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MASTER THESIS

ENERGY SECURITY ISSUES IN EU ENERGY POLICY: CASE STUDY OF SHALE GAS PRODUCTION IN EU

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Abstract

This paper analyzes the issues of energy security in European Union (EU) in the broader context of EU energy policy. Increasing demand for energy resources and their limited availability in Europe make EU member states dependent on external energy suppliers and vulnerable in the event of price shocks or supply difficulties. The gas crises between Russia and Ukraine in 2006 and 2009 stimulated the revision of existing policies in energy sector; since the 2014 Crimean crisis EU energy security became a hot topic for debate focused on decreasing EU's reliance on Russian gas.

This study seeks to investigate whether unconventional sources of energy, like shale gas, could help to meet EU energy security needs. First of all, this thesis identifies what energy policy is in order to examine afterwards EU energy policy, and bring to light its peculiar features. Then, the key elements of energy security strategy were described that proved to be helpful in further case study centered on prospects of shale gas production in EU.

The research conducted from the standpoint of regional security complex theory finds out that countries sharing the same border with Russia or situated in its proximity are more dependent on Russian gas supplies and have less diversified energy mix than their western counterparts. Technological shift was identified as a driving force that would help to attain EU energy policy objectives. Lastly, it was determined that shale gas could partially compensate for natural gas imports provided issues of upgrading of existing and building new infrastructure, mitigation of environmental risks, and, very importantly, public acceptance.

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Dedication

For my son Isa

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List of Acronyms and Abbreviations

API	American Petroleum Institute
CBM	Coal Bed Methane
CEF	Connecting Europe Facility
CFSP	Common Foreign and Security Policy
E&P	Exploration and Production
EC	European Commission
ECSC	European Coal and Steel Community
EPA	United States Environmental Protection Agency
EU ETS	European Union Emissions Trading Scheme
EU	European Union
Euroatom	European Atomic Energy Community
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IR	International Relations
MMBTU/ MBTU	One million British Thermal Units
NGV	Natural Gas Vehicles
PCI	Projects of Common Interests
R&D	Research and Development
REACH	Registration, Evaluation, Authorization and Restriction of Chemicals
EIA	Environmental Impact Assessment
RSC	Regional Security Complex
RSCT	Regional Security Complex Theory
Tcm	Trillion cubic meters
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
TGC	Tradable Green Certificate
USA/ US	United States of America
WB	World Bank
WNA	World Nuclear Association

Chapter 1
Introduction

1.1. Statement of Problem

Energy policy is intrinsic to the very notion of European integration as it laid the foundation for European Union (EU) through the creation of the European Coal and Steel Community (ECSC) in 1951, and later the European Atomic Energy Community (Euroatom). It became one of the most important political issues within EU today. Energy policies used to be implemented by individual member states; until present some countries are hesitant to delegate full authority to supranational level. At the same time, more and more Europeans support meeting the energy challenges at EU level (Langsdorf, 2011: 2).

The peculiarity of EU energy market is in its mix of energy sources: oil has the highest share, followed by gas, coal, nuclear energy, and renewable energy sources. Despite this diversity some EU countries are greatly dependent on import of fossil fuels; thus, vulnerable in the event of price shocks or supply difficulties. Depletion of domestic reserves in EU and ambitious climate policy that goes in hand with energy policy may lead EU to rely more on natural gas imports. The gas crises between Russia and Ukraine in 2006 and 2009 stimulated the revision of existing policies in energy sector. The 2006 Green Paper of the Commission and Lisbon Treaty afterwards emphasize the importance of united representation of EU interests at the international level which becomes topical again in light of the 2014 Crimean crisis. Recent crisis and sanctions it entailed on both sides press EU to consider other energy sources to replace questionable gas supply from Russia thereby strengthening EU energy security potential. One of the options for such a substitute in a short term perspective could be an import of unconventional gas from the United States (US) or in a long term perspective production of the shale gas within EU. It is aspired that production of shale gas would transform the energy landscape of EU as it has happened in America where rise in production of unconventional gas progressively resulted in decrease of natural gas imports.

In this research paper author would like to study EU energy policy with special attention to energy security issues. By operationalizing the set of variables author aims to analyze the rational of shale gas extraction in the EU, challenges and benefits of introducing new technological approach in the most densely populated continent. The aims of this study are two-fold: (i) to study EU energy policy in general, and EU energy security in particular from the perspective of regional security complex theory; (ii) balance pros and cons of introducing new energy source like shale gas to EU energy landscape. Outcomes of the research could provide an insight that would help to overcome barriers to shale gas production in EU, and could in the long run help to better address the issues of energy security in Europe in the years to come. Additionally, shale gas formations could be found in other regions of the world, and the findings of current research could be helpful for other regional energy complexes dealing with similar energy security challenges as EU.

1.1.1. Research Question

This study will aim to answer the following research question and three sub-questions:

1. To what extent can unconventional sources of energy like shale gas secure EU energy supply?
    a. How well is EU regulatory framework prepared to accommodate unconventional sources of energy?
    b. To what extent energy infrastructure can ensure stable energy access to shale gas?
    c. What are risks and costs associated with shale gas import or production?

1.2. Methodology

1.2.1. Data Source

For the present research, primary, secondary and tertiary literature sources had been used. Tertiary sources were mainly employed to get the overall understanding of the historic background and composition of EU energy policy. Secondary sources were used to identify key actors in implementing and coordinating energy policy in EU as well as to understand the components of energy mix and complex legal framework and infrastructure related to it.

As primary sources, author consulted the Energy webpage on the website of the European Commission, EU Energy Law, EU Energy Policy Blog, European Energy Security Strategy, etc. Academic works by Buzan, Dannreuther, Legro, Moravcsik, Burchill, Jackson and Sorensen were of particular importance while formulating theoretical framework of the present study. Studies by David Buchan, Florence Geny, and some other scholars were taken as the basis for analysis of prospects of shale gas extraction in Europe. Thus, case study relies partly on the collected data from Internet, and available in Turkmenistan printed materials.

1.2.2. Qualitative Method

As the topic of the present research lies in the field of social sciences, to conduct this study, the author employed the tools and instruments of qualitative method, namely data collection, document analysis and single case study.

Collected data were used to briefly outline the origins of EU energy policy, to provide definitions of the key terms, to define energy policy in general and energy policy of EU in particular by covering such topics as its objectives, energy mix and energy security strategy. Data collection also helped to formulate theoretical framework, and provided wealth of materials for a case study. In order to analyze EU energy policy, author scrutinized thoroughly the laws and policies related to that issue from the internal criticism viewpoint. The same analytical method had been used to study legislative acts pertinent to unconventional energy sources.

Case study of unconventional energy sources, namely shale gas, and how it can strengthen EU energy security vis-à-vis recent crisis in Ukraine is central to this study. Although single case studies are extensively used in qualitative social science research to test theories and hypotheses, they have certain limitations, especially when it comes to explanation of causal relationship of two variables. It is impossible in the event of a single case study because variables do not vary, which eventually may lead to measurement error, hence, the rejection of true hypothesis. There is also a difficulty in explaining the phenomenon through one single variable. Besides, it may happen that the unknown variable produces the outcome. In short, through a single case study it is hardly possible to develop general statements applicable to other events (Sprungk, 2013). Regardless of those limitations, a single case study provides a detailed examination of one particular setting or event. That is why author will resort to analysis of advantages and disadvantages of shale gas extraction within EU since shale gas could be one of the most viable and economically wise ways to meet the ever growing energy demand and at the same time to diminish EU's vulnerability from natural gas imports from Russia.

1.3. Operationalization of EU Energy Policy in Regard of Shale Gas Production.

To get the comprehensive view on EU energy policy, which will be studied in the next chapters, it is important to operationalize four broad variables: the level of unity of EU energy policy and integration of EU internal energy market, economic recovery of shale gas production, and its environmental impact.

