-4.2%	-4.1%	8.4%
Pipeline exports	25.2	28.3	29.2	39.1	45.3	42.5	40.4	47.2	58.7	66.1	**67.6**	2.4%	12.1%	7.2%
LNG exports*	1.0	0.8	1.5	1.8	0.8	0.2	0.4	0.7	4.0	17.2	**28.4**	65.4%	30.1%	3.0%
Total exports	26.2	29.1	30.7	40.9	46.1	42.7	40.8	47.9	62.7	83.3	**96.1**	15.4%	14.1%	10.2%
Other North America														
Pipeline imports	25.2	28.3	29.2	39.1	45.3	42.5	40.4	47.2	58.7	66.1	**67.6**	2.4%	12.1%	7.2%
LNG imports	3.8	4.7	8.1	7.0	6.5	8.8	9.8	7.4	5.9	7.0	**7.5**	7.2%	11.9%	0.8%
Total imports	29.0	33.1	37.3	46.1	51.7	51.3	50.2	54.7	64.5	73.1	**75.1**	2.8%	12.1%	8.0%
Pipeline exports	99.0	89.9	90.2	85.0	80.8	75.9	71.8	71.6	79.5	80.8	**77.3**	-4.3%	-2.5%	8.2%
LNG exports*	–	–	–	0.1	–	–	†	†	†	†	**0.1**	22.9%	n/a	◆
Total exports	99.0	89.9	90.2	85.1	80.8	75.9	71.9	71.6	79.6	80.8	**77.4**	-4.3%	-2.5%	8.2%
Brazil														
Pipeline imports	10.7	7.7	9.3	9.3	9.5	11.0	11.4	11.2	9.8	8.4	**7.6**	-9.2%	-1.5%	0.8%
LNG imports	–	0.4	2.8	0.7	3.5	5.2	7.1	6.8	2.6	1.7	**2.9**	67.8%	n/a	0.3%
Total imports	10.7	8.1	12.1	9.9	13.0	16.3	18.5	18.0	12.4	10.1	**10.5**	3.8%	0.3%	1.1%
LNG exports*	–	–	–	–	0.5	0.1	0.2	†	0.6	0.2	**0.1**	-67.6%	n/a	◆
Total exports	–	–	–	–	0.5	0.1	0.2	†	0.6	0.2	**0.1**	-67.6%	n/a	◆
Other S&C America														
LNG imports	1.8	3.1	6.4	9.3	11.1	12.9	12.5	12.1	12.6	11.7	**11.6**	-1.2%	26.1%	1.2%
Total imports	1.8	3.1	6.4	9.3	11.1	12.9	12.5	12.1	12.6	11.7	**11.6**	-1.2%	26.1%	1.2%
Pipeline exports	10.7	7.7	9.3	9.3	9.5	11.0	11.4	11.2	9.8	8.4	**7.6**	-9.2%	-1.5%	0.8%
LNG exports*	18.2	19.5	21.4	23.4	23.4	24.1	23.3	21.4	19.8	19.1	**21.5**	13.0%	0.5%	2.3%
Total exports	28.9	27.1	30.7	32.7	32.9	35.1	34.7	32.6	29.7	27.5	**29.2**	6.2%	-0.1%	3.1%
Europe														
Pipeline imports	276.1	218.3	224.8	234.4	228.5	234.1	209.4	214.9	230.5	247.5	**249.1**	0.7%	-0.6%	26.4%
LNG imports	57.4	70.5	89.1	89.2	68.2	51.8	52.1	56.0	56.5	65.3	**71.5**	9.6%	1.8%	7.6%
Total imports	333.5	288.8	313.9	323.6	296.7	285.8	261.4	271.0	287.0	312.7	**320.6**	2.5%	-0.1%	34.0%
LNG exports*	2.5	3.4	5.1	6.1	8.1	9.0	13.0	11.0	10.6	8.0	**11.7**	46.5%	47.8%	1.2%
Total exports	2.5	3.4	5.1	6.1	8.1	9.0	13.0	11.0	10.6	8.0	**11.7**	46.5%	47.8%	1.2%

(Dudley, 2018)

The LNG exports globally between 2008 and 2018 are shown in Table 6. Looking at the table, the largest LNG exporters for 2018 are Qatar and Qatar. Australia. In terms of Europe, notable exports are Russia and Norway, with the rest of Europe having extremely small exports. During the 20-year period between 2008 and 2018, while Russian LNG exports were consistently above the US, it is observed that in 2017 US LNG exports increased by 430% resulting in 2017 and 2018 surpassing Russian LNG exports (Dudley, 2018).

Table 6. LNG exports globally between 2008 and 2018.

