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Liquefied Natural Gas exports from the United States and their impact on European energy security

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Master thesis

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Abstract

Over the past years, the United States has become a net exporter of natural gas. Policy makers on both sides of the Atlantic wish to use the new role of the United States to enhance European energy security. However, the literature suggests that Europe is an unlikely destination for Liquefied Natural Gas (LNG) from the United States, other markets are said to be more attractive destinations. The goal of this research is to examine the feasibility of LNG exports from the United States to Europe and to see how exports from the United States affect European energy security.

Research by Ebinger, Massy and Avasarala (2012) regarded the following topics to be key for feasible LNG exports: an adequate and sustainable domestic resource base, environmental issues, regulatory considerations, capacity and infrastructure, domestic demand as well as the global gas market. Their conclusion was that the main concerns were mainly in the legal field. The reasons for this were regulatory uncertainties, complicated and expensive licensing procedures and a generally hostile attitude of the public towards fracking. The legal and physical developments have not negatively influenced the feasibility and the most recent developments even have positive effects for export feasibility.

But, this research acknowledges the suggestion that the main concerns for exports to Europe are economic. Just 2 out of the first 21 LNG exports from the Sabine Pass in 2016 have had Europe as their destination. The EU is aware of these issues and has created a LNG strategy that aims to improve the attractiveness of Europe as destination market. The strategy seems to work properly and the goals are well-chosen. Both the physical infrastructure and political structure of the internal market of the EU receive serious attention. The common projects will eventually lead to a well-functioning internal market, improving the conditions for LNG imports. These market improvements also enhance the energy security of multiple countries that are currently (almost) completely reliant on Russian gas.

Existing research suggested that LNG originally destined for the United States was diverted to Europe and Asia as a result of the shift in the United States natural gas landscape towards exports. This research examines the statistics for the main suppliers. The conclusions are surprising, because no significant evidence was found that these transports have indeed been diverted to Europe; in fact, the opposite has been the case.

The lower prices on the European markets have led to decreasing LNG imports and an increase in pipeline imports from the traditional suppliers, most notably Russia. Another development that is taking place is a development away from long term contracts (LTCs) based on oil-indexation, towards spot prices at European hubs. This development has further decreased the European gas prices relative to Asian prices, effectively keeping LNG out of the European markets. But these developments have nevertheless strengthened the external energy relations of the EU; increasing bargaining power towards suppliers and creating a stronger normative position in the region because of internal market improvements.

Structure

List of Abbreviations

ACER	European Agency for the Cooperation of Energy Regulators
APERC	Asia-Pacific Energy Research Centre
BCM/bcm	Billion cubic metres of natural gas
BLM	United States Bureau of Land Management
CETA	Comprehensive Economic and Trade Agreement – bilateral trade agreement between Canada and EU, signed October 2016
DOE	United States Department of Energy
EaP	Eastern Partnership of the European Union
EC	European Commission
ECSC	The (former; 1952-2002) European Coal and Steel Community
EEA	European Economic Area
EEAS	European External Action Service
EEC	The (former; 1958-1993) European Economic Community, predecessor of the European Union.
EFTA	European Free Trade Association
EIA	United States Energy Information Administration
ENP	European Neighbourhood Policy of the European Union
EP	European Parliament
EPA	United States Environmental Protection Agency
ESS	Energy Security Strategy of the European Union
EU	European Union
EU28	All 28 EU Member States since July 1st 2013 when Croatia joined; situation before a (possible) British exit of the EU.
FERC	United States Federal Energy Regulatory Commission
FTA	Free trade agreement
GATT	General Agreement on Tariffs and Trade
GIE	Gas Infrastructure Europe
HR/VP	High Representative of the European Union, Vice President of the EC
IEA	International Energy Agency
IGU	International Gas Union
LNG	Liquefied Natural Gas
LTC(s)	Long term contract (-s)
MMBtu / mmBtu	One million British thermal unit of natural gas
MoU	Memorandum of Understanding

MS / MSs	EU Member State / EU Member States
NAFTA	North American Free-Trade Agreement
NATO	North Atlantic Treaty Organization
OPEC	Organization of the Petroleum Exporting Countries
PCIs	Projects of Common Interests of the European Union
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
TPP	Trans-Pacific Partnership – trade agreement between the United States and various Pacific nations including Japan and Australia, cancelled by new United States President Trump on January 23, 2017
TTIP	Transatlantic Trade and Investment Partnership - bilateral trade agreement between the United States and EU currently being negotiated
UNFCC	United Nations Framework Convention on Climate Change
US	United States of America
USSR	The (former, 1922-1991) Union of Soviet Socialist Republics
WTO	World Trade Organization

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1. Introduction

1.1 Background

There was a memorable, yet little known day for global geopolitics at the end of April 2016. It is so little known that it is even hard to find the exact date; but on April 26th 2016, the first Liquefied Natural Gas (LNG) shipment from the United States to Europe[1] arrived at its destination harbour in Portugal. The LNG carrier *Creole Spirit* delivered 174.000 cubic metres of LNG, which is the rough equivalent of one week of Portuguese domestic gas consumption (LNG World News, 2016). One-week worth of Portuguese gas consumption is not that memorable, such shipments arrive at ports on a daily basis. The memorable thing is the supplier of the gas; the fact that American[2] gas has reached the European continent is something that was unimaginable just a decade ago.

Back then, the United States saw rising LNG imports for which several import facilities were being built and planned (EIA, 2009). On the other end of the Atlantic Ocean, Europe imported a, by that time, all-time high 160,9 billion cubic metres (bcm) of natural gas in 2007 from the Russian Federation (Dickel et al., 2014). The 2006 Russian-Ukrainian gas conflict affected European markets and action was taken by the European Union (EU). The 2009 and 2014 Russian-Ukrainian gas crises inspired even more EU action (Grabau & Hegelich, 2016). It did not take long for the EU to strengthen its efforts of diversification to become less dependent on Russian gas. The disputes and other issues with Russia have made politicians and the public wary about the dependence on Russian commodities. And natural gas is the most politicized and controversial of all these commodities (Correljé, 2016; Siddi, 2015).

Energy and the geopolitics surrounding it are a top priority in the world, especially in Europe, the biggest importer of energy sources worldwide (Bilgin, 2009; Goldthau, 2013; Mitchell, 1996). This is potentially risky and a financial burden, therefore energy security is a major concept in EU politics and one of the pillars of the 2014 Juncker Commission (Glamotchak, 2015; Siddi, 2016). Aiming at renewable sources of energy is crucial in the EU strategies, but recent green policy choices of the EU and its Member States have not been made merely out of idealism. In fact, they are smart political choices, strategically and economically (Vinois, 2017). These choices have been necessary for the competitiveness of the EU markets, but the ambition of becoming a 'green powerhouse' is noble and has serious potential.

The EU is the main driver behind global environmental discussions and it remains committed to reaching emission targets (European Commission, 2017a; Najšlová, 2014). Climate change is a highly politicized topic and arguably the number one geopolitical topic of our time (Giddens, 2009; McCright & Dunlap, 2011). In the discussions on climate change and energy security, natural gas comes forward as the perfect *bridge fuel* from the conventional imported sources towards completely emission

[1] 'Europe' generally refers to the countries and institutions of the European Union in this thesis
[2] 'American' refers to the United States of America in this thesis

free energy sources (Franza, de Jong, & van der Linde, 2016; Schobert, 2002). This perspective is generally acknowledged; natural gas and renewables are the big winners in the race to meet energy demand growth until 2040 (IEA, 2016d).

The conclusion of these developments is that ten years ago both the United States and the EU were importing natural gas, whereas April 2016 saw the first contemporary delivery of American gas across the Atlantic. The possibility of LNG exports has been a surprising development even to Americans, but the developments leading to it did not happen overnight. Possible LNG exports from the United States to the EU are frequently mentioned and considered by policy makers on both sides; Czech and Hungarian diplomats (Leifheit, 2016), United States senators (Hoeven & McCain, 2014), European Commissioners (Cañete, 2015), United States secretaries (Peixe, 2014), European leaders (Emmott & Strupczewski, 2014), and the research service of the European Parliament (De Micco, 2016) are just a selection of that group of policy makers and politicians. And this is not surprising, successive American governments have paid high level attention to European energy security with bipartisan support (Shaffer, 2017).

The goal of these policy makers is to improve European energy security, based on the assumption that a new reliable natural gas supplier will help. Until now however the concrete implications for Europe and European energy security have remained relatively unclear. In addition, it is even unclear whether significant exports from the United States to Europe are even feasible. This research looks at both sides, to see how the LNG exports from the United States translate to European energy security and to find how likely those exports are.

1.2 Research Questions

Two topics have been presented in the introduction of this research; European energy security and LNG exports from the United States. Influential politicians on both sides of the Atlantic see potential benefits for European energy security if LNG will be imported from the United States. But the impact has not been extensively examined so far. The EU focuses heavily on renewables, it is interesting to see how LNG imports from the United States would fit in. But it is still unclear whether these imports are feasible on a significant scale. The goal of this research is to examine the feasibility of LNG exports from the United States to Europe, and to describe how these impact European energy security. This will be done with the following main research question:

How do Liquefied Natural Gas exports from the United States (since 2007) impact European energy security and to what extent are exports to the European Union feasible?

This research asks four sub-questions to answer the main research question in the best possible way.
Sub-question 1: *How do LNG imports from the United States fit the energy security goals of the EU?*
Sub-question 2: *To what extent are LNG exports from the United States to the EU feasible?*

Sub-question 3: *To what extent are European LNG imports from the United States feasible?*
Sub-question 4: *What is the impact of LNG exports from the United States (since 2007) on the energy security of the EU?*

1.3 Academic state of the art

As discussed in the background and research question section, this research will cover three main aspects; EU energy security, feasibility of LNG exports from the United States to Europe and the consequences of the LNG exports from the United States on EU energy security. This section will deal with the existing literature on these topics, before the methodology of this research will be explained in the section hereafter.

1.3.1 European energy security

Firstly, this research examines EU energy security. The concept of energy security is widely discussed by scholars, but there is no consensus or common principle for the analysis of energy security (Löschel, Moslener, & Rübbelke, 2010). There are however, several works that are commonly cited, such as work by the Asia Pacific Energy Research Centre (APERC, 2007), Sovacool and Mukherjee (2011) or Cherp and Jewell (2011). The APERC research is characterized by its focus on the *four A's*[3] which was a starting point for other researchers such as Kruyt, van Vuuren, de Vries, and Groenenberg (2009). Sovacool and Mukherjee come up with twenty indicators, Cherp and Jewell look at energy security from three different disciplines[4] and have developed a comprehensive figure that is often cited (Kopp, 2014; Lucas, Escribano, & González, 2016; Månsson, Johansson, & Nilsson, 2014).

There is also research that has developed a concept for usage in that respective work, such as Escribano and Garcia-Verdugo (2012) or Haghighi (2007) and research that combines elements of other research on energy security such as Kopp (2014) or Chester (2010). Escribano and Garcia-Verdugo (2012) focus on European energy security and their conclusions mainly look at renewables and the potential of energy plans in the European neighbourhood. They emphasize the *Europeanization* of energy in international energy corridors[5], which is still a part of energy strategies of the EU.

But surprisingly, these EU strategies have not received significant academic attention yet. Lucas et al. (2016) discuss European energy security but only briefly mention the EU Energy Security Strategy; stating that the strategy does not actually discourage the usage of fossil fuels. The Energy Security Strategy of the EU is discussed by Franza and van der Linde (2017) and Boersma and Goldthau (2017), as part of the wider EU external energy relations. Research coupling the specific energy security goals of the EU strategies to the developments regarding LNG exports from the United States does not exist yet.

[3] Accessibility, acceptability, affordability and availability
[4] Political science, economics, natural science and engineering
[5] Land plots allocated for special planning as preferred locations for energy transport in all its forms

1.3.2 Feasibility of LNG exports from the United States to Europe

Ebinger, Massy, and Avasarala (2012) looked at the feasibility of LNG exports from the United States. This research identified the main factors that influence the feasibility of LNG exports: an adequate and sustainable domestic resource base, environmental issues, regulatory considerations, capacity and infrastructure, domestic demand as well as the global gas market. Other research has also looked at these factors and the general conclusion is that the amount of recoverable gas poses no problem, but that difficulties lie mostly in the regulatory field (Boersma, Ebinger, & Greenley, 2015; Konschnik & Boling, 2014; Stevens, 2012).

The first LNG exports from the United States have mostly had other destinations[6] than Europe. Raising the question whether Europe can be a serious destination[7] for American LNG as high ranked politicians and security people in the United States would like to see in support of European energy security (Traynor, 2014). A positive answer to the feasibility question would be welcome for policy makers counting on these exports, and there is research that concludes that Europe will seriously benefit (Kim & Blank, 2015; Kopp, 2014; Koranyi, 2016; Luciani, 2016). But there is also research such as Kopp (2014) or Chyong (2016) suggesting that the EU will only receive little LNG from the United States. Most research, including the ones positive on the consequences for the EU, consider the EU to be a second choice, residual LNG market; such as Koranyi (2016), Rogers (2015), Franza (2014), Franza and van der Linde (2017) Henderson (2012) and Luciani (2016). So, there are different perspectives on the feasibility of LNG exports from the United States to Europe and there are different ideas regarding its consequences.

1.3.3 Impact of LNG exports from the United States on EU energy security

The EU strategy for Energy Union and Energy Security Strategy might positively influence the perspectives; experts such as O'Hanlon and Boersma (2016) and Goldthau (2013) praise the work of the EU and expect Europe to become the "[World's] largest and most attractive gas import market, with suppliers from all world regions competing for market shares" (Goldthau, 2013, p. 8). But as of yet, there is no research that directly connects the energy security goals of the EU to the LNG exports from the United States.