Although qualitatively it is difficult to measure the level of unity of EU energy policy, including the issues of energy security, it is possible to assume that depending on the level of cooperation between member states it can take any place between two imaginary points of completely unified or fragmented policy. Until present, EU was not able to implement common energy policy for different reasons: divergent energy profile of each member state defines the need for import of different types of energy carriers, their quantities as well as suppliers. Thus, the difference in energy profiles determines the difference in import of energy sources among 28 EU member states. Speaking about natural gas import, Baltic States, for example, are 100% dependent on gas imports from Russia, whereas such countries as Spain and Portugal are not using Russian gas at all (Jopp, 2014a). Due to this difference, the countries are differently affected by oil and gas shocks which in turn influence their willingness to entrust prices and commit themselves to further common energy market integration (Tensmeyer, 2012). In the field of energy policy, EU lacks genuine community competences. Most energy related issues are at the discretion of individual member states, which have also a right to veto any decision at EU level that contradicts their national interests. Furthermore, the role of other actors in energy field shall not be undermined. In gas sector only, we can distinguish such actors as states, government agencies, international organizations, private companies, and consumers. As Severin Fischer rightly notes "while political actors [national governments] can structure internal markets, they become more and more powerless when the playing field becomes international" (2010:13). Fischer (2010:13) goes further putting forward economic actors, to be more precise – large energy companies, as the dominant players in international energy game.

One of the founding pillars of EU energy policy is sustainability which provides EU with incentives to hold progressive environmentally conscious position in the world. Since energy and environmental issues are closely associated, and meeting the requests of majority EU member states who asked for a stronger focus on climate issues, during the summit in March 2007 European Council called on Member States to "develop a sustainable integrated European climate and energy policy" thereby putting climate protection in the framework of energy policy (2007: 1). For the needs of meeting climate change goals, EU uses abundantly natural gas, one of the relatively clean burning fuels in comparison to coal or traditional oil, which makes it 64% dependent on supply of natural gas[1]. Presently, Russia is EU's largest natural gas supplier, accounting for 32% of its gas imports (Eurostat, 2014). Pursuing its ambition to be a world leader in the fields of environmental and climate change policy, EU member-states committed to what is known as the 20-20-20 strategy. It means that collectively EU members have to reduce by the year 2020 its greenhouse-gas emissions by 20% compared to 1990 level, increase the share of renewable energies to 20% of total EU energy consumption, and improve energy efficiency by 20% (EC, 2014e). Additionally, EU has introduced EU emissions-trading scheme (EU ETS) with its "cap and trade" principle that allows setting the total amount of greenhouse gas (GHG) emissions to be emitted by all installations included in the system.[2] Over time the cap is reduced which results in lowering the emissions. Companies are authorized to trade the received emission allowances under the cap. By pricing carbon and imposing heavy fines, EU has managed to bring climate change problem to company boards thereby efficiently promoting investment in clean and low-carbon technologies (EC 2014f). Investing in renewables is another way to ensure energy security with respect to the principle of sustainability. That is one of the reasons why EU pays a particular attention to the development of alternative energy sources, such as wind power, solar energy, hydropower, biomass, etc. Due to environmental concerns, the idea of development of unconventional sources of energy in Europe is not welcomed by certain member-states. Shale gas production has a short history; therefore, the long term environmental impact is yet to assess. According to Howarth et al. (2010), GHG emissions from shale gas extraction are greater than from conventional gas. Operationalization of environmental impact will help either to support or refute this statement, and also assess its impact on decision about shale gas extraction in EU.

[1] Today, EU is the world's largest energy importer, importing about 55% of its energy supply. In 2011 oil comprised about 37% of the EU's primary energy consumption, natural gas – 24%, coal – 18%, and nuclear energy – 12% (European Commission, 2011).

[2] EU ETS covers more than 11,000 power stations, industrial plants and other installations, including airlines in 31 countries (EC, 2014f).

Profitability is another important factor that could shape decisions of EU member states. According to the European Energy Security Strategy an accurate overview of unconventional economically recoverable resources will be required to start commercial scale production (EC 2014b: 13). It is plausible that member states intending to explore shale gas reserves can replicate the experience of the United States. In America, in addition to energy security, the economic benefits in 2010 included contribution to US gross domestic product (GDP) more than $76 billion, and $18.6 billion of its share in federal, state and local government revenues, not mentioning creation of the great number of new jobs (HSDL, 2013: 4). Thus, shale gas has a potential to contribute to economic development, job creation, and income of EU member states. Surely, being less expensive than renewable energy, shale gas can contribute to energy security and meeting climate targets under condition that its production cost will be at least as cheap as the imported conventional natural gas (Buchan, 2013: 1). Another challenge related to exploration of shale gas is that "it has not yet gained widespread public acceptance in the EU" (Shepherd, 2013). While operationalizing this variable author will consider geological aspects, preparedness of EU infrastructure, legal regulations, and other factors.

Therefore, operationalizing unconventional gas in terms of environment sustainability, economic benefits, internal market integration and unity of European energy policy in general would help to define the role that could be attributed to shale gas in addressing the issues of EU energy security.

1.4. Thesis Structure

Research thesis on EU Energy Policy will consist of seven chapters: introduction, five body chapters, conclusion, and references. Chapter 1, Introduction, will provide brief overview of EU energy policy formation; assert the statement of problem, aims of the paper and research question. It will also describe the methodology of current study, explain the reasons for applying qualitative method, and rational for selecting single case study. At the end it will provide a general overview of the thesis. Chapter 2 on the State of the Art will cover the findings of previous research on EU energy policy, more specifically how it addresses the problems of energy security; will identify gaps in existing literature, and state the importance of current research. Chapter 3 will be devoted to conceptualization of energy policy by providing definitions of such notions as "energy", "energy policy", and “energy security”. It will also describe EU energy policy, energy mix of individual member-states, provide overview of energy related legislation, and explain current challenges for securing energy supply.

In Chapter 4 author will focus on theoretical framework defining the theory that will match best the needs of current study that will help to formulate the set of hypotheses. Chapter 5 will speak about prospects of shale gas production within EU by studying the technology of extraction and environmental concerns, availability of infrastructure, and all associated costs. Chapter 6 will provide the main findings based on the results of case study, and will highlight the contribution of the study to current literature on the topic. And, finally, Chapter 7, Conclusion, will encompass all findings and summaries, and explain the limitations of this study.

Chapter 2
State of the Art

EU energy is widely studied topic. To date, most research regarding EU energy policy has focused either on its historical background, its evolution due to changes in legislative framework, or on liberalization of EU energy market and obstacles to single energy market (Langsdorf, 2011; Braun, 2011; Andoura et al., 2010; Eikeland, 2004; Kanellakis et al., 2013). Energy policy is the founding pillar of European integration which was marked by the establishment of the ECSC in 1951, and Euratom in 1957. Both treaties laid the legal grounds for common energy policy (Andoura et al., 2010: II). Closely integrated energy market was meant to enhance energy security and boost competition in energy sector. However, the first decades of cooperation were rather slow with the main focus on national priorities. The oil crisis of 1973-74 gave the first impetus for development of common strategy to tackle energy problems, which was reflected in the 1974 "Council Resolution concerning a new energy policy strategy for the Community" (Langsdorf, 2011: 5). The further big step forward was related to the 1987 Single European Act and its economic objective of completing the internal energy market. Successive the 1992 Maastricht Treaty and the 1997 Amsterdam Treaty dealt mainly with security of supply issues. From 1990 the energy policy receives a new environmental dimension after the first assessment of the Intergovernmental Panel on Climate Change (IPCC) in 1990, and consecutive adoption of Kyoto Protocol. It made clear that climate change and energy issues should be considered jointly, and that challenges is impossible to meet on the nation state level, but rather shall be addressed on global or at least regional level. Combination of energy policy and climate change objectives led to creation of quantifiable 20/20/20 targets explain to be reached until 2020. In his report Per Ove Eikeland (2004) claims that despite visible progress EU energy policy is not always consistent with the principle of free and fair competition that is crucial for building efficient internal market. He sorts out the potential sources of such inconsistency as well as tries to investigate the impact of regulatory policies on efforts to create and maintain internal market with free and fair competition.