Natural gas: LNG exports

Billion cubic metres	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Growth rate per annum 2018	Growth rate per annum 2007-17	Share 2018
US	1.0	0.8	1.5	1.8	0.8	0.2	0.4	0.7	4.0	17.2	**28.4**	65.4%	30.1%	6.6%
Peru	–	–	1.9	5.2	5.1	5.7	5.7	5.0	5.5	5.6	**4.8**	-14.5%	n/a	1.1%
Trinidad & Tobago	18.2	19.5	19.6	18.2	18.3	18.4	17.6	16.4	14.3	13.4	**16.8**	25.0%	-2.9%	3.9%
Other Americas*	–	–	–	0.1	0.5	0.1	0.2	†	0.6	0.3	**0.1**	-61.3%	n/a	•
Total Americas	19.3	20.3	22.9	25.2	24.7	24.3	23.9	22.1	24.5	36.5	**50.1**	37.2%	6.6%	11.6%
Russia	–	6.8	13.5	14.3	14.3	14.5	13.6	14.6	14.6	15.4	**24.9**	61.5%	n/a	5.8%
Norway	2.1	3.1	4.6	4.4	4.6	3.8	4.6	5.6	6.1	5.4	**6.6**	22.1%	42.3%	1.5%
Other Europe*	0.4	0.2	0.5	1.7	3.6	5.2	8.4	5.4	4.5	2.5	**5.0**	99.3%	n/a	1.2%
Total Europe & CIS	2.5	10.2	18.6	20.4	22.4	23.5	26.6	25.6	25.2	23.4	**36.6**	56.4%	64.6%	8.5%
Algeria	21.9	21.4	19.5	16.7	14.9	15.0	17.4	16.6	15.7	16.5	**13.5**	-17.9%	-3.8%	3.1%
Angola	–	–	–	–	–	0.4	0.4	–	0.9	5.0	**5.2**	3.1%	n/a	1.2%
Egypt	14.0	13.1	10.0	9.0	6.9	3.9	0.4	–	0.8	1.2	**2.0**	70.5%	-21.9%	0.5%
Nigeria	22.7	16.1	24.1	25.7	27.9	22.5	26.1	26.9	24.6	28.2	**27.8**	-1.3%	2.2%	6.5%
Other Africa	5.2	5.4	5.3	5.0	4.6	5.2	5.0	5.0	4.4	4.9	**5.4**	8.9%	8.2%	1.3%
Total Africa	63.8	56.0	58.8	56.4	54.2	47.0	49.5	48.5	46.3	55.8	**54.0**	-3.4%	-1.2%	12.5%
Oman	11.3	11.8	11.7	11.0	11.1	11.5	10.6	10.2	11.0	11.4	**13.6**	19.0%	-1.0%	3.1%
Qatar	41.1	51.8	77.8	100.7	104.0	105.8	103.6	105.6	107.3	104.0	**104.8**	0.8%	10.1%	24.3%
United Arab Emirates	8.3	7.8	8.7	8.3	8.1	7.9	8.6	7.6	7.7	7.3	**7.4**	1.7%	-1.3%	1.7%
Yemen	–	0.4	5.5	8.8	7.1	9.9	9.4	1.9	–	–	**–**	n/a	n/a	–
Total Middle East	60.7	71.8	103.8	128.7	130.3	135.2	132.2	125.4	126.0	122.7	**125.8**	2.5%	7.3%	29.2%
Australia	20.9	25.1	25.8	26.0	28.3	30.5	32.0	39.9	60.4	76.6	**91.8**	19.9%	13.9%	21.3%
Brunei	9.4	9.0	9.0	9.6	9.2	9.5	8.6	8.7	8.6	9.1	**8.8**	-4.0%	-0.5%	2.0%
Indonesia	27.8	26.9	32.4	28.7	24.4	23.1	21.7	21.6	22.4	21.7	**20.8**	-4.1%	-2.8%	4.8%
Malaysia	30.4	30.4	31.0	33.2	31.4	33.6	34.0	34.3	33.6	36.1	**33.0**	-8.5%	1.6%	7.7%
Papua New Guinea	–	–	–	–	–	–	5.0	10.1	10.9	11.1	**9.5**	-14.6%	n/a	2.2%
Other Asia Pacific*	–	–	–	–	–	0.1	0.2	0.8	0.5	0.8	**0.6**	-27.0%	n/a	0.1%
Total Asia Pacific	88.6	91.5	98.3	97.5	93.3	96.8	101.5	115.5	136.4	155.4	**164.5**	5.8%	5.6%	38.2%
Total LNG exports	**234.9**	**249.7**	**302.4**	**328.3**	**324.9**	**326.8**	**333.6**	**337.1**	**358.3**	**393.9**	**431.0**	**9.4%**	**5.4%**	**100.0%**

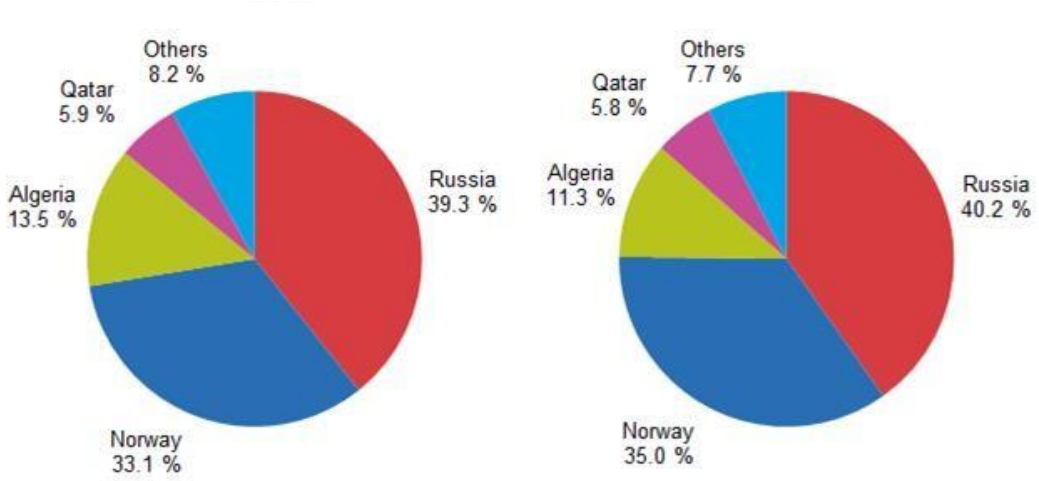
*Largely consists of re-exports.
•Less than 0.05%.
n/a not available.
Gross LNG trade.