There is research on the global consequences of the LNG exports from the United States; Medlock, Jaffe, and Hartley (2011, p. 11), Boersma and Johnson (2012, p. 3), Sakmar (2013, p. 327), Kim and Blank (2015) among others, suggest that because of the developments towards feasible exports from the United States, LNG originally destined for that country became available on the global market. According to these works of research, LNG transports were diverted to Europe and Asia, improving the

[6] Primarily to Latin America where the markets have a more favourable return (Horslen, 2016)
[7] Economically, legally and politically

bargaining power of the European markets (Bordoff & Houser, 2014; Noreng, 2017). Putting pressure on the natural gas prices in Europe (Dickel et al., 2014). Chapter five of this work examines these impacts by looking at the sources and pricing of natural gas in Europe. Based on these results, a connection will be made towards the energy security goals of the EU.

1.4 Methodology

The academic state of the art has shown that there are some gaps in the literature. The EU Energy Security Strategy has remained underexposed so far and there is no literature that connects the EU energy security goals with the consequences of the LNG exports from the United States. This research wants to connect these issues, by firstly examining the EU energy security goals, based on the Energy Security Strategy (European Commission, 2014a). Secondly, this research analyses the feasibility of LNG exports from the United States to Europe. And thirdly, these topics will be combined and the impact of LNG exports from the United States on European energy security will be discussed.

Chapter two will discuss European energy security. The EU strategy specifically designed to improve the energy security, the Energy Security Strategy, will be outlined and used to determine the energy security goals of the EU. Then with these goals in mind, the biggest concerns will be discussed based on Eurostat (2016, 2017) data, to see how LNG imports from the United States may make a difference. After which the sub-question for this chapter[8] is answered.

Chapter three describes the feasibility of LNG exports from the United States to Europe, based on the issues considered by research from Ebinger et al. (2012): an adequate and sustainable domestic resource base, environmental issues, regulatory considerations, capacity and infrastructure, domestic demand as well as the global gas market. Together these perspectives cover political, economic and legal considerations. As mentioned in the research question section, the sub-question[9] will be answered.

Chapter four also follows political, economic and legal considerations, but this chapter looks at the European import feasibility of American LNG. The second chapter of this research examines the difficulties of European energy security and introduces concerns that potentially hinder LNG imports. These issues will be addressed in chapter four, based on academic literature and scientific data. After which the sub-question[10] for this chapter will be answered.

Chapter five will focus on the consequences of LNG exports from the United States as expected by the literature. The academic state of the art of this research mentioned that the first consequences have already been visible, mostly concerning the availability of natural gas on the global markets and the effects this had on pricing. The respective developments of these for Europe will be analyzed, based on the relevant data. The data will focus on the period from 2007 onwards, as the year 2007 marks a clear shift in the United States. It was the year in which its natural gas imports were at an all-time high;

[8] "How do LNG imports from the United States fit the energy security goals of the EU?"
[9] "To what extent are LNG exports from the United States to the EU feasible?"
[10] "To what extent are LNG imports from the United States feasible for the EU?"

imports have declined ever since and the country is now a net exporter of natural gas. This chapter answers the final sub-question[11] of this research.

Chapter six is the concluding chapter of this research. This chapter will answer the main research question, based on the findings in the other chapters. The findings of the other chapters will also be described again. After which policy recommendations and the limitations of this study will be presented.

1.5 Significance of this research

Europe is the biggest importer of natural gas in the world and it is extremely reliant on one specific source for these imports, Russia (Siddi, 2015). Being too reliant on one source is never the perfect option, but in this case, the strategic importance of natural gas makes it potentially harmful for the EU. Tense developments in the relations with Russia, as well as gas conflicts leading to interruptions of the gas flow show this (Yafimava, 2013). So, it is the EUs top priority to diversify its sources and now the biggest ally has become a net exporter of gas. This is a great scenario for many, especially given the link between national security and energy security (Flaherty & Filho, 2013).

Apart from concerns on national security or energy security, natural gas is set to play a crucial role[12] in the coming decades. Natural gas is a far more environmentally friendly fuel than oil or coal and it is a great substitution for these, especially in the energy sector (Aoun, Faure, & CIEP, 2015; R. B. Jackson et al., 2014). The 2015 Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) on greenhouse gases and emissions shows global political commitment to fight climate change, also by the United States and the EU. The environment is prioritized and gas can be a perfect bridge between the worst fuels for the environment such as coal and oil, and the rise of environmentally neutral technologies such as solar and wind powered energy (Franza et al., 2016). The EU is the main proponent of environmental goals and it is clear that natural gas plays a vital role in the European energy mix, also for the decades to come (Boersma, 2016).

The academic state of the art of this research has shown that there are some gaps in the existing literature. From an academic point of view, it is particularly interesting that this research combines sensitive geopolitical issues, two major global powers and environmental concerns. The sensitivity of the topic and the linkage between the United States and EU make this research an addition to the fields of global politics, energy policies, European studies, energy studies and more. This research describes what has happened in the United States and Europe, and analyses the effectiveness of EU energy policies. Because the Energy Union and Energy Security Strategy are directly linked to the findings of this study, policy recommendations will be presented based on the findings.

[11] "What is the impact of LNG exports from the United States (since 2007) on the energy security of the EU?"
[12] "The role gas needs to play in the transition can't be overstated" - BP upstream chief executive Bernard Looney (BP, 2017)

2. EU energy security goals

Before any analysis on the impact of LNG exports from the United States to the EU on European energy security can take place, it is important to define European energy security. This chapter will first give a short historical background, because energy security is a long-time concern in Europe. After this background, the Energy Security Strategy (ESS) of the EU will be examined. This strategy presents the main European energy security goals. With these goals in mind, the current energy portfolio of the EU will be discussed to see what role LNG from the United States can play here. Then the sub-question for this chapter will be answered: *How do LNG imports from the United States fit the energy security goals of the EU?*

2.1 Historical background

Cooperation against energy dependence and concerns over European energy security have a long history[13] on the continent. It is no exaggeration to say that energy has always been at the heart of the European project. The fact that the European Community started as a community for coal and steel shows the strategic importance of these resources. The partnership has helped to keep Europe peaceful and made the continent prosperous again, but the strategic importance of energy resources has not declined since the 1950s (Yergin, 2012). For a long time, Europe was an exporter of energy, fuelled by its vast resources of coal. But eventually the cheap production of oil and its advantages over coal made the European coal industry effectively unattractive. A lot of the oil came from the Middle East, a politically unstable region, also in the 1950s. But the oil was cheap, so it only became an issue during the Suez Canal Crisis in 1956, which made Europeans clear that they had become dependent on foreign resources (Haghighi, 2007).

An agreement between the Member States was made for protecting the domestic energy production in 1964[14]. More need for cooperation then led to the 1968 Community Energy Policy (Haghighi, 2007). Through this common energy policy, the commission hoped to turn the strategic weakness of dependency into an opportunity to exert more influence on the global markets. The bigger aim was to achieve energy security through the diversification of sources and political cooperation (ECSC, 1964). The 1973 oil crisis was disastrous and showed that the European nations still needed a long way to reach a common position on energy (Haghighi, 2007). Also in 1974, the commission communicated the necessity for diversification of energy sources as a desirable objective. Natural gas was looked favourably upon because of its advantageous pollution aspects, rational use and long term advantages over other fuels (Langsdorf, 2011). From the 1980s onwards several major developments

[13] The EU is a direct descendent of the European Coal and Steel Community (ECSC), established in 1952 among Belgium, France, Germany, Italy, Luxembourg and the Netherlands
[14] The Protocol of Agreement on Energy Policy 1099/64

occurred: the collapse of the USSR, the signing of the Energy Charter Treaty, the creation of the EU, the establishment of the EU single market and in the end of 2007 the signing of the Lisbon Treaty[15].

Energy security is still a top priority for the EU and it is well addressed (Vinois, 2017). The *Energy Security Strategy* from 2014 is, as its name implies, the main strategy of the union to improve European energy security. In 2015, the Energy Union strategy was presented, which is the new EU foundation under its energy policy. The Energy Union consists of five main dimensions[16] that the EU addresses in the field of energy. It is no coincidence that the first word mentioned is *security*. The Energy Union strategy is the overarching strategy whereas the Energy Security Strategy specifically addresses energy security concerns. Therefore, the latter will be outlined in the next section.

2.2 Energy Security Strategy

Energy security is and has always been a significant European security concern. The EU has stepped up its efforts to ensure energy security over the last years, of which the Energy Security Strategy may be the most noteworthy example. The Energy Security Strategy (hereafter referred to as ESS) describes the main energy security concerns for the EU as follows (European Commission, 2014a):

- Secure supplies[17]
- Growing global energy demand[18]
- Exclusive dependency on one single supplier for several member states[19]
- Capability to deal with external energy shocks
- Imperfect internal market[20]

These main concerns form a definition of what the EU considers to be energy security, or at least the issues that the EU faces when it comes to energy security. They reflect the main goals of the EU, that are covered by the action plans presented in this strategy. These action plans are divided over the eight pillars, presented on the next page:

[15] A de facto EU constitution which entered into force in 2009
[16] Security, solidarity and trust; A fully-integrated internal energy market; Energy efficiency; Climate action; Research, innovation and competitiveness
[17] 1970s energy crises were severe, 2006 and 2009 Ukraine-Russia gas conflicts also seriously impacted EU gas market
[18] Expected to increase with 27% by 2030 (European Commission, 2014a) Concerns on growing global energy demand mainly regard the future access to energy sources
[19] "The most pressing energy security of supply issue is the strong dependence from a single external supplier. This is particularly true for gas […]: Six Member States depend from Russia as single external supplier for their entire gas imports and three of them use natural gas for more than a quarter of their total energy needs."
[20] "Energy security of supply concerns every Member State, even if some are more vulnerable than others. This is valid in particular for less integrated and connected regions such as the Baltic and Eastern Europe."

1. Immediate actions aimed at increasing the EU's capacity to overcome a major disruption during the winter 2014/2015;
2. Strengthening emergency/solidarity mechanisms including coordination of risk assessments and contingency plans; and protecting strategic infrastructure;
3. Moderating energy demand;
4. Building a well-functioning and fully integrated internal market;
5. Increasing energy production in the European Union;
6. Further developing energy technologies;
7. Diversifying external supplies and related infrastructure;
8. Improving coordination of national energy policies and speaking with one voice in external energy policy.

Source: Energy Security Strategy (European Commission, 2014a)

This strategy and its pillars show what the EU considers necessary actions in the field of energy security. The short-term, emergency measures mostly comprising stress tests[21] have already been implemented. The stress tests showed that such disruptions would have enormous impact, but better cooperation would significantly improve[22] the outcomes. Based on these results some direct measures were taken in preparation of the 2014-2015 winter and gas supplies will continuously be monitored.

In addition, the EU and Energy Community countries have prepared regional energy security preparedness plans (European Commission, n.d.-a; Vinois, 2017). The ESS sees a clear role for LNG in the emergency mechanisms, especially given the gas storage opportunities[23] and the flexibility[24] that LNG offers. The first pillar of the strategy recognizes that the role of LNG to increase short-term resilience depends on favourable terms for the EU. These favourable terms[25] include external factors but the internal market also plays a crucial role.

Next to the emergency actions, pillars 4 and 7 also recommend LNG imports. The former deals with the internal market and the latter with diversification of external supplies. The seventh pillar specifically mentions the United States as possible supplier:

"In the US, the first liquefaction plant on the East-Coast is expected to be operational by 2015-2017 with a capacity of about 24 bcm/y. Many other projects are being developed"

[21] The stress tests simulated energy supply disruption scenarios for a period of one or six months, focusing on disrupted Russian gas supplies to the EU

[22] "A prolonged supply disruption would have a substantial impact in the EU, with the Eastern Member States and the Energy Community countries being affected most. Finland, Estonia, the Former Yugoslav Republic of Macedonia (FYROM), Bosnia and Herzegovina, and Serbia would miss at least miss 60 per cent of the gas they need" (European Commission, 2014b)

[23] "The EU's gas storage, together with increased scope for reverse flows, can play a mitigating role in the event of supply disruption"

[24] "The flexibility of supply in the short term and availability of alternative external sources depend on competition on the world markets, most notably for LNG"

[25] "The role of LNG as a ready tool to increase resilience in the short term is undermined by high global LNG prices on Asian markets and long term contracts for pipeline gas deliveries […] A well-functioning market sending correct price signals will also help steer gas flows and boost storage levels in the event of restrictions to supplies"

But it also identifies the issue that:

> *"It is expected that most of the volumes would be directed to the Asian markets"*

Nevertheless, some European companies already engaged in LNG supply negotiations with American partners and the ESS praises the opportunities by stating:

> *"These evolutions should be facilitated by adequately reflecting priorities in EU external policies, in particular in the on-going negotiations on a Transatlantic Trade and Investment partnership (TTIP)"*

The ESS outlines the energy security goals of the EU, fully consistent with the competitiveness and industrial policies and it takes environmental goals into account. The commission sees LNG as a crucial component in this regard so a specific LNG strategy has been introduced (European Commission, 2016a). Possible LNG imports from the United States suit the goals and means of the ESS very well, they are even specifically mentioned and thus a crucial part of the strategy.