Kannellakis et al. (2013: 1020-1021) and Susanne Langsdorf (2011: 6) note that consistency in EU energy policy could be traced from 2007 with the introduction of the Strategy "An energy policy for Europe" that outlined the objectives as we know them today, namely sustainability, security of supply and competitiveness. This action plan was later endorsed by energy policy provisions included in the Lisbon Treaty. From the legal point of view it represents a benchmark in EU energy policy. From the beginning ECSC and Euratom Treaties provided an overarching legal basis to deal with energy issues. With expiration of ECSC in 2002, Euratom Treaty remained, but providing legal basis for nuclear energy issues only (Andoura et al., 2010: II). Jan Frederik Braun scrutinized in his paper how energy policy was affected by the Treaty of Lisbon. Similarly to the Task Force from Notre Europe (Andoura et al., 2010: III), he concludes that Lisbon Treaty had rather minor effect since Energy Title was presented in form of compromise between national sovereignty over natural resources and shared EU competence. Braun claims the novelty brought in by Lisbon rules is in EU's external representation over energy matters by new institutional actors, the high representative and the European Council President.

Leaving aside the cornerstones of a common EU energy policy, a number of papers analyze EU stance towards the issue of energy security and diversification of energy supply with the whole block devoted to complicated relations with one of the major EU energy supplier – Russia. (Kusku, 2010; Belkin, Morelli, 2007; Van der Meulen, 2009; Zieniewicz, 2010, Smith, 2011, Bozhilova, 2009; Molis, 2011). Eda Kusku (2010) analyzes from the viewpoint of intergovernmentalism the prospects for EU to develop a common energy security policy. Intergovernmentalists claim that cooperation between countries is possible as long as their interests converge. However, diverging energy situations, interests and goals of EU member states does not help to formulate common energy security policy. The limited capacity of the EC in this regard and the absence of common interests of all member states render further integration least likely (Kusku, 2010). Applying New Institutional Economics theory Van der Meulen (2009) claims that EU energy policy puts under risk the energy security. His article "Gas Supply and EU-Russia Relations" is equally devoted to analysis of energy policy in EU and Russia. Frequently overlooked by scholars, Van der Meulen emphasizes the Russia's need through strict institutional governance guarantee the natural gas demand and access to the European market. I don't see how Russia's energy policy priorities should influence EU energy policy itself.This is quite opposite to Commission's policy focused on liberalization of markets, thereby favoring free competition over the energy security. Member states are more concerned with security of supply, which balances Russia's need for security of demand. This makes member states diverge from the Commission policy, and consider the liberalization of the market rather as a long-term goal (Van der Meulen, 2009).

Analysts Paul Belkin and Vince Morelli (2007) also attest that EU faces a challenge of creating common energy policy, leaving the priority in policy formulation after the individual states. They concluded that the major role of EU lies in determining power grid interconnection and energy infrastructure as well as coordinating the development of renewable energy, storage and distribution of emergency energy supplies (Belkin, Morelli, 2007: 28). EU energy security is highly dependent on the external relations with non-EU states. Due to the growing importance, energy issue became an integral part of EU's Common Foreign and Security Policy (CFSP) (Belkin, Morelli, 2007: 27). The success of EU in energy security would primarily depend on its ability to diversify its energy suppliers by exploring potential of partnerships with energy export countries. In recent years, one of EU concerns was to reduce dependency on Russia, the prime EU supplier of natural gas. Russia is considered to be unreliable partner for a number of reasons, such as lack of accountability from Russian state monopolies Gazprom and Transneft, gas supply crisis of 2006 and 2009, etc. (Smith, 2011). Some EU countries, Baltic states of Lithuania, Latvia and Estonia, has no option but to import gas from Russia, and are, therefore, obliged to pay higher prices for energy than other EU member states. That is why Baltic States are such fervent supporters of EU common energy policy because alone they are too weak to protect their interests in negotiations with partners such as Gasprom and Transneft (Molis, 2011: 5). Alena Zieniewicz (2010: 239) rightly notes that regional gas market becomes ever more globalized; hence, EU shall take into consideration the interests of other global actors like China and, finally, gain access to the large reserves of natural gas available in Central Asia and decrease its dependence on Russia. Fostering of regional cooperation among the states of South-East Europe, such as Greece, Bulgaria and Turkey, offer another viable alternative to decrease energy dependency on Russia (Bozhilova, 2009: 4). Those countries are in proximity to the world's gas and oil reserves that could help to save on transmission costs thereby reducing the negative effects of distance. Thus, pipeline 'mapping' in the region would work towards ensuring EU energy security, political and economic stability in South-East Europe.

Multiple studies are devoted to energy efficiency, renewables and alternative sources of energy (Backlund et al., 2012; Jacobson et al., 2009). Conventional way to improve energy efficiency is by using energy efficient technologies. However, Backlund et al. (2009: 1-2) argue that a cost-effective way to improve energy efficiency is by improving energy management practices mainly in manufacturing and commercial sectors. That will help to achieve medium term energy saving targets set by EC for 2020, and also to meet the long-term targets set for 2050. Researchers talk about "extended energy efficiency potential" when the energy efficiency potential could be enhanced by efficient energy policy tools, namely energy management components (Backlund et al., 2012: 11). Another way to reach efficiency in energy sector is by generating power from renewable sources of energy. The EC proposal on use of renewable energy was based on a pan-European, harmonized tradable green certificate (TGC) scheme. Jacobson et al. (2009: 7) argue that a pan-EU TGC system would be a deadlock for Europe which should rather design policies that would help to meet innovation challenges caused by extensive use of technologies working on renewable energy. The assessment is based on three case studies of areas where TGC scheme was implemented: UK, Sweden, and Flanders.

Lessen GHG emissions and ensuring energy security by using natural shale gas could be an option for EU (Wold, 2014; Boersma & Johnson, 2012; Buchan, 2013). While comparing of shale gas adoption in US and EU, Tim Boersma and Corey Johnson (2012: 573) point out that shale gas development in Europe is in its infant stage. One of the core problems revealed is that there is no unanimity between EU member states on whether shale gas should be or not extracted within EU. To active advocates as Poland where private companies have started drilling wells oppose France and Bulgaria that banned shale gas technologies; while there are also those, like UK, who prefer not take any side (Boersma & Johnson, 2012: 573-574). Researchers argue that shale gas could become a clean alternative to coal; but it should not be forgotten that extracting shale gas is more intensive industrial activity than extracting regular natural gas; hence, is not as clean as it is speculated to be by interested parties (Buchan, 2013: 1-2). In his Master thesis project Einar Wold (2014) reflects whether shale gas revolution in EU would be as successful as it was in the US which led to increase in use of natural gas and decrease in carbon emissions. For this, author studied the role of natural gas in EU power industry, and evaluated its potential for decreasing GHG emissions. The steps to popularize the use of natural gas in EU is by increasing penalty for using coal, reducing prices for natural gas, and increasing its availability on the market. All this would require large investments in infrastructure and geological research, and after thorough analysis Wold (2014: 67) remains unsure if the use of shale gas would be a right thing for Europe at the given time.

Current research studies the energy policy of EU, and trends in further strengthening of EU energy security by diversifying energy supply or capitalizing on a more extensive use of unconventional sources of energy, such as shale gas. An examination of literary sources indicates that the history of EU energy policy and its development with evolution of legal framework as well as energy security, energy efficiency and many other issues has received substantive study. At the same time, the outcomes of different studies on the positive and negative aspects of EU-wide use of shale gas provide quite divergent results although the question of shale gas extraction every year becomes more and more topical. Therefore, there remain gaps in analyzing the rational for shale gas production within EU, and my research contributes to the existing literature and international discussion on this issue.