Source: (Dudley, 2018)

Russia was the main supplier of natural gas to the EU in both 2017 and 2018. The only other countries with a significant share of total imports outside the EU were Norway and at some distance Algeria and Qatar. The global share of all countries exporting natural gas to the EU was 8.2% in 2017 and 7.7% in 2018 in terms of commercial value. In 2018, Russia supplied 201 billion cubic meters of natural gas to European countries or 38% of Europe's total gas demand (Chyong, 2019). Figure 15 shows the extra-EU imports of natural gas from main trading partners for the period 2017 and 2018.[5]

[5] *Source: https://ec.europa.eu/eurostat/statistics-explained*

Figure 15.Extra-EU imports of natural gas from main trading partners, 2017 and 2018



Source: (Staub & Lead, 2015)

European LNG imports increased by 9% in 2018 to stand at 52.4mt, representing 19% of LNG imports globally, and accounting for 17% of global growth, with expansion supported by growing imports from Russia. Going into 2019, imports into Europe appear to have grown robustly in the first half of the year amid ample global supply, which has led to inventories in the region reaching multi-year highs. As a result, European LNG imports could come under some pressure in the second half of 2019, whilst the start-up of the natural gas pipeline' Nord Stream 2' from Russia in 2020 could have an impact next year. Nonetheless, in the short-term, with the shut-in of the Groningen field in the Netherlands, the output from the mature North Sea in long term decline, and the potential for Rotterdam to become an LNG bunkering hub, there remains scope for further LNG import growth. Overall, European LNG imports are currently projected to increase by 14% y-o-y in 2019 to an estimated 60mt. Looking further ahead, US LNG export projects that are scheduled to come online towards the middle of the next decade are thought likely to target European markets. The potential there for exists for some political tensions to arise, should the US and Russia compete to supply European markets, whilst Europe may also face political and economic decisions regarding its energy sources (Smead, 2019).

Figure 17. France LNG Imports by source

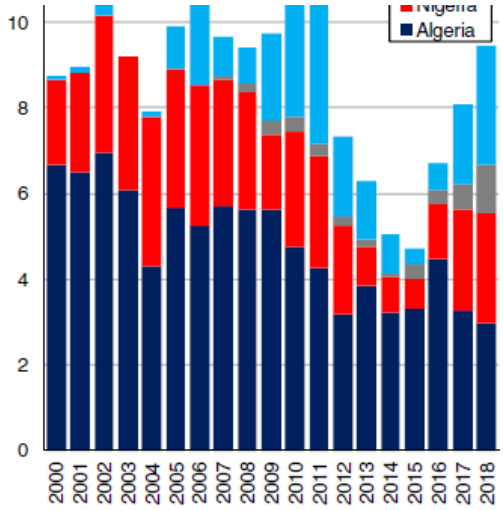
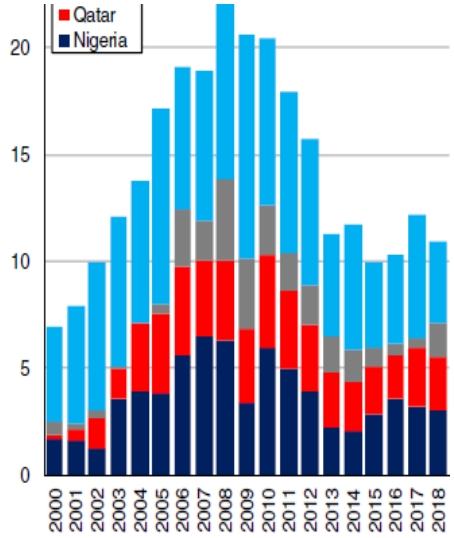


Figure 16.Spain LNG Imports by source



Source: (Dudley, 2018)

Imports of liquefied natural gas in Europe in 2019 are likely to be formed by the events of the end of 2018, including the existence of an LNG supply, a decline in European domestic gas production and an increase in demand for natural gas, including industrial development sector and the competition between gas and coal in the energy sector. If these conditions remain, high levels of LNG could be delivered to the gas markets across Europe. However, the behavior of pipeline owners will be a major factor in determining the amount of LNG reaching European terminals. Even after exporting record volumes to Europe in 2018, Russia keeps additional export capacity, which could lead to increased competition with LNG, especially if global LNG prices rise with higher demand (Sharples, 2019).

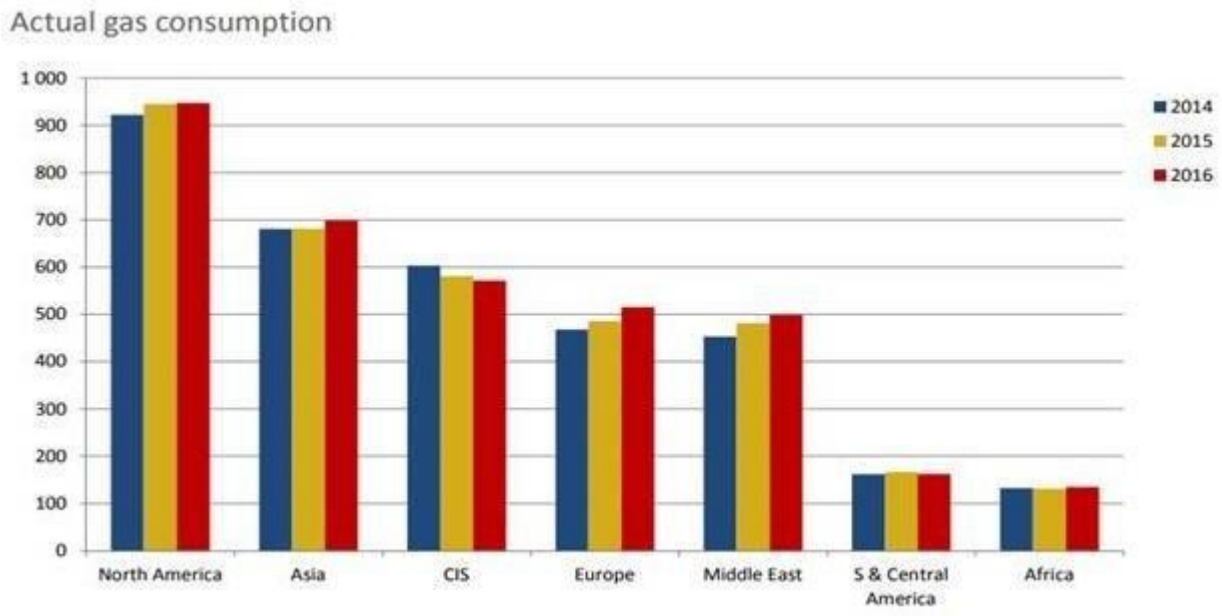
In 2018, 13 Member States imported a total of 62 billion cubic meters of LNG (bcm, gas equivalent), up 11% from a year earlier. LNG imports accounted for 14% of all non-EU gas imports in 2018 (52.4 million tones). Spain was the largest LNG importer in the EU with 25% of total EU LNG imports in 2018, followed by France (22% 14%) and the United Kingdom (11%). Less than 30% of the EU's gas needs are currently covered by domestic production (Figure 17) (Dudley, 2018).