2.3 LNG Strategy of the EU

The ESS specifically called for a comprehensive strategy on LNG. The LNG Strategy effectively connects the main goals and measures of the ESS (Boersma & Goldthau, 2017), and it emphasises the potential of LNG when it comes to gas security[26], competitiveness[27] and sustainability[28]. In order to exploit the full potential of the growing global LNG market and to make the EU an attractive market for suppliers, three things are crucial according to this strategy:

- Ensure that the necessary infrastructure is in place[29]
- Complete the internal gas market[30]
- Cooperation with international partners[31]

[26] "LNG, the prospect of a dramatic (50%) expansion in global supply over the next few years and consequently of lower prices presents a major opportunity for the EU, particularly when it comes to gas security and resilience"
[27] "as markets become exposed to greater competitive challenges from international suppliers. In some cases the impact of such changes can be significant, as in the case of Lithuania" See also section 4.2 of this research
[28] "LNG has the potential in some cases to reduce environmental impacts, and hence support the EU's sustainability objective"
[29] "to complete the internal market and allow all Member States to benefit from access to international LNG markets, either directly or via other Member States. This is particularly urgent for Member States that are overly dependent on a single supplier"
[30] "so that it sends the right price signals – both to attract LNG to where it is needed and to allow the necessary investments in infrastructure to take place"
[31] "to promote free, liquid and transparent global LNG markets. This means intensifying dialogues with current and future suppliers and other major LNG consumers to remove obstacles to the trading of LNG on global markets"

Chapter four will examine these key issues for feasible LNG imports as identified by the EU. The ESS illustrates the objectives of the EU for energy security in general and the LNG strategy outlines the role that LNG should play in fulfilling these objectives.

The third point of the LNG strategy, cooperation with international partners includes the ambition to remove all obstacles to the trading of LNG on global markets. This is another area where possible LNG imports from the United States come in. But it is another document that makes this connection; the Energy Union strategy explicitly mentions that: "[The EC] will work to remove obstacles to LNG imports from the United States and other LNG producers" (European Commission, 2015a). This also came forward in the talks on a Free Trade Agreement between the two blocs, which will come forward in section 3.6 of this research. The specific mentioning of the United States makes clear that EU policy makers do not only see the potential of importing American LNG but also wish to use it. The obstacles referred to will be addressed and assessed in chapters three and four.

2.4 EU energy portfolio

The EU prioritizes energy security and the strategies that have been discussed aim to improve it. The main concerns according to these strategies are the dependence on foreign energy sources, especially some worrying cases that are dependent on one single source. This section briefly analyses the current energy portfolio of the union, to see what role natural gas plays, what the trends are and how LNG imports from the United States fit in.

2.4.1 Domestic consumption

The most notable indicator for an energy portfolio is the consumption. The energy sources used in the EU are divided in the following categories: petroleum products, solid fuels, natural gas, renewables and non-renewable wastes. All data used in these sections are from Eurostat (2016). Figure 1 on the next page shows the EU28 energy consumption by fuel type in the year 2014. Petroleum products, most notably oil, fuel 34% of the energy. The second largest source of energy is natural gas, with 21% of total consumption. Solid fuels, of which coal is the most dominant, completes the top three with 17%. Nuclear power was at 14% and renewables at 13% of the total domestic energy consumption.

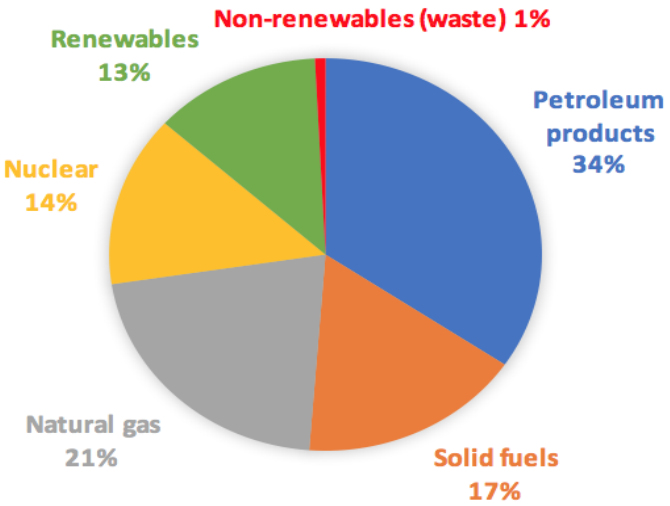

Figure 1: EU28 Gross inland energy consumption by fuel type, 2014[32]

The percentages show that petroleum products and solid fuels still make up over half of the total EU energy consumption. And the trends are clear according to Eurostat (2016): consumption of all fuels except for the renewables and the non-renewable wastes[33] has decreased between 2005 and 2014; with annual rates varying between -1,43% for nuclear and -2,86% for natural gas[34]. These trends seem to fit the EU climate goals very well; the renewables are indeed on the rise and starting to replace polluting fuels. But the declining natural gas consumption does not align with the focus on natural gas as cleaner alternative for petroleum products or solid fuels.

More natural gas imports may decrease the European dependency for petroleum or solid fuel imports. And more LNG would improve the environmental issues because it is cleaner than those fuels. Should these additional imports come from a different source than the current main suppliers, then it would also improve the distribution of those imports. This will be discussed more extensively in the next section. These are strong arguments in favour of LNG imports from the United States, should they prove to be feasible. A look at the distribution of the users of energy further emphasizes the possible gains from more LNG imports:

[32] Data from Eurostat (2016), chart by author.
[33] Renewables increased with an average 5,81% annually in this period. Non-renewable wastes, although still marginal, saw an average annual increase of 5,47%
[34] Solid fuels declined with -1,87% and petroleum products with -2,27%

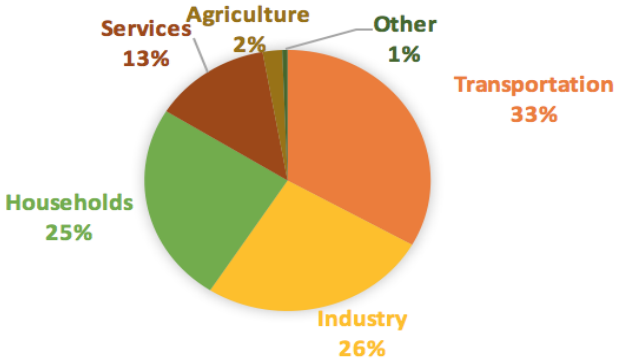

Figure 2: Distribution of energy consumption between sectors in EU28, 2014[35]

The transportation sector is the main energy consumer in the EU, traditionally using petroleum products (Noreng, 2017). The LNG strategy specifically mentions that it will significantly impact the transportation sector[36], where it will be an alternative for petroleum. Also specifically mentioned in the LNG strategy are industry and other consumers[37]; LNG is likely to reduce the environmental impact in these sectors (European Commission, 2016a; Franza et al., 2016).

2.4.2 Energy sources

Another issue of the fuels discussed in the former section, is the import dependency of the EU. More natural gas use can decrease the dependency on fossil fuels and petroleum, and it can also decrease the import dependency for these fuels[38]. Primary production of energy in the EU has significantly gone down in the period between 2005-2014 for all fuels except for the renewables and non-renewable wastes. This research focuses on natural gas and has already emphasised the positive sides of the fuel and the EU strategies that aim to strengthen its position in the energy portfolio. But the decline of domestic natural gas production will continue; European natural gas sources are running out and the extraction of the largest gas field Groningen[39] is troubled by earthquakes (Luciani, 2016). The declining domestic production is covered by increasing imports, with a higher import dependency as a result.

The import dependency is worrying, but most concerns regard the dependency of some countries on a single source, mostly Russia[40]. The *2nd State of the Energy Union Report* looks at the connection

[35] Data from Eurostat (2016), chart by author.
[36] "Where LNG will increasingly be used as an alternative to marine fuels in shipping and to diesel in heavy duty vehicles such as lorries"
[37] "LNG may also play a role in reducing environmental impacts in the supply of heat and power, for example to industry or other consumers in remote and/or off-grid areas currently dependent on more polluting fossil fuels"
[38] Import percentage for: petroleum products 90%, natural gas 66% and solid fuels 42%. Russia is the main supplier of all three fuels (Eurostat, 2016).
[39] In the Netherlands; estimated amount of recoverable gas left is over 1.000 bcm. See also: http://www.nam.nl/content/dam/shell/static/nam-en/downloads/pdf/flyer-namg50eng.pdf
[40] Which is also the biggest supplier of the three main sources of European energy

to sources, with an 'aggregate supplier concentration index'[41] showing the dependency of the EU28 on single suppliers (European Commission, 2017b). The results are that the average total supplier concentration has increased with 1,6% in the period 2005-2014. And the trend is still upward, as the most recent Eurostat (2017) report shows.

The highest dependency on one source is generally found in countries that were east[42] of the former iron curtain (Luciani, 2016). Prices are higher on these markets because of the Russian monopoly and the EC has accused Gazprom[43] of unfair pricing among other malpractices (Franza & van der Linde, 2017). But also various countries that were at the western side of the iron curtain have a serious import dependency on Russia; Austria[44] and Finland[45] are the clearest examples (Chyong & Tcherneva, 2015).

Importing LNG from the United States can decrease the need for petroleum and solid fuels, as discussed in the former section. But it would mean that the import dependency for natural gas will increase. This means that the developments will not only have positive effects, it can still to a declining dependency on Russian gas.

2.5 EU energy security goals and LNG imports from the United States

The introduction of this chapter asked: *How do LNG imports from the United States fit the energy security goals of the EU?*

First, this chapter has introduced energy security as a European concern. The EU is very dependent on fossil fuel imports for its energy needs and this situation is economically difficult, politically worrying and conflicting with environmental goals. The main energy security concerns are according to the EU:

- Secure supplies
- Growing global energy demand
- Exclusive dependency on one single supplier for several member states
- Capability to deal with external energy shocks
- Imperfect internal market

The Energy Security Strategy identified LNG imports as a good way to improve energy security; as an emergency measure in case of external shocks, but also to improve conditions in the longer term. LNG imports from the United States are specifically mentioned in the ESS, among others. So, LNG imports from the United States do not only fit the energy security goals of the EU, they are specifically named in the strategy.

[41] "this indicator measures the importance of total imports of main energy carriers to a Member State from suppliers outside the European Economic Area (EEA)" (European Commission, 2017b)
[42] The dependency on Russian gas is over 95% in the Czech Republic and Slovakia. Bulgaria and Estonia were completely dependent on Russia for natural gas (European Commission, 2017a).
[43] The state-controlled Russian natural gas company, see also Johnson and Derrick (2012)
[44] Over three quarters of Austrian natural gas supplies originate from Russia
[45] Finland is completely dependent on Russia for its natural gas supplies

The energy portfolio of the EU has also been discussed in this chapter; the trends fit the EU energy and climate goals very well because the renewables are on the rise and starting to replace polluting fuels. However, the gap left by most fuels is not completely filled by renewables, as can be concluded from the domestic production statistics. Natural gas is the most environmentally friendly back-up option in the transition from fossil fuels to completely clean renewables (Coote & Hopkins, 2017; Goldthau, 2013). Which is acknowledged by the EU in its relevant strategies (European Commission, 2014a, 2015a). As a result, the EU-wide natural gas demand will remain stable and might even grow again in the years to come (EIA, 2016c; European Commission, 2012; IEA, 2016c).

This inevitably means more imports; potentially conflicting with other goals of the ESS. The section on energy sources concluded that the import dependency continuously increases and several countries are worryingly dependent on Russian energy sources. Possible LNG imports from the United States can improve the situation for both cases.

3. Export feasibility of the United States natural gas market since 2007

The previous chapter has identified and outlined the issues of European energy security. Concluding that importing LNG from the United States does indeed fit the EU strategies on energy security. The political wish for American LNG exports to Europe is thus understandable, but it also raises feasibility questions. Mainly because the first significant LNG exports from the United States have mostly had other destinations than Europe[46]. This chapter looks at the factors that impact the feasibility of LNG exports, to examine the feasibility of exports from the United States to Europe. The factors that will be discussed are the most important factors for feasible exports according to Ebinger et al. (2012):

- An adequate and sustainable domestic resource base (3.2)
- Domestic demand (3.3)
- Capacity and infrastructure (3.4)
- The global gas market (3.5)
- Environmental and regulatory issues (3.6)

(The numbers in between the brackets indicate the section of this research in which it is discussed)

Analysing these factors and the developments in the years since the Ebinger et al. (2012) research will help to understand how these factors have impacted exports and how likely they are to impact exports in the future. By doing so, this chapter will answer the second sub-question of this research: *To what extent are LNG exports from the United States to the EU feasible?*

3.1 Historical background

The United States has become a net exporter of natural gas, after decades of being a net importer. This fact has triggered widespread interest in the opportunities of these exports for European energy security. This short historical background helps to understand the recent developments and current situation.

When looking at the history, it is both surprising and unsurprising that this 2017 research looks at American LNG exports. Surprising because the United States has been a net importer of natural gas for decades; unsurprising because the country was among the pioneers of the transportation of LNG in the 1950s. The United States has been the breeding ground of major natural gas usage and the country produced more than 70% of the global production in the end of 1950s (Weems & Sullivan, 2014).

LNG exports from the United States remained at a low level in the first decades however, around 3 bcm annually. These relatively small American LNG exports went to Japan, the country that still is the biggest importer of LNG globally (EIA, 2016d). Domestic gas production in the United States has been relatively stable between 450 and 550 bcm for decades but the production took off in the last decade (IEA, 2016b). The rising natural gas production of the past years has opened the possibility for

[46] Just 2 out of the 21 first LNG exports in the period from February to July 2016 went to European destinations (Sakmar, 2016)

significant LNG exports. These developments can almost completely be credited to the so-called *shale gas revolution*[47]. The name revolution implies a development that happened overnight, but it was over 20 years in the making and the numbers only became significant around 2006 and rising production remains the trend[48] (Stevens, 2012). Two technologies are crucial when it comes to recovering shale gas; horizontal drilling and hydraulic fracturing, also known as 'fracking'. Fracking is a highly controversial method where chemicals, among other substances are injected into the well at high pressure after which the shale releases the gas (IGU, 2012; Stevens, 2012).