Chapter 3

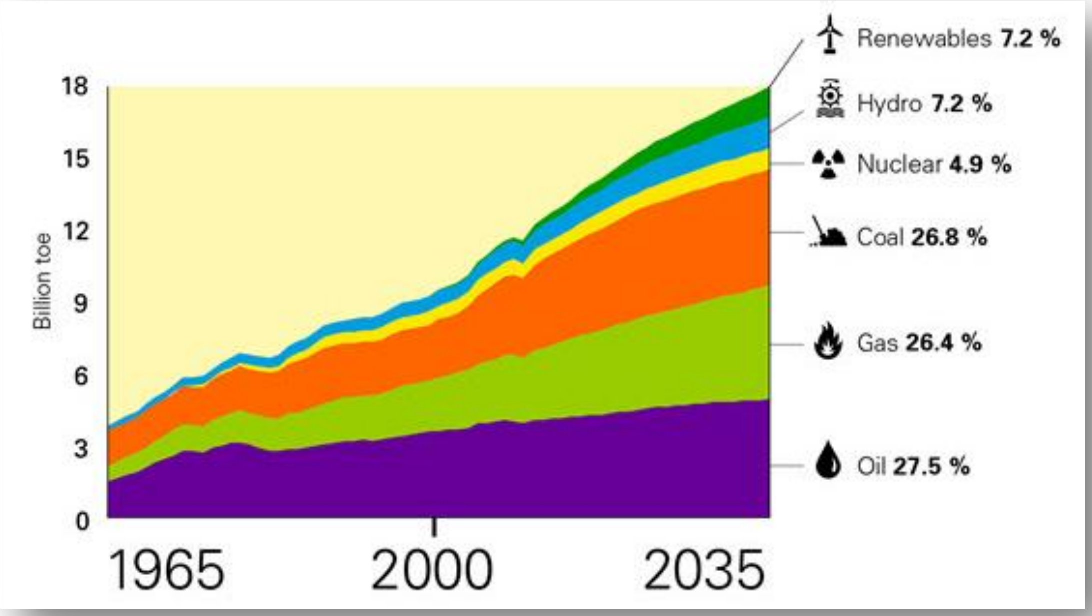
Concept of Energy Policy and the Energy Policy of EU

3.1. Theory

This study is based on the theory of regional security complex. This theory is employed to explain how production of unconventional resources of hydrocarbon energy within EU could help to ensure its energy security.

The comprehensive definition of energy security will be given later in this chapter. In general, it means the availability or continuity of energy commodity supply at an affordable price. It comprises long-term and short-term security: the first one is associated with resource availability whereas the latter one is related to supply disruptions of the fuel or electricity. Demand for energy increases each year, and forecast means that we will need many sources in the future (*Figure 1*). According to BP, by 2035 the world will need 41% more energy than in 2012 (Eyton, 2014). This makes energy security so important for many countries worldwide, and makes it an integral part of their energy policy.

Figure 1. Energy Consumption by Fuel 2035 Projects. Source: BP Energy Oultook 2035 (http://www.bp.com/en/global/corporate/about-bp/energy-economics/energy-outlook.html)



The origins of EU energy policy goes back to the after war period and is marked by the creation of the ECSC. Energy security is a more recent phenomenon originated in 1970s and that became more pronounced in 2000s mainly due to complex interrelations with Russia. Today energy security issues are embedded into Energy Security Strategy which could be considered as an EU response to Ukrainian crisis, but mostly as a step forward on the way of ensuring a stable supply of energy for the economy and citizens of EU.

Energy policy is important to proper functioning of economic, social, and even environmental aspects of any society. Under the general concept of energy policy we may address various issues, such as energy production, consumption or distribution. Representing one area of public policy, it may address a wide range of issues from legislation to energy conservation or taxation. In order to define energy policy, it is necessary to define two terms "energy" and "policy," to be more accurate it is better to define the concept of "public policy".

3.2. <u>Terms and Definitions</u>

3.2.1. <u>Energy</u>

According to American Petroleum Institute (API: 2014), energy is the capacity of a system to do work be it an airplane or tidal wave. All living things need energy and so does technology and different machines created by people. Unlike humans, animals or plants that consume food or generate energy through biosynthesis, machines require fuel or electric energy. Therefore, the concept of energy is very broad since energy could be found in different forms: electrical energy, electromagnetic, mass or nuclear energy, chemical, thermal, radiant or solar, and mechanical energy that in its turn is subdivided into two categories - potential and kinetic energy. The first one characterizes the stored energy whereas the second on is associated with a movement. Energy has a unique property – based on the law of conservation of energy it can transfer from one form to another. Energy is always designated according to its nature. For example, heat may become thermal energy, or nuclear energy may be transferred in electrical energy. For this study author would primarily refer to hydrocarbon fuel energy and to a lesser extent to nuclear and renewable energy.

Fossil fuels or hydrocarbons are combustible geologic deposits of organic materials formed over hundreds of millions of years from decayed plants, animals and stored in form of natural gas, oil and coal in the earth's crust. The extraction of fossil fuels enabled the development of industry and overall improvement of living and working conditions.

However, hydrocarbons are finite resources, and with rising energy demand worldwide, geopolitical instability, rising international energy prices policy makers of many countries face the challenge to ensure energy security, and employ different means for this purpose including development of alternative sources of energy, such as renewables or unconventional sources.

3.2.2. **Public Policy**

Public policy is the set of actions called policies, and they are politically determined by the government. Some American public policy scholars attest that public policy consists of political decisions for implementing programs to achieve societal goals (Cochran and Malone, 1995).

Birkland's main research focus in public policy theory was on the fields of disasters, accidents and homeland security. Nevertheless, his identification of certain attributes that define public policy is very important. In his book on theories and concepts of public policy-making he specifies five of them. In Birkland's words, public policy is:

- The policy made in "public's" name;
- Policy generally made or initiated by government;
- Policy interpreted and implemented by public and private actors;
- What the government intends to do, and
- What the government chooses *not* to do (Birkland 2001: 17).

The last two statements echo with the one proposed by Thomas Dye in his research on organizational theories in American politics, specifically on Elite theory and Pluralism. He gives a very brief, yet precise definition of public policy arguing that it is "whatever governments choose to do or not to do" (Dye, 1995: 2). This definition fully reflects the logic of current research that focuses mainly on the policies and the role of the government or regional organization EU that acts on behalf of governments of its member states in policy implementation.

3.2.3. **Energy policy**

As an integral part of public policy, energy policy is a way that the government, or a group of governments in case of EU, has decided to address issues of energy production, distribution and consumption. Under the term of energy policy each country may put forward different set of measures regarding, for instance, fuels exploration or energy transmission, pieces of legislation affecting energy use or emission standards, energy security and fiscal policies, among others. Energy policy is closely linked to the environmental policy because any activity related to energy has direct or indirect impact on environment. EU member-states chose to have common energy and climate policy in addition to their national policies. Their decision is explained by ever more complex challenges that are barely possible to handle on the national level, and importance of speaking with one voice on international arena to address various issues related to energy and climate policy, but most importantly to ensure energy security within EU.

In the framework of common energy and climate policy EU can do following:

- Law-making in issues concerning the environment and the single market (e.g. rules on competition)
- Measures on energy saving and efficiency
- Negotiation of agreements with partner countries outside EU
- Planning of trans-European energy networks
- Allocation of EU-Funds
  - For the development of new energy technologies
  - For financing some infrastructural projects (Projects of Common Interests (PCI))
  - For improving the trans-European energy infrastructure (Initiative Connecting Europe Facility (CEF))
- Issues concerning nuclear energy, except the decision to use it (Jopp, 2014c).