The rest is imported, mainly from Russia (43%), Norway (33%) and Algeria (9%), in addition to LNG sources, as 2018 annual data shows. In recent years, LNG share has

increased, accounting for about 14% of imports in 2018, with the majority coming from Qatar (33%), Nigeria (17%) and Algeria (13%). The EU's total LNG import capacity is significant - enough to cover about 45% of total gas demand. (480 (bcm) (Sharples, 2019).

Future European energy security will in the coming years increasingly rely on pipeline gas imports either in LNG form or on artificial or natural gas storage sites.

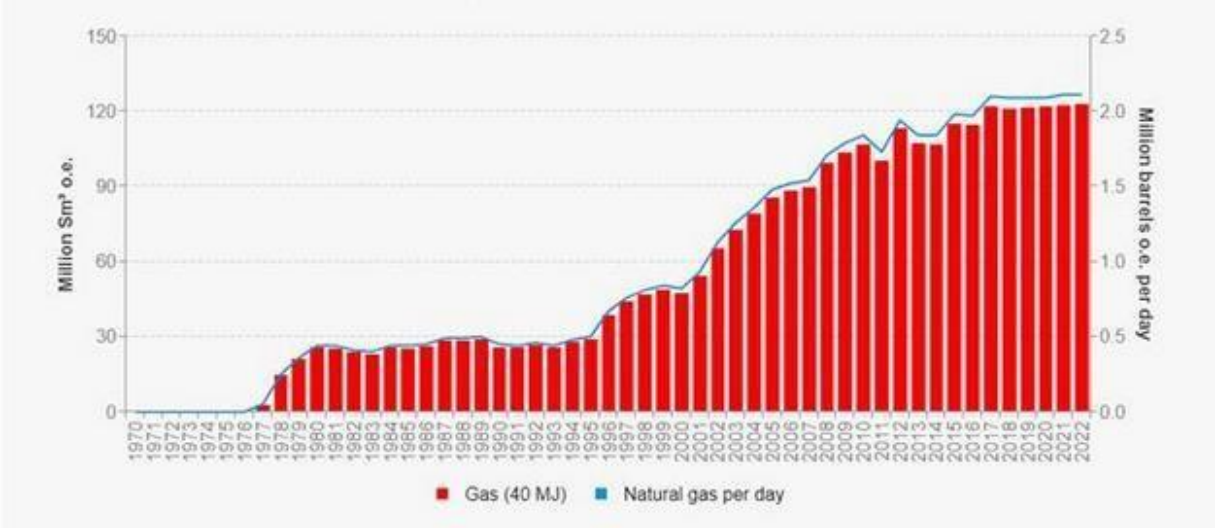
Figure 18. Annual Natural Gas Consumption by Region for 2014, 2015 and 2016.



Source: (Kan et al., 2019)

In Figure 18 we observe gas consumption for the years 2014, 2015, 2016 by region, with North America and Asia showing the highest prices (Kan et al., 2019). Europe, according to CEDIGAZ, consumed about 510 billion to 520 billion cubic meters of gas in 2016. According to the European Commission, for 2016 the EU-28 gas imports were covered by Russia at 39.5% of total imports, Norway at 34.4% by total imports, Algeria at 15% , 1% of total imports, Qatar 5.0% of total imports, and other sources 6.0% of total imports (Ruble, 2017). Particularly in the case of Norway, Figure 19 shows the rapid increase in its gas exports over a period of 50 years, from 1970 to 2016 and forecasts to 2020. (Shaton et al., 2019).

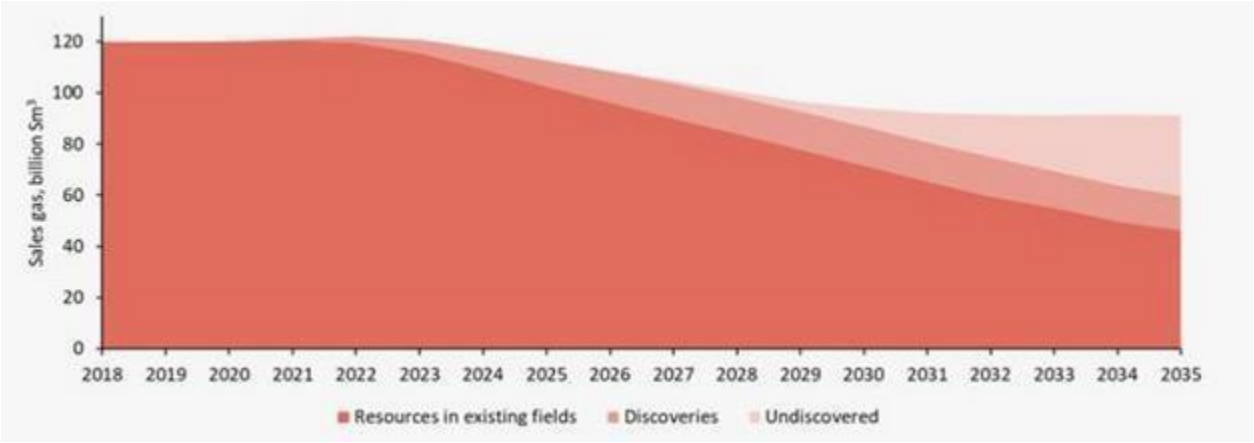
Figure 19. Norway's Annual Natural Gas Exports by 2016 and Forecast by 2022.