3.2 Domestic resource base

It is currently estimated that natural gas reserves of the United States are almost 65.000 bcm, which is enough to supply the domestic market for over 80 years at the current level of consumption[49] (EIA, n.d.-b). This potential is huge for the United States, only the proven current reserves of shale gas are already over 17.250 bcm (EIA, 2015), which is the rough equivalent of more than 21 years of current domestic consumption, from proven shale gas reserves alone.

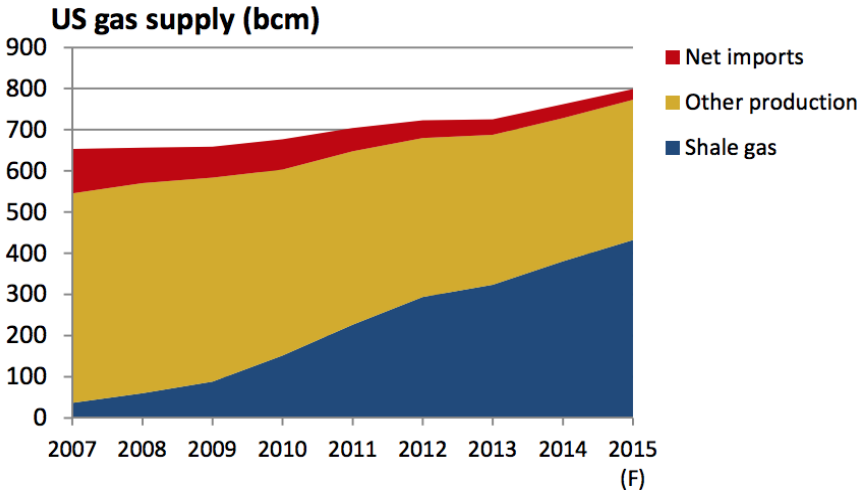

Figure 3: Sources of gas supplies of the United States, 2007-2015 in bcm (Lecarpentier, 2015)

Shale gas has become an addition and even replacement for conventional natural gas in the United States, given its potential and current production (Berman, 2016). BP estimates the total natural gas production in the United States to rise to over 1200 bcm annually by 2035 (BP, 2016b). This research also estimates total natural gas exports from the United States to grow to over 150 bcm annually after

[47] The shale gas revolution refers to technological developments in the extraction of natural gas from shale formations. Recovering gas from shale is far from new but technological breakthroughs in the late 1990s and early 2000s made it profitable and changed the amount of recoverable gas from irrelevant to game changing (Joskow, 2013).
[48] The United States natural gas production was at a record high 768.8 bcm in 2015 and towards the end of 2016, the country became a net exporter of natural gas for the first time (Clemente, 2016a; EIA, 2015a).
[49] Based on a yearly domestic consumption of around 800 bcm (773 bcm in 2015, but expected to go up slightly) (EIA, 2016a)

2025. The EIA (2017a) estimates the domestic production in 2018 to grow with 40 bcm, so enormous[50] growth rates are still the trend.

The shale boom has been so vigorous that spot prices have decreased dramatically, to become one of the lowest priced natural gas markets in the world (BP, 2016a; Jiang, 2016). The abundance of natural gas on the American market in combination with low prices and large resources make for great exporting potential.

3.3 Domestic demand

Of crucial importance to American LNG exports is not only the natural gas supply, but also domestic demand. For natural gas, domestic demand has not changed as dramatically as domestic production. Shale gas recovery provides for additional gas in the country, opening export possibilities as a result (Koranyi, 2016). The abundance has decreased the price of natural gas in the country, possibly increasing future demand, but there are no signs at this time that demand will rise more excessively than the domestic production (EIA, 2016c).

The EIA projects that domestic demand for natural gas will rise from the 773,3 bcm in 2015 to around 850 bcm in 2040 in the reference case scenario (EIA, 2016a). The expected increase in annual production of over 400 bcm towards 2035 easily covers the expected domestic consumption increase of 80 bcm. In these scenarios, over 300 bcm will be available for exports annually by 2035. When it comes to domestic demand and production, the export potential is enormous, even in cautious scenarios.

3.4 Capacity and infrastructure

The natural gas infrastructure in the United States is among the best developed in the world and new projects to improve the existing infrastructure keep on coming (DOE, 2015; Levi, 2013; Paranhos et al., 2015). Because of the spectacular change from being a LNG importer to becoming a net exporter of natural gas, the infrastructure for imports has lost relevance. Some (planned) LNG import terminals are being converted to export terminals, and several new LNG export terminal projects are proposed or under construction. At the beginning of 2017, there are two LNG export terminal in use: one is the Sabine Pass LNG terminal operated by the Cheniere company in Cameron Parish, Louisiana (Cheniere, n.d.) and the other is the Kenai terminal operated by Conoco Phillips in Alaska (Conoco Phillips, n.d.).

[50] 40 bcm equals the annual natural gas consumption of France (IEA, 2016a)

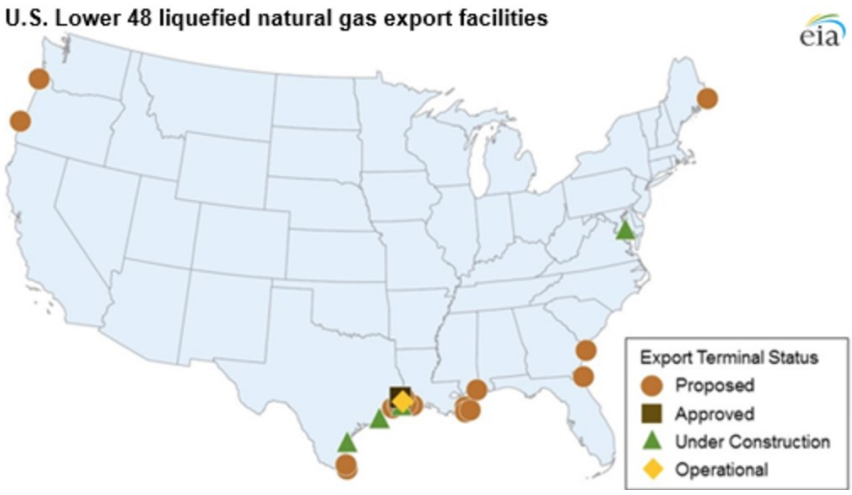

Figure 4: United States LNG export facilities and developments, October 2016 EIA (2016b)

Figure 4 shows the locations of all LNG export facility projects in the United States (excluding Alaska); including the operational- (Sabine Pass) terminal, proposed- and approved- LNG export terminals, as well as those under construction in October 2016. Alaska has been exporting small amounts of LNG for years, but new projects there are currently deemed uneconomic (DeMarban, 2016). The picture illustrates that the majority of the LNG export facilities will be around the Gulf of Mexico, geographically favouring exports to Latin America and Europe, but the recent expansion of the Panama Canal also allows for faster and cheaper exports, possibly even to Asian markets (Pedersen, 2016). Export-wise it can be said that the infrastructure has not been able to keep up with the rapid developments, LNG facilities have been: "[…] significantly less well developed than other aspects of the US market" (Levi, 2013, p. 8). But the prospects are good; most new liquefaction plants will enter into operation in 2017 (Koranyi, 2016).

LNG export capabilities will be over 90 bcm annually before 2020 already; exports in the coming years have been estimated between 50 and 100 bcm (BP, 2016b; Chyong, 2016). For example 60 bcm in 2020 and the main markets are in Europe and Asia according to Coote (2016) who also estimates that 45 bcm could make it to Europe given the circumstances; and these numbers are just a start. As mentioned in section 3.2, BP (2016b) expects the total exports to grow to over 150 bcm after 2025. The estimates given by Coote are on the conservative side if compared to others, but even these numbers are already very significant for Europe.

3.5 United States and the global gas market

Economic aspects are crucial for export potential: it must be attractive to export natural gas, otherwise no exports will take place. The natural gas prices in the United States are among the lowest worldwide, the price at the Henry Hub[51] has been between $1,70 and $6/MMBtu in the period from 2010 to now,

[51] The main natural gas distribution hub and price indicator in the United States; in Erath, Louisiana

February 2017; and the current price is just over $3/MMBtu (EIA, n.d.-a). The prices at European hubs have varied in that period between $5 and $11/MMBtu and are currently around $5/MMBtu. The difference between the two markets is relatively steady over the past years, around $2, which is a characteristic of the global gas prices (McDonald, 2016).

For LNG, the price differences are even more relevant than for pipeline transport. Shipping costs of LNG may or may not make certain exports economically attractive. Generally, the closer a destination, the lower the shipping costs for LNG vessels. Analysis by Platts shows that freight costs "from the American Gulf Coast to northern Asia via the Cape of Good Hope are $1.40/MMBtu, but drop down to $1.02/MMBtu when using the Panama Canal" (Pedersen, 2016). United States exports to Asian markets would even be profitable around the Cape of Good Hope.

This clearly shows that Europe has fierce competition for LNG imports from the United States. Even small price differences between markets influence the destination of the gas. And in Europe, LNG competes with cheap coal, support mechanisms for renewables and very competitive pipeline gas (Boersma et al., 2015). These issues match the widespread thought that Europe will be a residual market. The first shipments also support this claim, American LNG avoids Europe and flows to higher premium markets (Horslen, 2016).

Section 2.3 of this research has shown that the EU acknowledges this and it aims to become a more attractive destination market. Small changes can make a big difference in the competitive and flexible LNG market, chapter four analyses where Europe can make the changes necessary to become an attractive destination market.

3.6 Legal concerns

Next to physical aspects and pricing, also legal concerns affect export opportunities. Most research suggests that significant obstacles for American LNG exports are in the regulatory field, including Stevens (2012), Ebinger et al. (2012), Konschnik and Boling (2014), Regoli and Polley (2014) and Coote (2016). The main concerns in the environmental, domestic and international legal fields will be examined.

3.6.1 Environmental legislation

Even though shale gas and fracking are subject to debate in the United States, environmental concerns have not stopped shale gas developments[52] in the country. But every proposed federal action that was thought to have environmental impact required an Environmental Impact Statement (EIS), which delayed projects, possibly for years (Boersma et al., 2015). But this regulation has been streamlined in 2014, giving priority to big projects. The most relevant actor in this regard and in environmental

[52] Unlike in Europe where any significant shale production still has to take off and where most parties involved have recognized that this is very unlikely to happen any time soon (Neslen, 2016b).

discussions in general, is the United States Environmental Protection Agency (EPA)[53], which monitors shale gas production sites and conducts research on the environmental impact of gas production. Environmental discussions generally regard three issues when it comes to shale gas: water contamination, emissions and other types of pollution (IGU, 2012; R. B. Jackson et al., 2014). Yet: "Despite these environmental issues, the process of fracking has been largely exempt from [EPA] review" (Cook, 2015, p. 374). There is one key EPA research[54] on fracking, which started in 2012, but it is still under review for publication. The draft version says that the EPA has not found evidence that contaminating mechanisms have led to widespread, systematic impacts on drinking water resources (Banerjee, 2016).

This means that the responsible environmental agency does not have serious doubts on fracking after investigation, putting no brakes on further shale gas production developments. The election of President Trump takes away all further concerns that businesses had in this regard. He is sceptical about environmental law and dislikes regulations affecting businesses (Gosden, 2016). The first plans of President Trump include steps to eventually abolish the EPA and the new chief of the agency even denies that carbon dioxide causes global warming (Neslen, 2017; Pasha-Robinson, 2017).

3.6.2 Other domestic legal concerns

Another institution of importance to shale gas recovery is the Bureau of Land Management (BLM)[55], a part of the United States Department of the Interior. The BLM sells or leases ground for natural gas production. Important for this study is that the BLM could have harmed the development of shale gas production in the United States, but it has not been restrictive when it comes to shale gas recovery; some public auctions have attracted environmental protesters as a result (Finley, 2016).

Regional and State-level regulation are obviously a crucial regulatory layer and the research by Ebinger et al. (2012) saw some potential risks here: "As large-scale shale gas production is a relatively new phenomenon, several aspects of the regulatory regime—including issues of federal-versus state jurisdiction—have yet to be resolved (2012, p.9)". In the meantime, the regulatory processes have not become more stringent, most issues from the early stages of production have been resolved also because of the dynamism and rapid pace of shale gas development itself (Paranhos et al., 2015; Richardson, Gottlieb, Krupnick, & Wiseman, 2013).

Most United States regional and state-level regulation has characteristics of a 'race to the bottom' but this is not the case for shale gas (Spence, 2016). Research into the state of 'state shale

[53] The EPA administers the Clean Air Act and Clean Water Act among others, both touch upon shale gas production (Ebinger et al., 2012).
[54] On 'the potential impacts of hydraulic fracturing for oil and gas on drinking water resources', see also: https://www.epa.gov/sites/production/files/2015-06/documents/hf_es_erd_jun2015.pdf
[55] The BLM "manages vast stretches of public lands that have the potential to make significant contributions to the Nation's renewable energy portfolio. This gives the BLM a leading role in fulfilling the Administration's goals for a new energy economy [BLM] also manages Federal onshore oil, gas and coal operations that make significant contributions to the domestic energy supply" (BLM, n.d.)

regulation' found that the regulatory heterogeneity among the states is extensive; some states regulate less than half of the regulatory elements and some regulate all but one (Richardson et al., 2013, pp. 87-88). But regional and state-level regulators have not halted, and will not halt shale gas development mainly because: "In most states with large and established oil and gas sectors, such as Texas and Louisiana, policies tend to be stable and consistently pro-industry" (Levi, 2013, p. 10).