Despite the large set of competences entrusted to EU by its member-states, it cannot decide on:

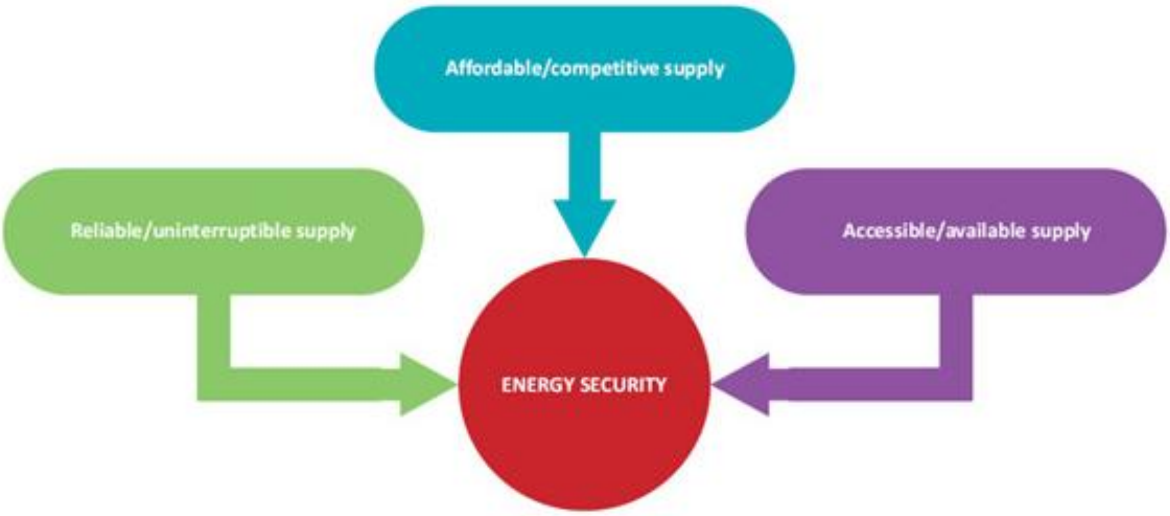
- Composition of energy mix of each sovereign state;
- Taxes;
- Financing of missing infrastructure; or,
- In accordance with the principle of "subsidiarity"[3], any other issue which is easier to handle on national state level, like public health, security issues, and others (Jopp, 2014c).

[3] The principle of subsidiarity aims at determining the most efficient way of intervention with regard to the areas of shared competences. Art. 4 par. 2 TFEU provides that shared competences include energy,

3.2.4. Energy Security

Energy security[4] is a complex concept that evolved over the time. Several authors indicate to the absence of the clear definition of the term. For instance, Marine Sigot (2013: 4) points that it is "a diffuse concept and its legal definition is still in process"; according to Orecchini et al. (2014: 5), energy security is a concept that can include a range of elements considered as important by a particular society. In Christian Winzer's words (2011: 2) it became "an umbrella term for many different policy goals," and in his attempt to define it he prefers a short and concise definition of energy security as "the continuity of energy supplies relative to demand" (2011: 4). Benjamin Sovacool (2011: 3-6) in the Routledge Handbook of Energy Security compiled 45 definitions of this term. For this study author choses to use the one provided by the International Energy Agency (IEA: 2014) that defines energy security as "the uninterrupted availability of energy sources at an affordable price" (*Figure 2*).

Figure 2. Defining Energy Security. Source: IEA, 2014 (http://www.iea.org/topics/energysecurity/subtopics/whatisenergysecurity/)



It is clear that continuity of supply and affordability of energy sources are essential to the functioning of modern economies. However, the availability of energy sources varies from country to country which makes it so important to diversify energy sources and pay particular attention to energy efficiency. One of the ways to improve energy

environment, internal market, and several other areas, and member states may exercise their competence only if the EU has not exercised, or has decided not to exercise them (TFEU: 2012: 51-52).

[4] Energy security is a term used for this paper along with the synonymous to it terms of the Security of Energy Supplies and Security of Supply.

efficiency is through the use of renewable sources of energy; to smoothen the uneven distribution of energy supplies policy makers aim at diversification of energy supplies; and, in the case of EU countries, the further integration of internal market. In this regard, implementation of common energy policy is of crucial importance. The major reason is that economies of EU member states depend on imports of more than 50% of its energy which makes it vulnerable to political events in other parts of the world (M2 Presswire, 2014). Figure 3 illustrates that some countries, like Malta, Luxembourg or Cyprus import almost all energy they consume.

Figure 3. EU Member States All Fuels Energy Dependency Rate as of 2012.
Source: Eurostat 2012, (online data codes: tsdcc310 and nrg_100a).

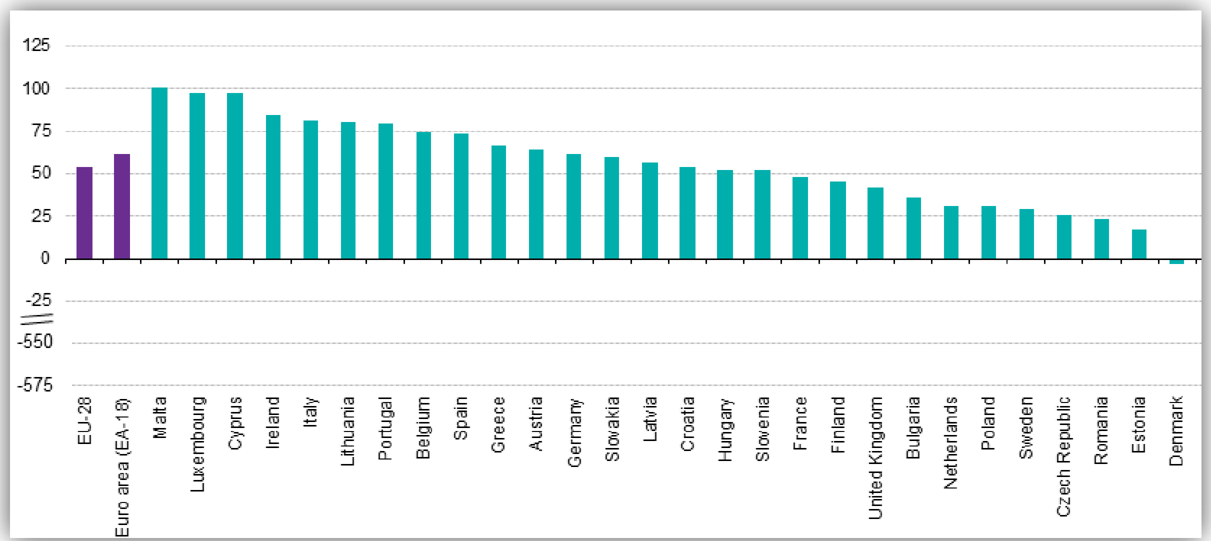
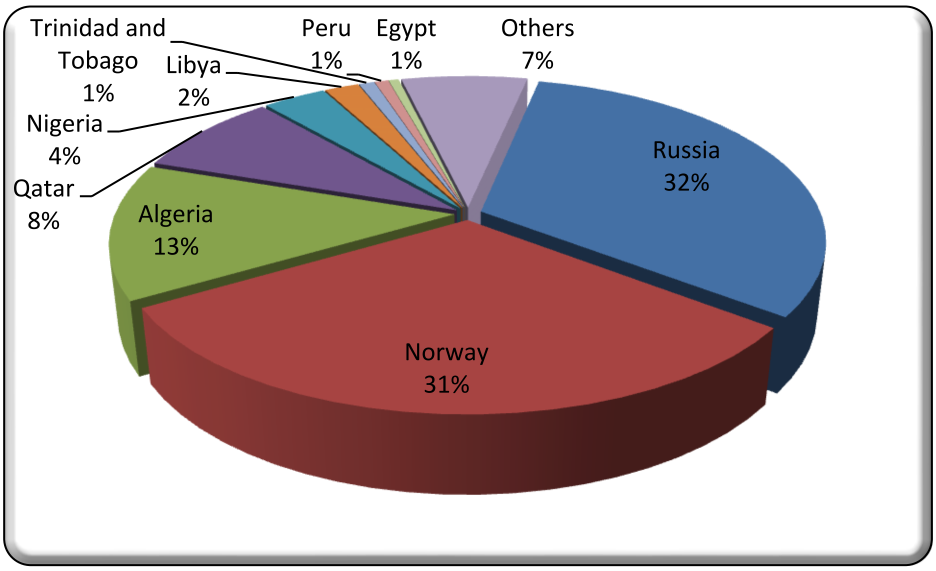


Figure 4. EU Natural Gas Imports by Country of Origin. Source: Created by author, figures from Eurostat 2014 (online data codes: nrg_122a, nrg_123a and nrg_124a).