Source: (Shaton et al., 2019)

According to the Norwegian Ministry of Energy, Norway exported 115 billion cubic meters of gas to Europe for 2016. We conclude that Norway plays an important component of European Energy Security. Future gas exports from Norway to Europe will be affected by the future energy policy, the International future prices of gas and oil, the future gas prices of European 'hubs', the future discoveries of new natural gas fields in Norway's Exclusive Economic Zone (EEZ) in Norway, the level of future EU domestic gas production and the EU's geopolitical relations with Russia (Wunsch, 2018: 35).

Figure 20. Future gas sales from Norwegian natural gas fields from 2018 to 2035.



Source: (Shaton et al., 2019)

"From 2022 onwards, Norway's reduction in gas production (Figure 20), while simultaneously reducing European gas production poses the crucial energy dilemma in the EU, replacing all these quantities with cheap Russian gas or paying a more expensive price for LNG imports. The choice of LNG is the right direction for European Energy Security. Also, another important element of

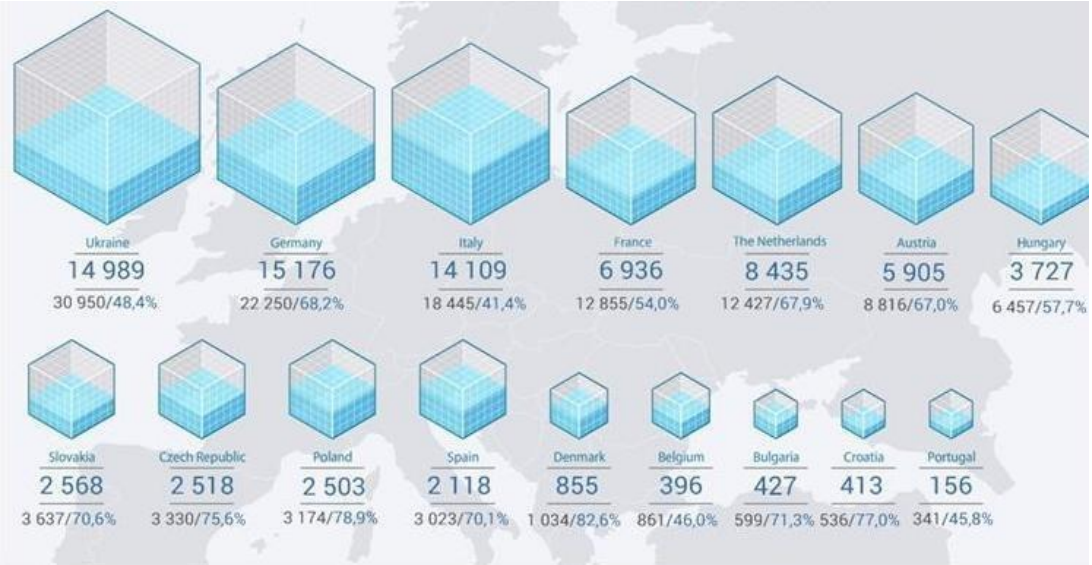
European Energy Security is artificial or natural gas storage areas" (Sharples, 2019). According to Naftogaz Europe (Ukrainian Gas and Oil Company, the largest in the country), countries have the following natural gas storage capacity:

Table 7. Countrie's following natural gas storage capacity. Source:

Country	Gas storage capacity (billion m^3)
Ukraine	31
Germany	22.2
Italy	18.4
France	12.8
The Netherlands	12.4
Hungary	6.3
Austria	8.8
England	4.6
Slovakia	3.6
CZECH	3.3
Poland	3.1
Spain	3.0
Denmark	0.9
Belgium	1.0
Bulgaria	0.55
Croatia	0.53
Portugal	0.34
Europe	133.01

(Szurlej et al., 2019)

Figure 21. European level of gas storage on 24/12/2017.