3.6.3 Free Trade Agreements and natural gas

Perhaps the most important legal concern for LNG exports from the United States to Europe is that of a Free Trade Agreement (FTA). All LNG export projects "must receive approvals from both the Department of Energy's [DOE] Office of Fossil Energy as well as the Federal Energy Regulatory Commission [FERC]" (Boersma et al., 2015, p. 2). Part of the DOE assessment handles exports to countries without a free trade agreement with the United States, such as the EU. Assessing whether or not the exports are in the public interest or not, exports to countries with a Free Trade Agreement (FTA) are automatically deemed in the public interest (Sakmar, 2012).

The Trans-Pacific Partnership (TPP) was the signature deal of President Obama and a highlight of global free trade, but it was the first *victim* of the 'America First' policy of President Trump[56]. The ambitious deal between twelve Pacific nations was the largest trade pact of the world when it was signed in 2016, but it never came into force (Worstall, 2016). The TPP would give an advantage to TPP nations for the feasibility of natural gas trade with the United States. So, the American withdrawal from TPP effectively straightened the playing field between those nations and the EU. Making exports to the EU more likely than they would otherwise be.

The United States and the EU are also negotiating an FTA, the Transatlantic Trade and Investment Partnership (TTIP). TTIP is under more pressure than ever given the political situation in the United States. The details about the trade negotiations are secret but a lot of information has become public, both through official means and through leaks. From the TTIP leaks before the 14th negotiation round in July 2016 in Brussels, it has become clear that the United States and EU aim to "eliminate all existing restrictions on the export of natural gas in trade between them" when TTIP comes into force, and together they would "cooperate to reduce or eliminate trade and investment distorting measures in third countries affecting energy" (Neslen, 2016a). TTIP would thus not only take away some limitations like a 'regular' FTA would do, it would take away all limitations (De Micco, 2016).

3.7 Feasibility of LNG exports from the United States to Europe

The wish to improve European energy security through LNG exports from the United States raised feasibility questions. Ebinger et al. (2012) examined this feasibility and their main concerns regarded

[56] See for example Diamond and Bash (2017)

legal issues. This chapter has discussed the same factors that were used in that research, and asked: *To what extent are LNG exports from the United States to the EU feasible?*

The outcomes are slightly different from those of earlier research. The legal concerns have not significantly harmed the shale gas or LNG developments, mainly because the relevant states themselves benefit most from the positive consequences of the industries. The election of President Trump brings new uncertainties, but his presidency is critical of regulation concerning businesses (V. Jackson, 2017). He is also critical of environmental challenges, so it is fair to assume that his presidency will improve the legal conditions for LNG exports. The domestic production, as well as the domestic demand have an extremely good outlook for LNG exports. Natural gas exports are expected to grow to a range between 50-100 bcm annually from around 2020, of which potentially even 45 bcm could make it to the EU.

But the economic feasibility is the biggest issue affecting the possibility of LNG exports from the United States to Europe. The European markets are not as lucrative as other markets and the concern that Europe will be a residual market for LNG seems justified.

4. Feasibility of European LNG imports from the United States

The previous chapters have identified one crucial aspect when it comes to the feasibility of European LNG imports from the United States: economic feasibility. Chapter three has shown that this is the main difficulty for Europe after chapter two already found that the EU identified this as core concern. But chapter two has also offered three goals of the EU, to exploit the full potential of the growing global LNG market and to make the EU an attractive market for suppliers:

- Ensure that the necessary infrastructure is in place[57] (4.2)
- Complete the internal gas market[58] (4.3; 4.4)
- Cooperation with international partners[59] (4.5)

(The numbers in between the brackets indicate the section of this research in which it is discussed)

Based on these three goals, this chapter will cover the infrastructure for LNG imports, the issues of the internal market as well as European external relations. These results will then lead to an answer to the sub-question for this chapter: *To what extent are European LNG imports from the United States feasible?*

4.1 Natural gas market

The first goal of the EU LNG strategy, to ensure that the necessary infrastructure is in place, covers both internal gas market infrastructure between EU MSs and also import infrastructure that connects the EU markets with foreign suppliers. This section describes the natural gas market of the EU countries, the usage and the suppliers of the gas.

The EU consists of 28 Member States as of now, before a possible British exit from the Union. And even though these countries have separate energy markets, they are interconnected and bonded by the EU. As such, the EU-wide energy market is usually looked upon as being one market. This research also looks at the complete EU gas market with attention for specific, mostly regional differences, between for example the Iberian Peninsula and the Baltic states.

The consumption of the complete EU gas market was between 382 and 442 bcm in the period from 2011-2015, as can be seen in figure 5 on the next page.

[57] "to complete the internal market and allow all Member States to benefit from access to international LNG markets, either directly or via other Member States. This is particularly urgent for Member States that are overly dependent on a single supplier"
[58] "so that it sends the right price signals – both to attract LNG to where it is needed and to allow the necessary investments in infrastructure to take place"
[59] "to promote free, liquid and transparent global LNG markets. This means intensifying dialogues with current and future suppliers and other major LNG consumers to remove obstacles to the trading of LNG on global markets"

Year	2011	2012	2013	2014	2015
Consumption	442 bcm	424 bcm	428 bcm	382 bcm	399 bcm
Net imports	298 bcm (67,4%)	275 bcm (64,9%)	279 bcm (65,2%)	257 bcm (67,3%)	277 bcm (69,4%)

Figure 5: EU gas consumption and imports between 2011-2015 in bcm[60]

Despite its advantages, EU gas demand has gone down over the past years. After an all-time high consumption in 2010[61] and these developments are: "completely counter-intuitive" (Stern, 2017, p. 2). It might be concluded that 'the word of gas' has not been spread sufficiently (Franza et al., 2016). When the prices were higher, Europe went for cheap coal and more investments in renewables instead (Vinois, 2017). From an environmental perspective, these two options do not correspond (Kopp, 2014).

Chapter two has shown that natural gas is still among the most important sources of energy in the EU and its will become more important again, mainly because of a growing need for imports (European Commission, 2014a; Stern, 2017). In fact, an early indication for 2016 shows an increase in demand[62] to 447 bcm (Elliott, 2017). Domestic production in the EU was at 142 bcm[63] in 2015 and the trend is downward; meaning that import dependency will continue to increase (European Commission, n.d.-c; Verdonck & Van der Starre, 2016). European conventional gas sources are running out and troubles with earthquakes in the biggest European gas field in Groningen, are the main reasons for the downward trend (Luciani, 2016). The gap between the consumption of 399 bcm and domestic production of 142 bcm in 2015, is obviously filled by imports. Shale gas is not an option in Europe because of widespread opposition and disappointing recovering attempts so far (Neslen, 2016b). And should shale gas eventually become an option, then the expectation is that it will only cover the declines in regular domestic production, without decreasing import dependency (Goldthau, 2013).

Figure 6 on the next page, shows how the imports are divided over the four biggest suppliers of pipeline gas and LNG. Russia[64] and Norway[65] together supply almost two thirds of total EU gas consumption. This is not necessarily a bad thing; with stable supplies and good deals, there would be no reason to worry. However, both are not the case anymore with the biggest supplier Russia. Political tensions and periods of unstable supplies due to crises are worrisome (Siddi, 2015). The aggressive stance of Russia in Ukraine has warned Western political leaders and economic sanctions from both sides harm the mutual trade. These developments have made it even more clear that the EU should aim to weaken this dependency in particular (Koranyi, 2016).

[60] Data from DG Energy (European Commission, 2015b, 2016b), figure by author
[61] Around 493 bcm in 2010 (Hafner & Tagliapietra, 2012)
[62] The natural gas demand is different from the total consumption because of re-exports and storage
[63] The equivalent of 4.989.000 Tera joules.
[64] Around 155 bcm in 2016 (Elliott, 2017); 180 bcm to Europe and Turkey, Turkish imports were around 25 bcm
[65] Around 115 bcm in 2016 (Elliott, 2017)

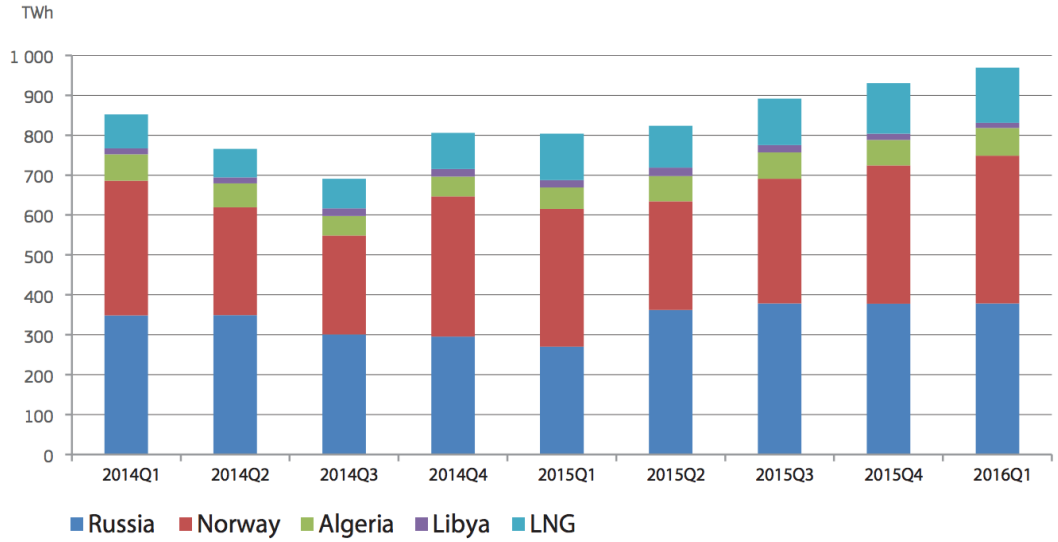

Figure 6: EU natural gas imports[66] between 2014-2016, by source. (European Commission, 2016b, p. 10)

The LNG imports in this figure include LNG imports from the other countries mentioned in the statistics; Algeria for example, is the second largest supplier of LNG to the EU. The biggest supplier of LNG to the EU is Qatar, also the largest LNG producer worldwide (IGU, 2016). The total LNG import capacity of the EU equals almost 200 bcm annually, but the yearly usage at the moment lies below one quarter of the total capacity; 45 bcm in 2014 (Wilson, 2015). To conclude this segment, European domestic gas production is in a downward spiral and the dependency on Russia is far from ideal. LNG imports have great potential for Europe, as these alone could completely replace Russian gas or even the entire domestic production.

4.2 LNG import infrastructure

The EU wide capacity to import LNG is enormous: almost 200 bcm on a yearly basis and the capacity is still growing. But as of now, only one quarter of this potential is being used; despite a strong wish for diversification of gas supplies (Mitrova, Boersma, & Galkina, 2016).

The enormous capacity and the low usage, in combination with the issues of dependency, raise some questions. Figure 7, as can be seen below, helps answering questions regarding the dependency on Russian gas. As can be seen, all active LNG import facilities in Europe were in western and southern Europe. Not a single LNG import facility was operated in eastern Europe, the region of the countries with the highest dependency on Russian gas. But, as the figure shows, several facilities are planned or under construction in eastern Europe.

[66] 500 TWh is the rough equivalent of 51 bcm.

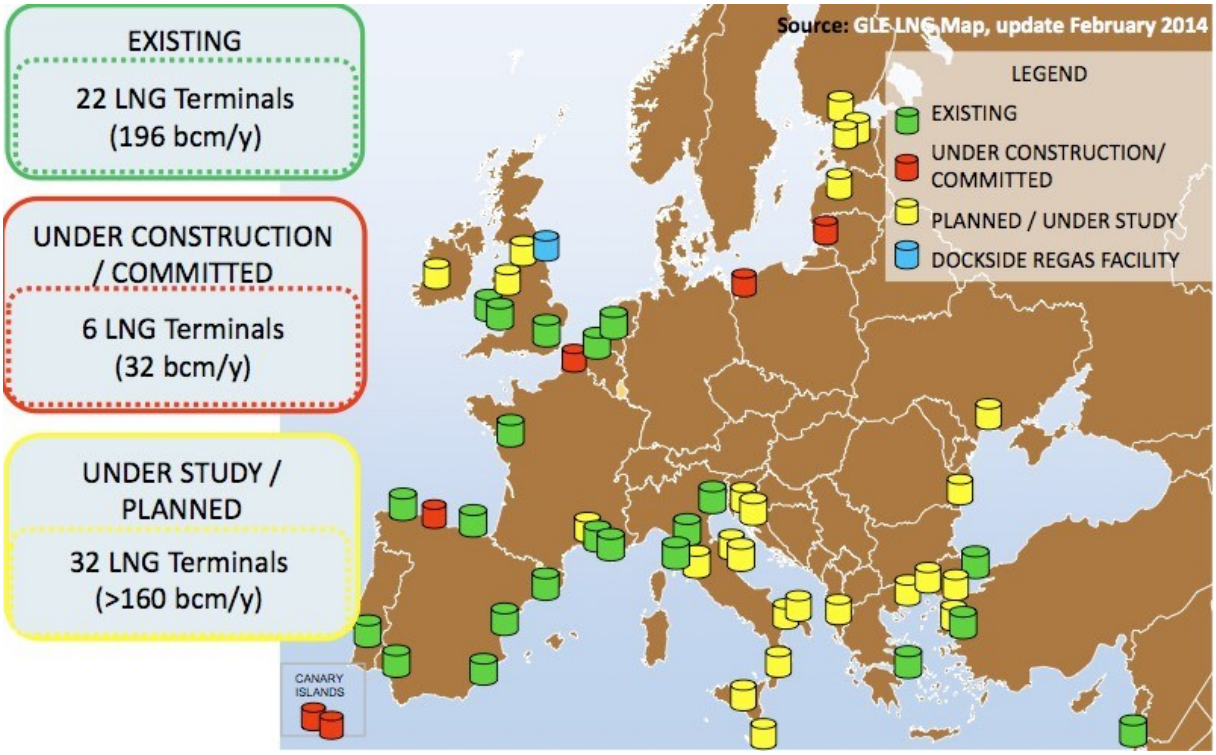

Figure 7: LNG Import facilities in Europe, February 2014. (Gas Infrastructure Europe, 2014)

There is in fact a success story to be told already, from Lithuania. The Klaipėda LNG facility opened in December 2014 and the positive effects have been clear from the start. Until the facility opened, Russia was the monopolistic supplier of natural gas to Lithuania, but 2016 is the year in which Norway surpasses Russia to become its most important supplier because of the opening to the global market[67] (Adomaitis & Harvey, 2016). Even though the current European LNG import capabilities are far bigger than the current usage of the facilities, figure 8 on the next page shows that there are a lot more LNG import facilities planned or already under construction if compared to figure 7, including multiple facilities in Italy and several facilities in eastern Europe.