EU energy dependency is especially pronounced with regards to natural gas tied to its specific transmission mode via pipelines. Figure 4 shows that EU relies on gas supply mainly from three countries, and the leading among them is Russian Federation that has a share of 32% of total EU natural gas supply as of 2012 (Eurostat, 2014). Thus, the Crimean crisis, and disruptions of gas supplies from Russia in previous years, made EU member states to seriously reconsider measures to be taken to ensure the security of gas supply.

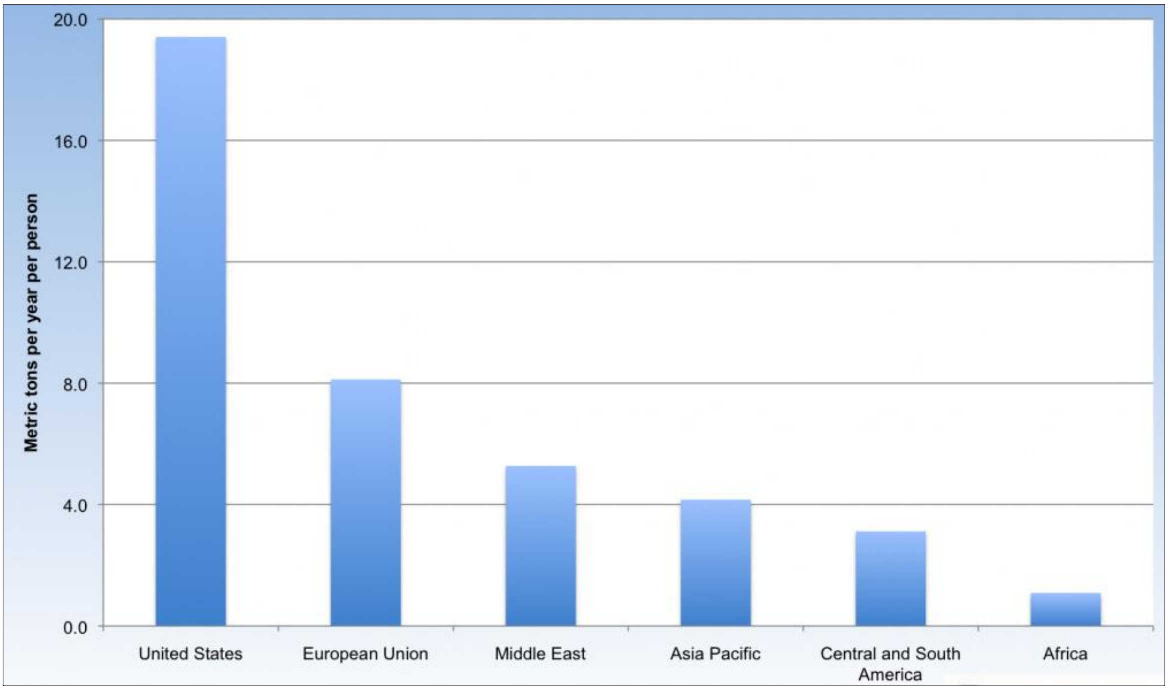
3.3. What is EU Energy Policy about?

3.3.1. EU Energy Policy Triple Objective

EU develops climate and energy policy in an integrated approach pursuing triple objective: sustainability, competitiveness and security of energy supply. First of them, sustainability, is aimed to minimize negative effects on climate by promoting renewable energy sources and energy efficiency (EC, 2013). GHG emissions with their disastrous impact on environment are the product of energy sector; mainly transport and manufacturing industries (Jopp, 2014b). GHG emissions cause global warming; therefore, massive reduction of GHG emissions is required to prevent climate change. This especially concerns industrial countries with high GHG emission rate. In EU the rate of GHG emissions varies from country to country depending on energy sources available there: brown coal in Poland or oil shale in Estonia put them on top of EU members list in GHG emissions whereas such an industrial country as France mostly relying on nuclear energy affect climate change to a lesser extent. Nevertheless, despite efforts to reduce GHG emissions, EU wide emission rate per capita remains quite high – in 2012 it was 7.4 tons (PBL, 2013: 50). However, comparing different regions of the world, the first place in carbon emissions per capita is attributed to the US that emits twice more greenhouse gases than EU, and more than three-folds compared to Middle East (*Figure 5*).

In order to achieve the second objective, competitiveness, EU has to pursue its goal for creating a single market, comprising European energy market as well; although in energy sector a lot of work yet to be implemented. Competitive energy market presumes offering Europeans a choice of suppliers be it gas or electricity company. This would help to provide fair and competitive energy prices and stimulate innovations. The main challenges on the way to a single energy market lies in peculiarity of its nature: it is gridbound, and dominated by big companies closely connected to the state. Those obstacles, especially in the gas and electricity sectors, impede the effective implementation of the internal energy market. In the period 1996-2009 three legislative packages were adopted to boost liberalization of energy market through such measures as consumer protection, market access, transparency, etc. However, some member states failed to fully implement the Third package, and once again it proved to be more difficult than expected to complete the internal market till the deadline set for 2014 (EP, 2014). Presently, Europeans can enjoy some positive effects of the conducted reforms: greater number of energy providers is available enabling consumers to compare prices and choose the one that offers the better deal. Furthermore, high cost of energy carriers is bad for international competitiveness of EU member states.

Figure 5. Per Capita Global Carbon Dioxide Emissions.
Source: Rapier, Robert (2012): Global Carbon Dioxide Emissions – Facts and Figures.



It shall not be forgotten that stability of EU energy market is determined by continuity of energy supply that leads us to the third objective – security of supply. Some member states, like Germany or France, are highly industrialized economies that rely on energy supply from their European partners, or most often from third countries. A number of factors should be taken into consideration in order to ensure security of energy supply, such as sudden rise of prices for energy carriers or inability of transit states to fulfill their commitments. To avoid the negative experience of 2006 and 2009, current instability in

Ukraine pushed EU policy makers to look for solution in further integration of internal energy market, modernization of infrastructure, diversification of energy suppliers and transit routes as well as turning more to renewable energy sources or exploring the possibilities of using unconventional energy sources like shale gas.

Therefore, issues of sustainability, competitiveness, and security of energy supply are interconnected and of crucial importance for Europe. To track the progress in achieving triple objective, they have been translated into binding targets. Cooperating closely with other countries in the framework of the United Nations Convention on Climate Change, EU strived to fulfill its commitment stipulated in the Kyoto Protocol to reduce the emission of the six main GHG by at least 5% compared to 1990 levels (BMUB, 2014). On EU level the European Commission in the 2030 Framework for Climate and Energy Policies[5] suggested to reduce domestic emission of GHG by 40% below the 1990 level by 2030 (EC, 2014a). This is considered to be a prerequisite to ensure that EU will be able to meet the target of cutting emissions by at least 80% by 2050 (EC, 2014a). By 2020, EU has committed to reduce its carbon emissions by 20%; increase the share of renewable energies to 20% of total EU energy consumption; improve energy efficiency by 20% (EC, 2014e).

3.3.2. <u>EU Energy Mix</u>

The difference of availability of energy carriers, and energy supply, hence different national priorities determine EU action on international arena. National energy mix determines the policies of individual member states and their attitude toward EU policy making. On the example of energy mix of three European countries - France, Germany and Poland, author will demonstrate the diversity of its national priorities that actually impede developing a common policy and act unanimously.