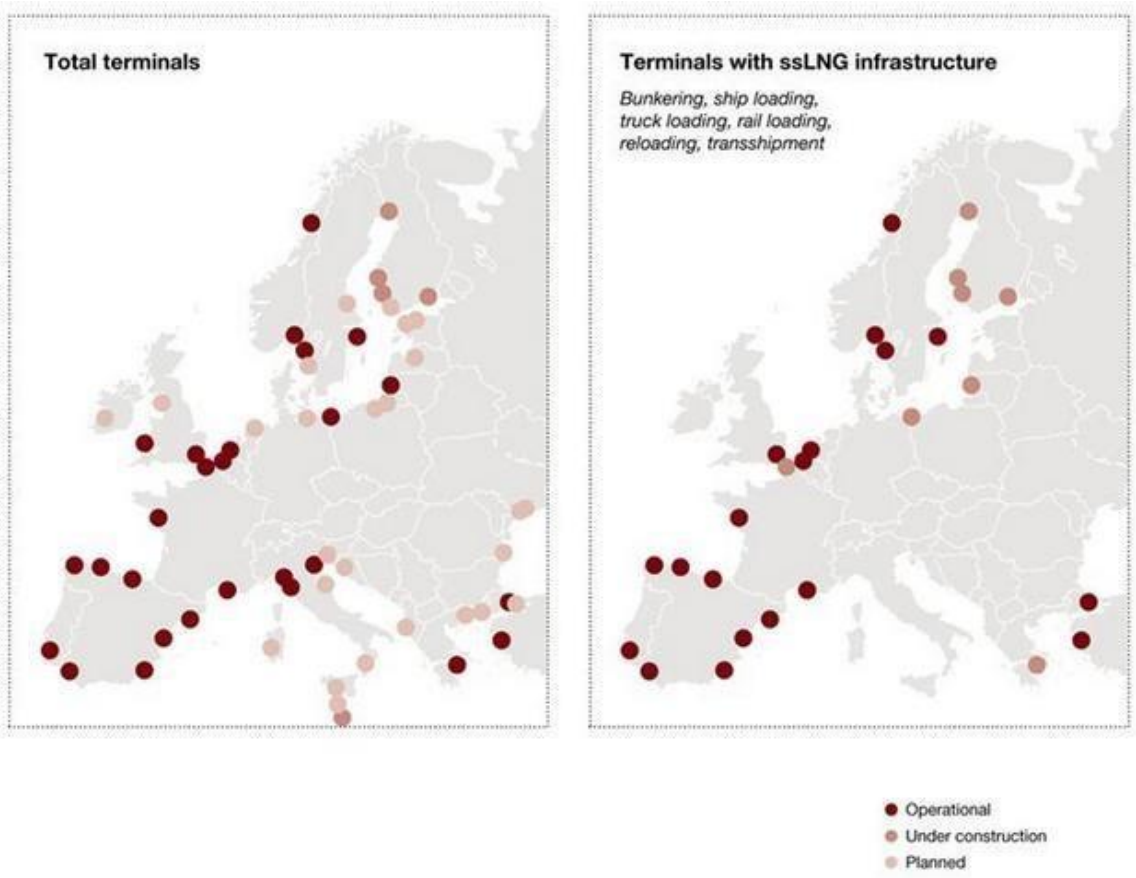


Source: (Bai et al., 2018)

"Europe can save up to 26% of its annual gas consumption, a factor that gives many advantages in shaping its future European Energy Security. In addition, Europe has many high-capacity liquefied natural gas import terminals, which it plans to increase in the coming years. Of course, the utilization of these infrastructures is still very low. Figure 21 shows European level of gas storage, with Ukraine, Germany and Italy having the largest storage capacity" (Bai et al., 2018: 585-586). Figure 23 shows the existing and future European Liquefied Natural Gas import terminals (Kan et al., 2019), while Figure 23 shows the significantly increased share of Liquefied Natural Gas (LNG) in the future European energy mix and design.

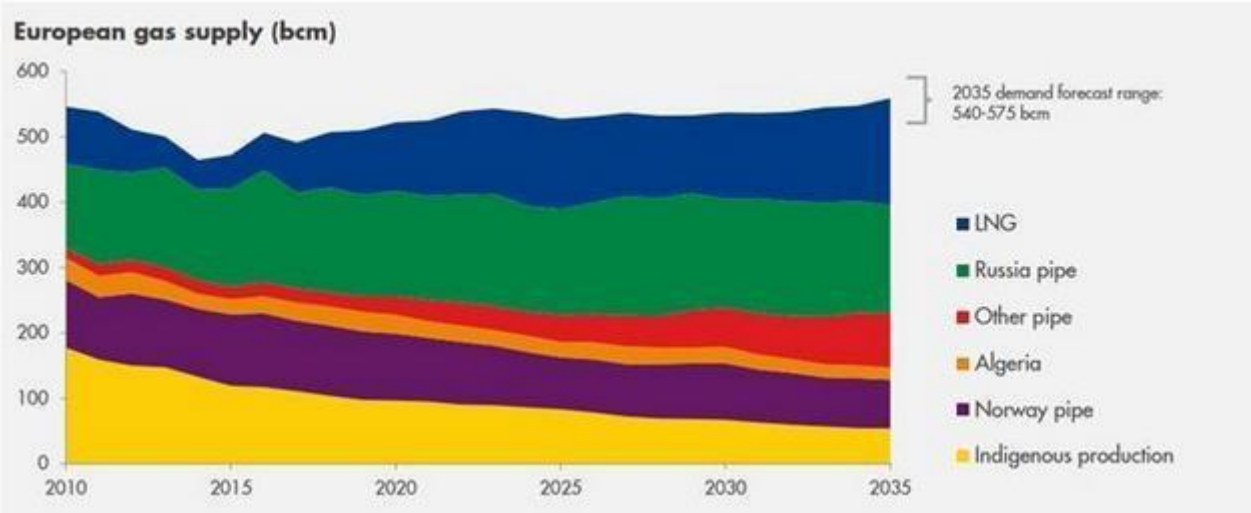
"The increased role of liquefied natural gas (LNG) in the future European energy mix will be a strong European paper over Russia in the future geopolitical and energy chessboard of Eurasia. The Eastern Mediterranean would be an excellent choice for Europe to supply LNG. Such a move would lead to a geopolitical convergence of the EU with Israel and Egypt with intermediate countries Greece and Cyprus" (Omoregie, 2019: 179).

***Figure 22. Existing and future European liquefied natural gas import terminals*.**



Source: (Kan et al., 2019)

Figure 23. The share of Liquefied Natural Gas (LNG) in the future European energy mix and design.



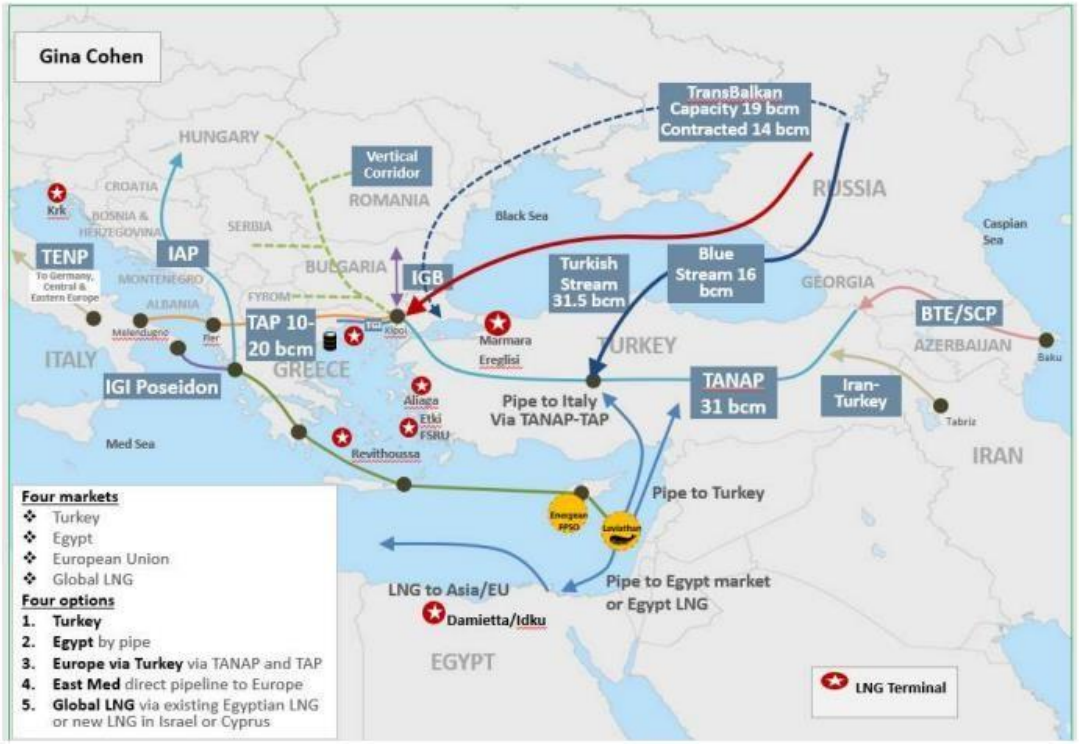
Source: (Omoregie, 2019)