Figure 8 on the next page shows that plans for LNG import facilities in Europe are so that in 2023 could be over 340 bcm annually, an increase in capacity of over 140 bcm within 6 years. 340 bcm means that all EU natural gas imports could come through LNG instead of through pipeline transport, making the EU markets as flexible as possible. It is fair to assume that not all planned facilities will become reality. But these are serious plans and the timespan is relatively short-term, so to say that the total EU-wide LNG import capacity will be over 300 bcm in 2023 is not even a big statement to make. With such capacity and current under-usage, a new supplier could be easily welcomed.

[67] And even before the facility entered into operation, Gazprom dropped the pipeline gas prices by 23%, bringing the price in Lithuania more in line with global gas pricing (Coote, 2016) This dramatic change in pricing is part of a bigger trend, towards more flexible global gas markets which will be discussed in chapter five.

Annual regasification capacity of large-scale LNG import terminals per country

billion m³(N)/year

	operational	under constr.	planned
BELGIUM	9		3
CROATIA			6
ESTONIA			7
FINLAND			3
FRANCE	22	13	23
GREECE	5	2	11
IRELAND			3
ITALY	15		37
LATVIA			5
LITHUANIA	4		
MALTA			2
NETHERLANDS	12		4
POLAND		5	3
PORTUGAL	8		
ROMANIA			8
SPAIN	69	3	7
UK	52		26
TOTAL EU	195	23	146

Figure 8: Capacity of European LNG import facilities per country, in bcm. (Gas Infrastructure Europe, 2015)

4.3 Internal market infrastructure

The LNG strategy clearly identifies the incomplete internal market as biggest challenge when it comes to importing LNG. And as discussed in chapter two, also the Energy Security Strategy (ESS) has several pillars[68] that aim to improve the internal market of the EU. The regulatory frameworks of the MSs have been aligned more and the EU regulatory measures such as the Energy Packages, Natural Gas Packages and the relevant strategies, all have seriously improved the interconnectedness. Reverse-flow[69] has been allowed and made possible in the union, so that Germany for example is exporting natural gas to its eastern neighbours and even to Ukraine (Kopp, 2014; Łoskot-Strachota, 2016).

But the real limitations become visible when the interconnectors between the national gas markets are examined. In an ideal scenario, natural gas can come in anywhere in the EU and end up in any other country. But right now, it is physically impossible to transport gas from Spain to Estonia or from Germany to Finland, because the Baltic States and Finland are completely separated from the rest of the EU natural gas network (Bryza & Tuohy, 2016). Also illustrative for this situation is that there is no direct connection between France and Italy, whereas the gas markets of Germany and the Netherlands are already connected at eight different points (ENTSOG, 2016). The projects that will eventually lead to a fully connected European gas market are called Projects of Common Interest[70] (PCIs) by the EU (European Commission, 2015c). As we have seen, European LNG import capabilities are almost 200 bcm annually already and this capacity will be increased significantly in the years to come. But the

[68] As discussed in section 2.2 of this research.
[69] Pipelines that allow natural gas flows in both directions.
[70] Current PCIs include a pipeline connecting Poland and Lithuania, a pipeline connecting Estonia and Finland and ten LNG import facilities across the continent.

interconnectedness of the gas market is not yet good enough for gas to flow freely from any country in the EU to another.

The consequences of this for the feasibility of LNG imports from the United States are that a lot of countries can physically import LNG from the United States, but these are mostly countries that are well-connected (and supplied) already. These countries have access to other, possibly cheaper sources and do not necessarily need LNG from the United States. Countries that can really use LNG from the United States remain either locked from LNG import facilities or need to get the commodity through another EU country.

So, it is not surprising that research such as Moryadee, Gabriel, and Avetisyan (2014) suggests that especially Spain benefits from LNG exports from the United States. Others suggest that the UK and the Netherlands are the biggest winners (Boersma et al., 2015). But with the PCIs and other planned projects, the infrastructural feasibility or LNG imports from the United States will continue to improve, also increasing the benefits for the other EU countries (Vinois, 2017). These sections have shown that the developments are plenty and spread over the continent. This, together with the PCIs and the EU strategies will allow for ever improving conditions.

4.4 Regulatory framework

The former section described the physical connections between the EU natural gas markets. But the EU also identified issues regarding the political connections of natural gas between the EU nations. “In addition to sufficient infrastructure, properly functioning and liquid gas markets are also required if EU consumers are to benefit from LNG's potential in terms of diversification and, at least in the short- to medium-term, as a highly competitive alternative to pipeline gas” (European Commission, 2016a).

According to the strategy: substantial progress has been made in implementing existing EU energy legislation, in particular the Third Energy Package[71] and the network codes. Several policy measures have been taken by the EU to weaken the dependency on Russian gas. The Third Energy Package and the preceding Second Energy Package have successfully improved competition and market principles on the EU gas market, forcing dominant suppliers such as Gazprom to offer better conditions (Dusciac, Popescu, & Parlicov, 2016; Koranyi, 2016; Yafimava, 2013).

But the MSs and their national regulatory authorities (NRAs) should take all necessary action to complete the internal gas market: eliminate the remaining regulatory, commercial and legal barriers and provide access for these markets to effective regional gas hubs. This description clearly shows that even available physical connections do not equal one internal market. The different national systems are not very surprising with the distribution of competences in mind.

[71] Covering five main areas: ownership unbundling, strengthening regulators, cross border cooperation between transmission system operators, increased transparency in retail markets and the establishment of the Agency for the Cooperation of Energy Regulators also known as ACER (European Commission, n.d.-b; Vinois, 2017).

As described in the historical background section of this chapter, the 2009 Treaty of Lisbon has a chapter dedicated to energy. The legal basis for EU energy policy is laid down by Article 194 TFEU[72]. Energy policy is a *shared competence*[73], making it subject to the principle of subsidiarity[74]. This means that the EU may only intervene if it can act more effectively than the Member States separately. In practice, the treaties let every EU country decide their own energy mix[75] (Langsdorf, 2011). As a result there are several debates on deals and pipelines such as Nord Stream 2, a proposed gas pipeline that divides Europe politically (Gurzu, 2015). There are also completely different energy policies such as the 'Energiewende' in Germany, which is moving away from nuclear power, but is also importing nuclear energy from France. Germany even restarted extremely polluting lignite plants to cover the losses (Buchan, 2012; Conca, 2015).

4.5 Cooperation with international partners

The third goal of the LNG Strategy focused on cooperation with international partners. This part of the LNG strategy specifically mentions the developments in the United States as it describes the potential for future supplies. Surprisingly enough, this part of the strategy only describes on page 11, that the EU:

"has a keen interest in promoting free, liquid and transparent LNG markets around the world"

And that this should be achieved by working closely with international partners and in international fora, to: "ensure that market participants are not prevented from establishing commercial relationships (for example by territorial restrictions) and that there are no limitations on free trade – either under normal market conditions or in the event of external shocks."

The EU is usually regarded as a soft power when it comes to international relations, but the regulatory framework for energy makes the EU a "soft power with a hard edge" (Goldthau & Sitter, 2015). The internal regulations are successful and the normative power of the EU can be witnessed in its neighbourhood. EU external relations, especially in the direct neighbourhood encompasses policies promoting the values, principles and legal framework of the EU known as the acquis communautaire[76] (Niezen, 2017). This is also the case in energy.

[72] 194(1) TFEU "In the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment, Union policy on energy shall aim, in a spirit of solidarity between Member States, to:
(a) ensure the functioning of the energy market;
(b) ensure security of energy supply in the Union;
(c) promote energy efficiency and energy saving and the development of new and renewable forms of energy; and
(d) promote the interconnection of energy networks."

[73] Shared competences (Article 4 of the TFEU): the EU and EU countries can legislate and adopt legally binding acts. EU countries exercise their own competence where the EU does not exercise, or has decided not to exercise, its own competence.

[74] "In areas in which the European Union does not have exclusive competence, the principle of subsidiarity, laid down in the Treaty on European Union, defines the circumstances in which it is preferable for action to be taken by the Union, rather than the Member States"

[75] 194(2) TFEU: "Such measures shall not affect a Member State's right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply, […]"

[76] The acquis communautaire, or acquis in short, is the name for the existing body of law that has been adopted up until now, see also Chalmers, Davies, and Monti (2011)

The EU tries to *Europeanize*[77] countries in its neighbourhood through for example the ENP and the Energy Community[78] (Dusciac et al., 2016). Cooperation of the EU with third countries in the region such aim to create unity in the energy sector. The partnerships to the east can even be seen as an effort to effectively form a buyers cartel, according to Goldthau (2012).

European LNG imports from the United States can also help some countries in this regard, most notably Ukraine or Moldova (Brown & String, 2013). These countries are traditionally dependent on Russia; receiving a strategic commodity like natural gas from the United States would be an enormous diplomatic and strategic change. This could also strengthen the bargaining power of the Energy Community and improve the political position of the EU vis-à-vis Russia in the neighbourhood.

4.6 Feasibility of LNG imports from the United States

The second chapter of this research identified three goals of the LNG strategy of the EU, to make Europe a more attractive destination market. Chapter three concluded that this strategy is indeed necessary for the EU to become an attractive destination for American LNG. By looking at the three goals from the strategy, this chapter provided a framework for answering the sub-question for this chapter: *To what extent are European LNG imports from the United States feasible?*

This chapter has indicated that the LNG import capabilities of the EU are more than sufficient: Russian gas could be completely erased from the energy portfolio if the LNG import capacity would be used more. Chapter three has shown that imports of about 45 bcm annually would be feasible from the perspective of the United States. 45 bcm equals more than 10% of the total demand of the EU, it is more than the yearly consumption of for example France or Spain and it would make the United States the third biggest supplier of natural gas to Europe[79].

The import capacity of the EU can easily handle that, although internal market imperfections influence the possible destinations of the gas. This is the biggest problem of the EU natural gas market and also arguably the main issue for European energy security. Some parts are not connected to other EU countries at all, and these are also the parts with the highest dependency on Russian gas. The EU fights this crucial issue in several ways, most importantly through the PCIs. The further alignment of the regulatory frameworks of the countries, as well as of neighbouring countries in international cooperation are very successful. All in all, the conclusion here is that importing LNG from the United States is currently to some extent. Physically, a lot of LNG can be imported, but it is not yet possible to transfer the natural gas to the countries that need it the most. The regulatory streamlining also aims to

[77] The spread of EU values, policies and law, see also Schimmelfennig (2015) or Niezen (2017)
[78] Different regulations and standards of the EU are 'exported' to neighbouring countries as part of this. The EU actively promotes its values; through its regulatory and rule setting powers the acquis of the union is spread, as a normative power. This external dimension of EU regulation is used to enhance its energy security, by encouraging neighbours to follow the EU, thus making them more reliable partners.
[79] Algeria supplied 36,2 bcm in 2014

improve the attractiveness of the EU as destination market of LNG, but it remains to be seen whether this will help. The next chapter examines the consequences so far, also looking at the attractiveness of the EU as destination market for LNG.

5. Impact of LNG exports from the United States on European gas supplies

The chapters so far, have shown that the exports are economically feasible; American LNG can be competitive on the European markets and analyses have shown that the exports are positive already for several countries involved; most notably Spain, the United Kingdom and the Netherlands.

Chapter three and four have looked at the feasibility concerns on both sides of the Atlantic. The other goal of this research is to examine the impact of the exports from the United States, on European energy security as discussed in the second chapter. Research has identified two main consequences so far, that impact European gas supplies:

- LNG originally destined for the United States became available on the global market, transports have been diverted to Asia and Europe
- The increasing availability of LNG on the global markets has put pressure on the natural gas prices in Europe and has increased European bargaining power towards its traditional suppliers

This chapter will focus on the sources of European natural gas, on the effects on pricing and on EU energy relations, to find out how LNG exports from the United States impact European energy security. Thus answering the final sub-question of this research: *What is the impact of LNG exports from the United States (since 2007) on the energy security of the EU?*

5.1 Sources of European LNG

It is assumed that countries that were planning to export LNG to the United States have diverted their exports to the EU as a result of the shale gas revolution (Boersma & Johnson, 2012; Sakmar, 2013); "LNG supplies whose development was anchored to the belief that the United States would be a premium market have been diverted to European and Asian buyers" (Medlock, 2012). This would include LNG from Trinidad and Tobago, Egypt, Nigeria and Algeria (Clemente, 2016; Fiueira, 2014; Okere, Olayinka, & Salau, 2016; Oxford Business Group, 2016). This diversion of exports originally meant for the United States has brought more LNG on the global spot markets, giving Europe access to supplies that were not available before (Noreng, 2017; Skłodowska, 2015).