French energy policy is based on extensive use of nuclear energy with 58 nuclear reactors being built across the country. Nuclear energy was a source for 77% of electricity production in 2007 (Jopp, 2014b). To base the economy on nuclear energy was a political decision aimed to minimize France’s vulnerability in times of crisis on import of energy carriers from third countries. However, with the election of President Francois Hollande

[5] The EC affirmed the 2030 Framework for Climate and Energy Policies in January 2014. It is built on the 2020 climate and energy framework with consideration of targets set within EU Low-Carbon Roadmap 2050.

since 2012 France set to reduce the proportion of nuclear power in its energy mix (WNA, 2014a). The positive side of using nuclear energy is that it does not entail high level of GHG emissions in comparison, for instance, of oil or coal. Therefore, it is easier for France, than for Germany or Poland to commit itself for climate protection, and insist on establishing low GHG emission quotas (Jopp, 2014b). Learning the tough lessons from the 1974 oil crisis, France for decades elaborated its energy security strategy by diversifying the range of gas and oil suppliers as well as its transport infrastructure. However, the liberalization of the French energy market proved to be difficult since government was reluctant to open market for new energy providers, and to modify its structure.

Unlike France, Poland presently does not have a single nuclear plant. Its energy mix is dominated by black and brown coal that constitutes the largest share of energy consumption. The use of coal in energy sector results in high rate of GHG emissions: 8.3 metric tons per capita compared to 5.6 in France (WB, 2015). That is why it is more challenging for Poland to cope with the negative effects on climate change. Another challenge is to ensure energy security. Poland’s economy is partially dependent on natural gas and oil that is imported from Russia. Inherited transport infrastructure does not help to solve the problem of diversification of energy suppliers. Single pipeline secures the transportation of gas and oil from Russia through Belarus. Historical path determined Polish negative attitude towards Russia, its desire for securing energy supply, and also government control over big energy companies. Being one of the most flexible countries in terms of adaptation and regional integration in comparison to other East European member states, Poland has different priorities in energy policy, and proved to be able to translate some of them into EU policies. As an option to minimize the polluting effect on environment, Poland considers switching from coal to natural gas either by purchasing liquefied gas or extracting environment friendly shale gas.[6] The latter one will allow not only making Poland greener, but will contribute to its economic growth.

Germany has the most balanced energy mix, and diversified network of energy suppliers. Oil has the largest share, then coal, natural gas, and renewables with nuclear sources completing its energy mix. Germany is the biggest consumer of energy in EU, which respectively equates in the highest rate of GHG emissions. Germany was the first among the member states to react on accident at Fukushima nuclear power plant by

[6] According to Polish Geological Institute, the most conservative estimates of Poland shale gas resources amount to 346-768 billion cubic meters (Shale Gas Europe, 2014b).

making a commitment to shut down its nuclear reactors by the end of 2022 (WNA, 2014b). As during the oil shock of 1973/74 Germany would rely on coal to secure its energy supply and invest more in the development of renewables to substitute the nuclear energy. Although liberalized, German energy market is dominated by the oligopolies, internationally known big energy companies RWE, EnBW, and others. Being the largest country in Europe Germany took on a leading role in design of common European energy policy promoting the greater use of renewables. However, after the disaster in Fukushima it became difficult for Germany to reach a consensus with France and other important players in EU energy policy.

Despite the desire and urgency in creating common energy policy the priorities of EU member states are different and at times quite opposite. EU legislation has little influence on the decisions of member states "to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply." (Art.194, Para.2, TFEU). Although three countries examined hereinabove strive to attain the triple objective of EU Climate and Energy Policy, their efforts are far from being common. For instance, France suggests increasing the share of nuclear power in EU energy mix; Germany sets its agenda on developing renewable energy whereas Poland gives priority to economic development over the climate policy objectives. It seems quite unlikely that EU member countries reach consensus in near future which make the development of common policy so difficult.

3.3.3. EU Energy Security Strategy

Based on an in-depth analysis of the member states energy dependence, and as a response to the recent Ukrainian crisis, in May 2014 the EC presented the EU Energy Security Strategy. It basically included short-term measures to be taken immediately as well as tried to address medium and long-term challenges. Under the short-term measures were proposed energy security tests that would help to reveal the existing problems, and be better prepared in the event of sudden disruption of gas supply. Possible emergency measures may include switching to alternative fuels, developing emergency infrastructure, increasing gas stocks, and, finally, reducing short-term energy demand (EC, 2014d). Although the Strategy was welcomed across EU, and the proposed actions were acknowledged as timely and necessary (BEE, 2014; CEER, 2014), some organizations, such as German Renewable Energy Federation claimed that those measures would only mitigate the symptoms of potential crisis, and, at best, postpone the emergence of future crises (BEE, 2014: 5).

The EC proposes to address medium and long-term challenges by implementing actions in five key areas:

- Increasing energy efficiency and reaching the proposed 2030 energy and climate goals;
- Increasing energy production within EU and diversifying energy suppliers and routes;
- Completing the internal energy market and building missing infrastructure;
- Speaking with one voice on international arena on energy policy topics;
- Strengthening emergency and solidarity mechanisms and protecting critical infrastructure (EC, 2014d).

The next chapter of this study will provide a theoretical framework for analysis of possible increase of energy production within EU by employing unconventional sources of energy like shale gas.

Chapter 4
Role of Unconventional Sources of Energy in EU Energy Security Policy

4.1. Unconventional Sources of Energy

Unconventional or non-conventional sources of energy are the hydrocarbons that require unconventional methods and expertise for production. They are different from conventional resources by the state of the hydrocarbon, the types of technologies required for their extraction, and, most importantly, by the nature of geologic reservoir. Unlike conventional oil and gas resources that have a well-defined area of deposits and are comparatively easy to extract through a wellbore, unconventional hydrocarbon deposits usually extend on large areas, are lower in resource concentration, and require complex technology for extraction or conversion of resources which consequently leads to a higher price per unit of energy. To "unconventionals" are attributed shale gas and liquids, coal bed methane (CBM) produced from coal seams, methane hydrates, tight gas from low-porosity sandstones and carbonate reservoirs, heavy oil, and complex gas. For this research author will focus on one unconventional resource of hydrocarbon energy, namely shale gas.

Shale gas is a natural gas from shale formations represented in forms of reservoirs with low permeability[7]. The shale acts as both the source and the reservoir for the natural gas. Unlike the conventional reservoir that allows for easy flow of the gas to a well, shale gas reservoir requires additional mechanical stimulation to free gas for collection from its original source rock formed from sedimentary deposition of mud, clay, silt, and organic matter. Only shale formations with certain characteristics allow producing natural gas.

As a result of technological developments today shale gas is the fastest growing natural gas resource worldwide. Shale gas could help close the growing gap between domestic production and consumption of energy in the EU, hence to ensure its energy security. The 2012 Joint Research Center study on unconventional gas in Europe asserted that shale gas could partially replace conventional gas in EU under condition that public accepts it and environmental issues are met (EC, 2014b: 13). But what are the risks

[7] In case of shale gas the term "permeability" refers to the capacity of porous sediment rock to transmit a fluid (U.S Department of Energy, 2014).

associated with shale gas production? Is such extraction cost-effective? How environmentally safe it is? How well EU energy infrastructure and legal framework are prepared to accommodate shale gas?

Various reasons have been put forward to explain the need for shale gas in ensuring energy security in Europe, but this study will focus only on three arguments: realist – one of the dominant theories in international relations (IR) studying security issues, liberal - equal and individual rights based philosophy, and regional security complex logic – theory that explains security interdependence within regional complex. To fully answer the question why there is a need for shale gas, the explanation begins with the realist argument.

4.2. <u>Realist Approach</u>

Realism is one of the dominant IR theories, especially in studying the issues of security. Jeffrey W. Legro and Andrew Moravcsik claim that realism "is not a single theory, but a family of theories", which could also be referred to as a "paradigm" (1999: 9). This paradigm comprises three core assumptions: (1) the nature of the actors: rational, unitary, political units in anarchy; (2) the nature of state preferences: fixed and uniformly conflictual goals; (3) international structure: the primacy of material capabilities (Legro and Moravcsik, 1999: 12-18). For a long time realism was associated with "hard power", or simply saying military power defined the political power of a nation. The founding father of modern realism Hans Morgenthau expanded the notion of "hard power" by including a number of other constituents, namely, "geography, natural resources, industrial capacity, military preparedness, population, national character and morale, and quality of diplomacy and government" (Sutch and Elias, 2007: 49).