5.3. The EU's PCIs

Projects of Common Interest (PCIs) are key cross border framework projects that connect the energy frameworks of EU countries. The objectives that EU must accomplish its energy approach and climate destinations are right off the bat, reasonable, also secure and manageable energy for every European resident and thirdly, the long haul de-carbonization of the economy as per the Paris Agreement and PCIs helped all EU Member States to accomplish these objectives. The conditions that must have projects remember a huge effect on energy markets and market combination in the least two EU countries, the lift rivalry on energy markets and help the EU's energy security by expanding sources just as add to the EU's climate and energy objectives by coordinating renewables. Since 2013, every two years, the European Commission draw up a new list of PCIs. More specifically, on 31 October 2019, the Commission published its fourth list of PCIs, which contains 151 projects, 102 electricity transmission and storage, 6 smart grid deployment, 32 gas, 6 oil and 5 cross- border carbon dioxide networks (Kotek et al., 2019).

Projects of Common Interest may benefit from accelerated planning and permit granting, a single national authority for obtaining permits, improved regulatory conditions. Furthermore, benefit from lower administrative costs, enlarged public participation via consultations and last but not least, increased visibility to investors. This corridor structures three large pipelines: Blue Stream, the Trans-Balkan Pipeline (TBP) and TurkStream 1 and 2 (Acebillo, 2015). TBP has a central role in the region since the 1980s, when Russia started to export natural gas to Turkey and the Balkans, but this project phased out when the existing transit contract with Ukraine comes to an end in 2020. Consequently, the TurkStream 1 and 2 replace TBP as the leading supply line on a north-south route (Korsman, 2019). Figure 24 shows the import and export routes linked to Turkay'snorthen corridor and Figure 25 shows the Blue Stream & TurkStream gas pipelines (Franza, 2015).

Figure 24. Import and export routs linked to Turkay'snorthen corridor.



Source: (Acebillo, 2015)

Figure 25. Blue Sream & TurkStream gas pipelines.

Source:(Franza, 2015)

5.4. Eastern Mediterranean: A recent development

Eastern Mediterranean (EastMed) is a 1,900km natural gas pipeline project connecting the gas reserves of eastern Mediterranean to Greece. The pipeline will have the capacity to move 10 bcm every time of gas to Greece and Italy and other south-east European countries. The limit of its capacity is expected to be expanded to a most extreme of 20bcm/y in the subsequent stage. The EastMed pipeline incorporates a 1,300km seaward and 600km inland pipeline segments. It will move natural gas from the Levantine Basin in Israel to Greece and Italy. The $5.9bn venture has been affirmed as the Project of Common Interest (PCI) by the European government. It is being created by IGI Poseidon, which is mutually claimed by the Public Gas Corporation of Greece (DEPA) and Edison International Holding (Aslanli & Isayev, 2019).

The EastMed pipeline is the most key decision for our nation for the transportation of natural gas from the fields of Israel and Cyprus to the European Markets through Crete, the Peloponnese and NW Greece to Italy, as it will incredibly redesign the geopolitical explicit load of our nation in the Eastern Mediterranean simultaneously, the plausibility has been talked about, to broaden the EastMed pipeline, through the previously existing framework, towards Bulgaria and Romania, just as other European countries. Enthusiasm for contribution in the EastMed pipeline has been likewise communicated by the Egyptian side.

The EastMed pipeline project will improve Europe's energy security by broadening its courses and sources and giving direct interconnection to the production fields. It will give a chance to Cyprus to converge with the European gas framework, which will additionally upgrade gas exchanging the south-east European area. The undertaking will likewise bolster the financial advancement of Cyprus and Greece by giving a steady market to gas sends out. It will empower the advancement of gas exchanging centers Greece and Italy and encourage gas exchanging south-east Europe (Aslanli & Isayev, 2019).

5.5. Conclusion

Europe has adequate LNG import limits to profit by this short-to medium-term abundance supply. However, two obstacles could restrict LNG import to Europe. The EU competes with other byers, particularly from Asia, regarding the existing LNG volumes.

There are some infrastructural bottlenecks in the EU. In general, nonetheless, the broke down zone EU 28 and Switzerland has great access to different gas sources. Later on, the gas import request is required to expand, which establishes a test to the European security of gas supply. A few non-EU gas sources, for example, Algeria and Norway for instance, are impossible for future extra gas fares to Europe.

The LNG market faces an overall extension of import and export limits. The EU will profit by this circumstance, fundamentally until the mid-2020s. From Russia's perspective, Russia has an enormous, unused production potential; that is accessible for send out. The extra gas import request of EU 28 is required to be for the most part provided by pipeline gas from Russia and LNG. Rivalry the market will decide the particular extents.