The statistics of the deliveries to Europe in the period 2006-2014 are below; to see how the supplies of these sources have been affected. The year 2006 is used as benchmark given that 2007 was the year in which the United States had its highest[80] LNG imports. The countries are ranked from the

[80] Making it fair to assume that this was the last year in which specific exports to the United States increased

biggest exporter to the United States, Trinidad and Tobago towards the smallest of the four suppliers, Algeria (EIA, 2009). The data are from Eurostat (2016); the figures have been compiled by the author.

Figure 9: **Trinidadian** supplies to EU 2006-2014

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
Bcm	4,0	2,6	5,6	7,4	5,1	3,6	2,8	2,4	2,7

Figure 10: **Egyptian** supplies to EU 2006-2014

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
Bcm	8,0	5,4	5,7	6,8	4,6	3,9	1,8	0,3	0

Figure 11: **Nigerian** supplies to EU 2006-2014

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
Bcm	13,7	14,4	13,2	7,7	14,0	14,4	11,1	5,5	4,4

Figure 12: **Algerian** supplies to EU 2006-2014

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
Bcm	54,1	49,2	50,6	47,1	50,4	44,7	44,1	40,7	36,2

The country with the most notable change is Trinidad and Tobago. It has been the top LNG supplier for the United States and it saw a serious increase of exports to the EU in 2008 and 2009; the first two years of declining LNG imports from the United States. The fact that 2007 was significantly lower than 2006 might be because of the bigger demand from the United States. Before that, exports from Trinidad and Tobago to the EU28 were at 0,7 bcm in 2005 and non-existent in 2004.

Egypt also had a decline of LNG exports to the EU in 2007 with a slight increase in 2008 and 2009, but these numbers make it harder to conclude that there is a link with the developments in the United States. In general, these statistics do not show any serious correlation between the decreasing imports in the United States because of the shale gas revolution and the LNG imports of the EU. Unlike various authors such as Medlock et al. (2011, p. 11), Boersma and Johnson (2012, p. 3), Sakmar (2013, p. 327) and Kim and Blank (2015) all claim in their works, without further source or statistics.

Figure 13 below, shows the Nigerian natural gas exports to the United States. The literature suggests that Nigerian LNG has been diverted to Europe, but for both the EU and the United States, 2007 was the top year after which a decrease occurred. Based on the existing research, opposing trends should be expected, but the statistics do not align. Even though the statistics do not say anything about LNG possibly being diverted to Asian markets, to say that the shale gas revolution led to serious amounts of LNG being diverted to European markets is a statement not backed by statistics.

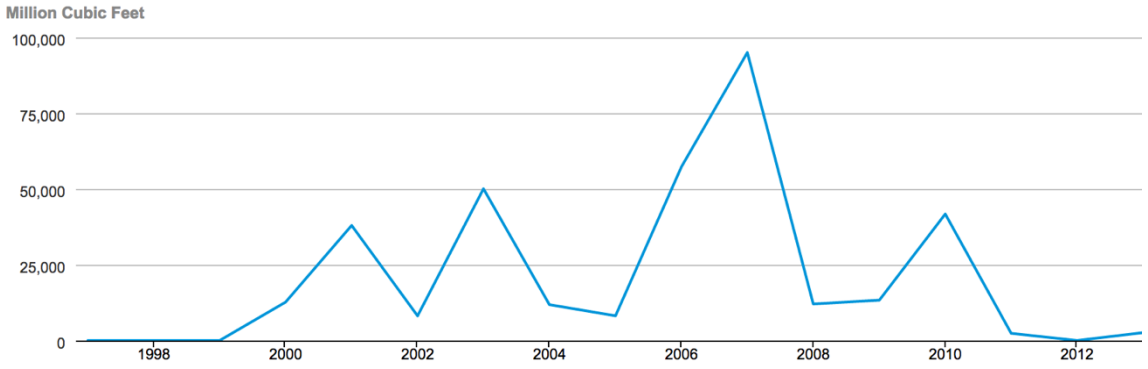

Figure 13: Nigerian LNG exports to the United States, 1998-2013 in million cubic feet (EIA, 2017b)

Figure 14: **Qatari** supplies to EU 2006-2014

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
Bcm	5,8	6,9	7,9	18,3	34,8	40,0	27,7	21,2	20,8

The biggest LNG exporter in the world, Qatar, has significant exports to the EU, as can be seen in Figure 13. The Qatari exports to the EU show the same (downward) pattern towards the end of this timeframe as the other exporters. Figure 14 shows the Qatari exports to the United States, with a surprisingly similar pattern. Also to the United States, 2011 was the top year of Qatari LNG exports. Conflicting with the theory that Qatari LNG shipments originally bound for the United States were diverted to the EU in this period. After the Fukushima disaster in 2011, Qatari shipments went to the Asia-Pacific region because of the price premium there (Lomagin, 2015).

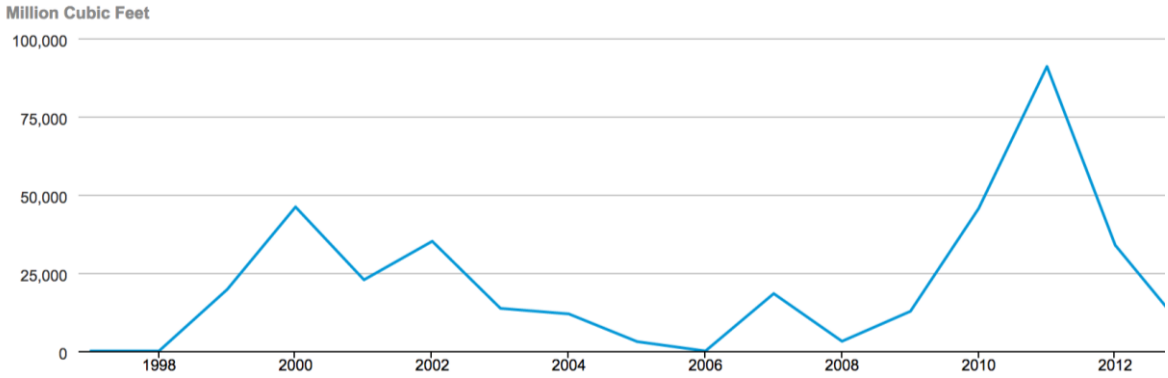

Figure 15: Qatari LNG exports to the United States, 1998-2013 in million cubic feet (EIA, 2017b)

These statistics are surprising because they do not align with the widespread assumptions in the literature. Even more surprising might be that all the exports of the four top LNG exporters to the United States had their lowest exports to the EU in the end of this timeframe, just like Qatar. Chapter four has

shown that European LNG imports are far from what they can be[81]; but these data even suggest a trend away from LNG, contradicting what might normally be expected[82].

Authors such as Kopp (2014) and Luciani (2016) blame the declining European LNG imports mainly on the increasing Asian demand after the Fukushima disaster. As a result, natural gas prices in Asia went up and moved away from the lower prices in Europe, making diversion of LNG shipments to Asia a lucrative business. Chyong and Kazmin (2016) and Hulshof, Maat, and Mulder (2016) concluded in their research that not just the demand shock in Asia resulted in the growing price differences in this period, but also the shift towards spot pricing in Europe and the high oil price. These developments together increased the price differential between Europe and Asia.

Because of the higher prices in Asia, LNG went there instead of to Europe; the difference for Europe was compensated by more pipeline imports (Chyong & Kazmin, 2016; Lomagin, 2015). Russian natural gas exports to Europe for example went up from 139 bcm in 2012 to 161,5 bcm in 2013; coinciding with the lower amounts of European LNG imports in this period (IEA, 2014). The fact that this has been compensated with more pipeline imports, from the usual suppliers has negatively influenced the diversification attempts of the EU and thus negatively impacted EU energy security.

5.2 Pricing of European Gas and LNG

The surprising findings of the previous section on the sources of European LNG, make it even more worthwhile to further examine the pricing of European gas and LNG. Researchers such as Apte and Critchlow (2011), Coote (2016) and Noreng (2017) say that as a result of the natural gas developments in the United States, prices for European gas have been put under pressure. This section will examine changing pricing mechanisms in more detail, as well as the effects on the prices for natural gas.

Chapter three already stated that the developments in the United States are potentially good for other importers such as the EU. The transformation to a *buyers' market*, away from LTCs is discussed by research such as Apte and Critchlow (2011), Chyong (2016), Kopp (2014) and Nakano (2016). With the expectation that the gas market would follow the same path as other commodity markets such as refined products and coal have done historically[83]. And indeed, the natural gas market has become more global and might become a truly global market with the gradual entrance of new suppliers and a wider availability of LNG (Luciani, 2016; Noreng, 2017). Because of this, changes in pricing mechanisms have occurred and new dynamics have been created. Especially the countries with a well-supplied gas market have driven the changes towards more flexible gas contracts (Agerton, 2016). These countries have the possibility to shop at the lowest priced supplier, putting pressure on the prices (IEA, 2016c).

[81] Around one fifth of the total capacity.
[82] Based on the enormous LNG import capacity of the EU in combination with EU policies and strategies that favour LNG imports
[83] "[…] the gas market is rapidly globalizing and evolving toward a gas-on-gas pricing model. In other commodity markets, the emergence of many different players and multiple cross-border flows rapidly led to a globally competitive market. As LNG trade flows move from local, bilateral arrangements to cross-regional and multiple-party participation" Apte and Critchlow (2011, p. 2)

Those developments are the main reason for a shift away from fixed long term contracts (LTCs), and towards hub pricing on the natural gas markets globally (Stern, 2014). The prospect of more LNG coming to the European market in the years to come makes the traditional oil indexed LTC pricing mechanism disappear gradually[84]. This has resulted in gas pricing in Europe that is increasingly determined by gas market fundamentals; based on gas-to-gas competition, not by the oil price or any other significant variable (Hulshof et al., 2016). But most European gas trade is still based on oil indexation, most notably the gas coming from Russia, North Africa and to some extent Norway.

As a result, Europe has become a hybrid market place when it comes to pricing mechanisms (Chyong, 2016). But it appears that the different pricing has led to 'buying if the price is right', instead of buying all gas needed this way. Spain and the Netherlands for example have long term contracts that provide for their normal consumption, but they use spot market dynamics to make profits (Luciani, 2016).

Global prices have diverged because of the different levels of oil-indexation, but comparable markets have converged (Merison, 2016). The European prices for example, where Growitsch, Stronzik, and Nepal (2015) found evidence of convergence in spot prices. Despite natural gas markets becoming more global, global spot prices have done the exact opposite of what was expected. Figure 16 below shows the development of natural gas prices at four global hubs between 1998 and 2015. One does not need to be a statistician to conclude that the opposite of convergence has happened from around 2009. Global prices have diverged and the European gas markets have converged, also visible in this figure.

Figure 16: Global natural gas spot prices in $/MMBtu, 1998-2015 (BP, 2016a)

The explanation for the divergence, instead of convergence, of global spot prices is simple and shows that the developments in the United States have helped to establish this situation. As explained, the

[84] In 2005, 74% of the gas sold was priced by oil indexation, a number that had dropped to 30% in 2015 (Roux & Ahoniemi, 2015). The percentage of spot contracts or non-LTCs has developed in the other direction, from 20% in 2010 to 33% in 2013 (Theisen, 2014, p. 31).

United States market is the least connected to the oil price, after that come the European markets, the Japanese market is still the most connected to the oil price. When oil prices went up in 2009, this had no real impact on the natural gas prices in the United States, but the partly to oil-prices connected European markets noticed an increase in gas prices. The Japanese market obviously had the biggest increase of natural gas prices when the oil prices went up and the increased demand after the Fukushima incident explains the rest (Chyong, 2016).

As explained earlier, prices in Europe need to be high enough vis-à-vis the American prices for LNG imports from the United States to be economically feasible. This fact has already influenced prices for EU countries that have become better connected with other gas markets in recent years, as it has forced Gazprom to reduce its prices (Bordoff & Houser, 2014; Krutikhin, 2016). The company appears willing to start a price war in order to keep more LNG out of the European markets and it has the best papers for undercutting competitors (Koranyi, 2016). Lower prices will benefit the European economies and its consumers, but this research also shows that this does not necessarily improve European energy security.

5.3 EU energy relations

The changes on the natural gas market relevant for the EU have been discussed, but as this research has shown, the external energy relations of the EU are another important aspect. The period of this research saw completely changing EU-Russia relations, but even a severe sanctions regime has not hindered natural gas trade between them. An energy relation that has however changed, is the relation between the EU and the United States.

The Energy Union strategy of the EU explicitly states the wish to remove all obstacles to LNG imports from the United States and other sources. This changing relationship strengthens the position and bargaining power of the EU and may help to depoliticize natural gas in Europe (Bordoff & Houser, 2014; Chyong, 2016; Goldthau, 2013; Koranyi, 2016). Should TTIP make it through, it might have even more impact given the fact that the United States have withdrawn from the FTA in the Pacific, the TPP. In this case the EU would have a FTA with the United States and other potential markets[85] for American LNG would not (Rademaekers, Slingerland, Bressand, Felbermayr, & Törnmarck, 2015).

Despite the developments between the EU and the United States, the EU should not forget the potential in its neighbourhood. There are good and bad examples to be given in this regard. The good examples have been specified in the ESS and include the Southern Gas Corridor (Koranyi, 2014) and extensive relations in the European Neighbourhood Policy (ENP)[86] with twelve countries including Ukraine (Duke, 2017). The former is a big project aiming to connect the gas rich Caspian Sea region with Europe. The latter has been discussed in chapter four of this research and should improve the

[85] Such as Japan or Vietnam
[86] "Energy cooperation helps to increase energy security in the EU-ENP area. The Aim is secure and stable energy at affordable prices" (EEAS, 2016)

conditions and trade in the wider neighbourhood of the EU. The success of these will also significantly influence the position and strategy of Gazprom in Europe and Ukraine (Łoskot-Strachota, 2016).

On the other hand, there are ongoing talks with important energy partner Algeria to join the ENP (Allal, 2016; EEAS, 2016). These talks are a good sign in essence, but they started more than a decade ago Darbouche (2008). Algeria is the third biggest supplier of natural gas to the EU and is the natural gas power of the Mediterranean region with over 4.500 bcm of proven gas reserves (Aissaoui, 2016). But the country is struggling to attract international investments (Allal, 2016). This discrepancy is another proof that the ENP fails to deliver, as is generally argued in the literature (Börzel & Hüllen, 2014). Algeria is just one example; the bigger conclusion is that the EU can enhance the relations with its neighbours, even though this is already a key part of the ESS.

5.4 Impact of United States LNG exports on European energy security

This chapter has examined the changes in the most important areas for this research. The sub-question that was asked for this chapter was as follows: *What is the impact of LNG exports from the United States (since 2007) on the energy security of the EU?*

The former chapters have shown that the mere perspective of LNG exports from the United States to Europe has influenced policy makers and it has triggered more attention for the possibilities of LNG. This chapter shows that the combination of these developments has led to lower prices of natural gas in the EU. The infrastructure is being improved continuously in Europe offering new possibilities for markets that were excluded from the wider European gas market or from other sources than their monopolistic supplier. Both developments will continue and will increasingly impact the EU gas market, probably resulting in a price war between the traditional suppliers of pipeline gas to the EU and competitors offering LNG.

The winners of decreasing prices and potential price wars are the European consumers, but the risks have become clear in this chapter. The relatively lower prices on the European markets in the last years has kept out new LNG and pushed out existing LNG suppliers. Thus, both the import dependency and the supplier concentration have been affected negatively, contradicting EU policies and goals.

6. Conclusions

This chapter will combine the different aspects and the sub-questions of this research to answer the original research question: ***How do Liquefied Natural Gas exports from the United States (since 2007) impact European energy security and to what extent are exports to the European Union feasible?***

6.1 General conclusion

The main consequences expected of the feasibility of LNG exports from the United States, were positive consequences for European energy security. But closer examination of the developments has shown that although there are some very positive developments already, some consequences conflict with the European goals for energy security.

The developments towards LNG exports from the United States and the first exports have had two main effects on European energy security. The prices have decreased relatively if compared to other global markets, including in the countries that were most dependent on one source[87]. The developments in the United States have also further enhanced the ongoing move away from long term contracts (LTCs) in Europe towards spot pricing, based on gas market dynamics. But this has made the EU economically less attractive as a destination market for LNG. As a result, European LNG imports dropped in this period and the pipeline imports increased. Meaning that the developments in the United States have effectively made the EU more dependent on Russian gas, but at a lower price than before.

The feasibility of LNG exports from the United States to Europe is also hampered as a result. Exports to Europe are not as attractive in an economic sense as exports to Asia or Latin America for example. But the original physical and legal concerns surrounding the feasibility of such exports have faded completely.

The EU actively aims to improve the market conditions to make it a more attractive destination market and the developments are positive. It can be argued that the more flexible contracts and the transformation to a buyers' market are favourable to the EU Member States and improve EU energy security. In Europe more natural gas is becoming available from diverse sources and the prices are under pressure.

If the EU succeeds to increase its attractiveness as a destination market for LNG then significant imports from the United States can be expected. As much as 45 bcm in the coming years, which would make the United States the third biggest natural gas supplier of the EU. The potential in the next decades is even bigger, but the competition of other countries for these supplies will also continue. Figure 17 on the next page offers a simplified scheme of the impact of United States LNG exports on EU energy security.

[87] Thus, most endangered from an energy security perspective

Effects on:	Impact:	Because:
Natural gas prices	+ +	Prices have decreased, even in the countries with the worst energy security situation; Move away from LTCs towards spot pricing favours buyers
Natural gas supplies	-	More natural gas has become available, but the pricing effects have negatively influenced the supplier concentration and import dependency of the EU
EU energy relations	+	Bargaining power of the EU towards suppliers has improved; Position of EU natural gas markets and policies positively affect its stance in the region

Figure 17: The impact of LNG exports from the United States on aspects of EU energy security compiled by author

6.2 Specific conclusions

The chapters in this research have answered different sub-questions covering three main issues. The European energy security goals, the feasibility of LNG exports from the United States to Europe and the impact of LNG exports from the United States on European energy security. The specific conclusions of this research will be outlined here:

6.2.1 European energy security goals

The academic state of the art has identified that the specific energy security goals of the EU strategies are underrepresented in the literature. And as of yet, no research has coupled the EU energy security goals to LNG exports from the United States. Chapter two has introduced *energy security* in a European context, by looking at the history, EU strategies and the current energy portfolio of the union. The Energy Security Strategy (ESS) of the EU, has been outlined and the following EU energy security goals were identified:

- Secure supplies
- Growing global energy demand
- Exclusive dependency on one single supplier for several member states
- Capability to deal with external energy shocks
- Imperfect internal market

The ESS consists of eight pillars that aim to achieve the energy security goals and LNG imports feature prominently in the strategy. Possible LNG imports from the United States do not only suit the goals, they are specifically mentioned.

Increasing natural gas imports can decrease the European dependency for petroleum and solid fuel imports. More natural gas imports improve the environmental situation because gas is cleaner than the other conventional fuels. If these additional imports come from another source than the current main suppliers, then those imports would also improve the distribution of natural gas sources. These are strong arguments in favour of importing LNG from the United States.

The ESS has identified LNG imports as a great way to improve energy security and rightfully so. LNG can improve the European ability to deal with external shocks and it can also improve energy security conditions in the longer term. Imports from the United States are specifically mentioned in the strategy so they fit the European energy goals very well.

6.2.2 Feasibility of exports from the United States to Europe

LNG exports from the United States to Europe are seen as perfect way to strengthen European energy security. United States policy makers wish to help the EU and strengthen their own position on the continent, European policy makers welcome the accession of a new supplier, that also happens to be their main ally. Earlier research however has identified some issues that affect the feasibility of such exports.

Ebinger, Massy, and Avasarala (2012) examined the feasibility of LNG exports from the United States in general. This research identified the main factors influencing the feasibility of LNG exports: an adequate and sustainable domestic resource base, environmental issues, regulatory considerations, capacity and infrastructure, domestic demand as well as the global gas market. Other research has also looked at these factors and the general conclusion is that the amount of recoverable gas poses no problem, but that difficulties lie mostly in the regulatory field.

The historical background of this chapter has shown that although the United States was a frontrunner in the development of LNG transports, the country only exported very small amounts of LNG for decades. The availability of natural gas was not sufficient for large scale exports, in fact, the country was a net importer until the shale gas revolution occurred. The domestic resource base is even better now than it appeared some years ago and the outlook is extremely good.

Exports are expected to grow to a range between 50-100 bcm annually from around 2020, of which potentially 45 bcm could make it to the EU. Exporting 45 bcm to Europe annually would make the United States the third largest natural gas supplier of the EU. In the longer term, the total annual exports may even increase to a staggering 300 bcm by 2035.

Existing research suggested that the main difficulties for LNG exports from the United States lay in the legal domain. Concerns over environmental issues, regional and national regulations and time and money consuming licensing procedures loomed over the potential exports. This research has shown

that despite these fears, the developments in the United States have not been tampered. The legal framework has become less stringent in the timeframe of this research and the election of President Trump now takes away most of the concerns left in this regard.

The main feasibility concern for the EU proved to be the economic feasibility. Only 2 of the 21 first LNG exports in 2016 from the Sabine Pass went to Europe. This fits research that suggests that the EU market is not attractive enough as a destination market. The EU has also noticed this as a major issue, addressing the attractiveness of its market in the LNG strategy, as discussed in chapter two.

6.2.3 European import feasibility of LNG from the United States

The LNG imports that have made it to the EU over the last years have been traded with a strong premium at the European gas hubs; which makes the economics of spot importing very difficult to justify. Middle Eastern and north-African LNG is available in Europe at lower costs according to research. This means that in a normal open market situation, both the suppliers from the United States and the European customers will have better options than American LNG exports to the EU.

The EU is justly worried that it is not attractive enough as destination market for LNG exports. Backed by research that suggests that Europe will be a residual market for LNG. Chapter two presented the LNG strategy of the EU, which aims to improve this situation:

- Ensure that the necessary infrastructure is in place
- Complete the internal gas market
- Cooperation with international partners

These goals have been examined in chapter four. The total LNG importing capacity of the EU is very good, 200 bcm annually, but because of an incomplete internal market, this capacity is not or insufficiently available for the countries that are most in need of it. The internal market issues of the EU are partly physical and partly political. The missing physical links are being addressed by several projects, most notably the projects of common interests, that give priority and EU funding to crucial projects for the (inter)connectedness of the EU gas market.

The political issues are also being addressed and the research suggests that these efforts are paying off. The regulatory frameworks of the EU countries are becoming more similar and the internal market rules and regulations are even successfully exported to neighboring countries. These are promising signs that the internal market is being developed and headed in the right direction.

However, the current conclusion is that importing LNG from the United States is only feasible to a certain extent. The markets that can easily import LNG from the United States are also the markets that are well connected and supplied already. And their natural gas prices are too low for economically feasible imports from the United States. The EU countries most in need of a new natural gas supplier are not yet able to import LNG from the United States. But the internal market developments are

promising and they might even match the increasing LNG exports from the United States as well, given the fact that several new projects almost come into operation.

6.2.4 Impact of LNG exports from the United States on EU gas supplies

Politicians on both sides aim for LNG exports from the United States to Europe to improve the energy security of the latter. But surprisingly, even before the first exports have taken place, the impact has not necessarily been positive from the perspective of EU energy security. Chapter five has shown this and it may be counter-intuitive, but it is something for policy makers to keep in mind.

Research suggested that because of the decreasing American LNG imports, LNG transports have been diverted to Europe, but chapter five has shown that there is no statistical evidence supporting this. This positive impact suggested by the research even appears to be contradicting the European energy security goals. LNG imports have decreased in the last years and this has been compensated by more pipeline imports from the traditional suppliers, most notably Russia.

The pipeline suppliers have lowered the prices of natural gas exports to Europe. This has kept new LNG imports out of the markets and increased the market power of the pipeline suppliers, contradicting the diversification goals of the Energy Security Strategy. A real price war is expected in Europe, benefiting the consumers. The improving conditions on the internal market in combination with a price war can make the EU even stronger in its external relations, also towards its suppliers; which is a good development from the EU energy security perspective.

A side effect of the increasing global LNG market, fuelled by the developments in the United States, is the shift in pricing mechanisms. European gas was traditionally priced according to Long Term Contracts (LTCs), mostly tied to the oil price. But this mechanism is gradually disappearing on the continent which is moving towards spot pricing at natural gas hubs. These developments improve the flexibility of natural gas supplies, which is a positive development for European energy security.

6.3 Policy recommendations

More LNG will become available in the coming years, putting even more pressure on global prices. The gas market dynamics, and the fact that some notable LTCs between European countries and the main pipeline suppliers are running out further pushes the shift towards spot pricing. The expected price war in Europe will benefit the consumers, but will also threaten the EU energy security goals. Therefore, it is essential that policy makers look further than to just applaud a potential new and stable supplier of LNG. All aspects of energy security should be considered, especially given the EUs focus on the availability aspects, which suffers the most from the developments. Policy makers should not just assume that more sources automatically equal a better energy security situation. Policy makers, also in the United States, must know that supporting LNG exports to Europe can have adverse effects.

Spain has capped its own sources of natural gas imports, although this is still impossible for the EU countries to use a similar policy or to use it successfully because of poor connections. But the fact that other nations with well supplied gas markets, such as Germany or the Netherlands, still encourage and pursue more imports from the same sources does not show the solidarity that the EU needs. It might be a good policy for the entire union to actively promote caps in more member states. Separate caps for the different nations could also be a solution, possibly progressive caps that go down slightly.

Because of the sensitivity of the topic and national sovereignty it may be unlikely for EU member states to transfer more competences to the EU level, but the scale and political weight of the complete EU will always lead to better deals with foreign suppliers.

Even if the natural gas, or other conventional fuel, prices remain attractive and competitive, Europe should continue to invest in renewables to enhance energy security and avoid more need for imports. The goal of the EU to become a self-sufficient green energy power is perfect from the political as well as economic perspective.

6.4 Limitations of this study

This study has focused on specific consequences that were suggested in the literature or because of the importance given to it by the EU. Other consequences may also be important for European energy security but the scope and resources of this study did not allow for broader examination of all possible consequences. The consequences that were described in this research are just the result of the LNG exports from the United States, other causes or reasons have mostly been mentioned where relevant, but this research had to deal with real world circumstances.

This research looked at a problem that is prioritized by the EU. Because of this, the perspective has been on the EU as a whole, even though there are serious differences between countries and regions of the union. Studies looking at the specific consequences on regions or markets might show significant differences between the EU countries, potentially giving interesting results.

The available data by Eurostat covered a period with 2015 as the final year. The Energy Security Strategy is from 2014, making it interesting to further examine the effect of this strategy in the years to come, the same goes for the Energy Union strategy.

Given the importance of EU external action and energy relations, it could be interesting to see how the prospect of LNG exports from the United States has affected the focus of EU energy relations. It might be possible that relations with other partners, such as Algeria, Libya, Nigeria or Qatar have been neglected, as is suggested for the case of Algeria in section 5.3. Apart from the United States LNG, it can also be worthwhile to assess such relations in the light of the Energy Security Strategy.

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