Russia and the LNG world market have been distinguished as reasonable suppliers as they have adequate stores and production limits and as there is an export, transport and import infrastructure set up that would make these gas saves useable for the EU. Likewise, we can compute the degree of the EU's energy reliance with the assistance of the Herfindahl Hirschmann Index (HHI). A high HHI infers that for its gas supply the EU relies upon generally scarcely any huge suppliers. A low one shows that the stock is originating from countless generally little suppliers. Subsequently, countless little suppliers implies that these suppliers have less power to impact EU arrangements than few huge suppliers. Therefore, a high HHI means that progressively potential outer effect on EU-arrangements.

CHAPTER 6: Conclusion

Over the last 20 years, gas has become one of the fastest growing energy sources in the world. Together with coal and oil, gas is the so-called 'Big Three', accounting for 87% of primary energy worldwide in 2015. Although it is characterized by monopolies and high capital requirements associated with significant risks, its maritime transport LNG is a promising industry in global shipping.

Undoubtedly, a crucial part of the development and development of LNG trade is the fact that this is a sustainable energy investment with significant economic and environmental benefits. In the coming years, the growing demand to reduce global carbon dioxide emissions, in particular carbon combustion, is likely to support demand for natural gas, as combustion gas emits about 30% less carbon dioxide. oil and about 45% less than coal.

In a historic reversal, gas was first exported as an energy commodity by the US in the early 20th century. However, the oil crisis of 1973 brought significant changes to the layout of the world energy map. Efforts to reduce oil dependency have given impetus to the development of natural gas to gain its own share of the energy market.

From 1970 to the present, the course of gas has been on a positive track, except in recent years where it has experienced a modest increase due to the economic crisis. Global demand - gas consumption in 2013 was over 3.347 billion. cubic meters, while world consumption ten years earlier amounted to about 2,596 billion. cubic meters. Thus, we have seen a positive percentage change in the order of 28.9% over the past decade. In fact, in 2013, 29 countries imported liquefied natural gas, with the largest importers being Japan, South Korea and China.

US LNG is a “game-changer” for the European market US LNG has implications for the security of European gas supply and its competitiveness. The effect of capping the gas price to the US spot price increased by transportation and regasification costs (about
$8 considering total costs and $4 with variable costs), with excess capacities are ready to be exported to Europe, create new circumstances for the US to export US LNG with traditional suppliers under more favorable conditions.US LNG also provides Europe with a greater security of supply. Many political facts, like the Russian-Ukrainian crisis, or other global attacks have many negative influences in the EU’s energy market and set up the start to find alternative energy sources and energy suppliers for the European energy needs.

Nowadays, the growth in the United States LNG export capacity increases the security of European gas supply. The European Strategy for LNG should enhance this security by facilitating the construction of missing infrastructure (import terminals or interconnecting pipelines), so that each Member State may have access to this energy source. However, there are many projects, like PCIs (Projects of Common Interest) that compete US LNG because they cover the EU's need to diversify energy sources and commodities.

Another competitor for US LNG is Russia. Gazprom's reaction to this new competition seems to indicate that the group is preparing to defend its market share. The low Russia gas prices which reflect the falling crude oil prices are comforting this strategy. However, a price war cannot be an end itself or lost too long, neither for Gazprom nor for the Russian state. The risk of under-investment is significant at current oil and gas prices, and the strategy of traditional gas suppliers as regard requires cooperation between buyers and LNG producers to ensure that the necessary investments after the first wave of LNG project are made. To conclude, under circumstances, US LNG could change the energy market and create new opportunities for investment, different political cooperation at the energy field and cover European needs and implications for the security of supply..

The energy world today is brimming with vulnerability: numerous advancements added to a situation where it has gotten progressively hard to anticipate future patterns. Simultaneously, the European Union's gas import reliance is developing and in this manner additional chances that can imperil the EU's security of gas supply. Along these lines, while the circumstance turns out to be progressively difficult, it is likewise increasingly more significant for the EU to know how the dangers that challenge its protected energy supply of gas. European Union could diminish these risks just with the character of energy sources and supply. Hence, the EU has enacted focus to deal with these dangers and find for options energy sources, as Renewable Energy Sources or differentiate its suppliers, similar to US LNG ventures and Projects of Common Interest (PCI), to decrease Russia's gas energy reliance.

European countries have tried to expand their sources and courses of gas supplies as a way to lessen their reliance on the customary local exporter, Russia. Accordingly, makers, for example, Azerbaijan, Cyprus, Iran, Iraq, Israel, Romania, Turkmenistan have

communicated a premium and were thusly energized by Brussels, to investigate the probability of sending out gas to European markets.

Europe faces challenges identified with its future energy needs. The quick ascent in world interest, the proceeding with instability in energy-delivering regions, for example, the Middle East, the divided European inward market and rivalry for energy assets from developing economies, for example, China and India, and the expanding requirement for fuel movements to handle climate change. Subsequently, the security of its energy supply is currently a key worry for the European countries and the European Union. (EU). Europe is subject to Russia for its energy supply and restricts arranging an arrangement that tends to its developing number of worries for Russia (military, political, business) without endangering energy imports. Simultaneously, Russia's new American certainty, both in energy and other outside relations, has more than once drove it to torment its exchanging accomplices, including the EU.

As a rule, the European Union's energy reliance on Russia is perilously expanding following ongoing advancements in gas and the Moscow-Budapest Agreement. The Nord Stream 2 pipeline is relied upon to begin in Russia and end in Germany, while Turk Stream will arrive at Hungary utilizing Bulgaria and Serbia, obstructing the old landmass. Furthermore, According to the International Energy Agency (IEA), Europe's condensed natural gas imports will increment by about 20% by 2040 contrasted with 2016 levels. Russia was the biggest supplier of gas to the EU in 2017 as of 2018. The main different accomplices with a noteworthy portion of absolute imports outside the EU were Norway and at some separation Algeria and Qatar. The worldwide portion of all countries trading gas to the EU was 8.2% in 2017 and 7.7% in 2018 as far as business esteem. Gas as of now represents about a fourth of the EU's complete energy utilization. About 26% of this gas is utilized in the electricity age segment (counting cogeneration plants) and about 23% in industry.

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