Referring to "natural resources" it is presumable that energy could be considered as one of the elements of hard power. Ilgar Gurbanov (2013) goes further, and defines it as "the most effective factor to determine the political power of states." Given the present day realities, armed forces are not the best way to achieve the desired results, far more efficient is the availability of energy carriers, and ability of the governments to leverage them. Thus, energy diplomacy becomes a key for success. Michael T. Klare expert in natural resource issues, analyzes the causal link between global reliance on oil and natural gas and associated to it violence. In one of his multiple studies he suggests that in pursuit of control over energy resources regional conflicts and even great power war may erupt (2009: 44). The most recent events in history, such as Iraq war, demonstrate that it is quite common for armed conflicts to arise to settle the disputes over the ownership of energy resources.

Giedrius Česnakas rightly notes that realism paradigm is based on analysis of states as the main actors who determine energy relations on global level; the actors who are not willing to cede control over energy resources to the international companies, free market mechanisms or supranational entities (2010: 34). This statement is supported by the present day challenges faced by EU who from one side is positioning itself as the organization that has common energy policy, but many instances demonstrate the opposite, that each member state continues to pursue its own national interests.

Roland Dannreuther summarizes the key assumptions and arguments of realism proponents as follows: firstly, access to and control of natural resources, including energy, is a key ingredient of national power and national interest; secondly, energy resources are becoming scarcer and more insecure; thirdly, states will increasingly compete for access and control over energy resources; and, as a result, conflict and war are increasingly likely, if not inevitable (2010: 3).

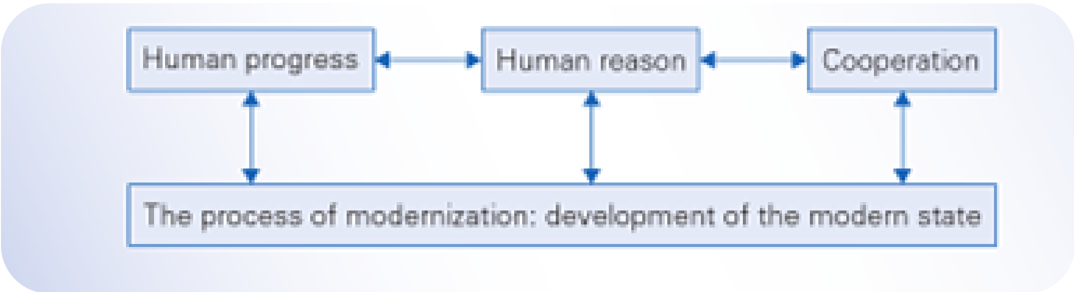
Realist approach partially explains why there is no unanimity between EU member states in reaching common energy security policy, but it does not really clarify how comparatively new source of energy, such as shale gas, would help to meet the challenge of narrowing the growing gap between energy demand and energy supply within EU. It does not take into consideration other actors besides the states that could contribute to energy security, and ensure the well-being of EU in general. For these reasons, realist logic was not chosen to formulate the argument of this study.

4.3. Liberal Tradition

Opposite to realist approach focused on balance of powers, liberalism values public opinion and international law. Liberalists believe that individuals are free from arbitrary state power, treat with respect human rights, and attest that political institutions shall also respect those rights by being democratic. Andrew Moravcsik claims that “Liberal theory takes on a "bottom-up" view of politics, whereby the demands of individuals and societal groups are treated as analytically prior to state behavior” (2001: 6). Unlike realists, liberalism does not share the belief that armed conflict is the only way to gain control over resources. This is so-called "democratic peace" introduced by Bruce Russett was supported by other fellow liberalist Scott Burchill. Burchill described the war as a "cancer on the body politic, the "disease" that could be "treated with the twin medicines of *democracy* and *free trade"* (2005: 59).

Jackson and Sorensen explain the core assumptions of liberalism. According to them, the conflict and war are inevitable, but it is intrinsic to human nature to reason and reach beneficial cooperation within the states and across borders (2013: 100). Another liberal assumption is that liberals believe in progress, or more precisely progress for individuals. The role of the state, in this regard, is sort of constitutional that serves to establish and enforce the rule of law. Jackson and Sorensen further summarize the ideas of liberal theorists Locke, Kant, and others by stating that modernization brings the progress into almost all areas of life that, consequently, results in better life for a majority of individuals (2013: 101). Thanks to modernization, and the ability of human beings to reason occurs greater international cooperation (*Figure 6*).

Figure 6. Basic Liberal Assumptions. Source: Jackson, Robert and Sorensen Georg (2013): Liberalism, in: Introduction to International Relations. Theories and Approaches, p 102.



In international relations Andrew Moravcsik distinguishes three main variants of liberal theory, namely, Ideational, Commercial, and Republican Liberalism (2001: 10). The first one is about compatibility of social preferences across fundamental collective goods, the second focuses on incentives for cross-border economic relations, whereas the central idea of the third one is the nature of domestic representation.

In terms of international energy politics Dannreuther distinguishes two categories: so-called 'dark underbelly' of the international energy industry, when the government of energy dependent countries or companies accept unlawful practices, and liberal policy prescriptions of 'what needs to be done' in the management of the international energy industry (2010: 6). Although liberalism does not explain how extraction of shale gas in EU can help to strengthen its energy security, it sheds the light on driving force behind international cooperation. That is why liberal logic will be applied to complement theory selected further in this chapter to formulate the main argument of the study.

4.4. Regional Security Complex Theory

Introduced by a leading scholar in the English School of International Relations Barry Buzan the Regional Security Complex Theory (RSCT) is fundamentally different from the first two theoretical approaches presented earlier in this study.

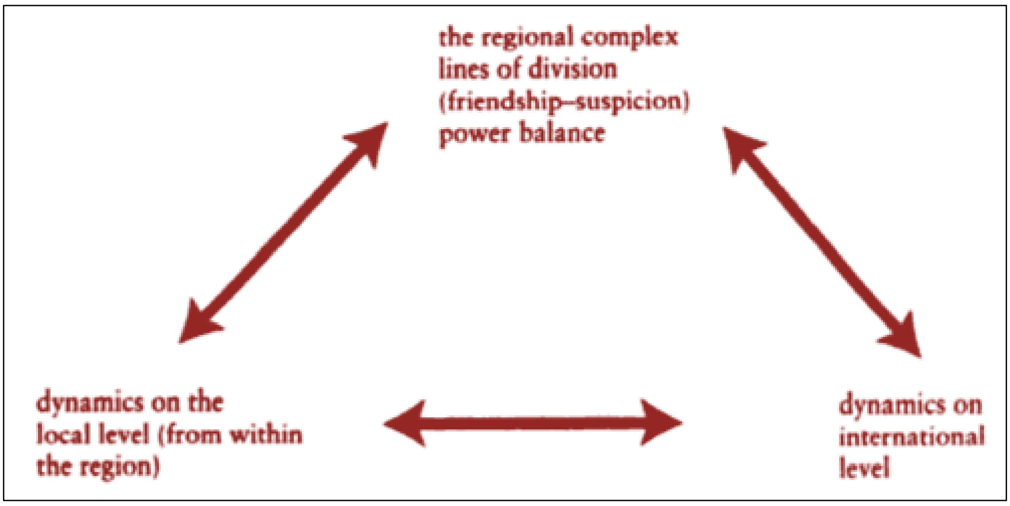
According to Buzan and Waever (2003: 4), "the central idea in RSCT is that, since most threats travel more easily over short distances than long ones, security interdependence is normally patterned into regionally based clusters: security complexes." Scholars further show the interlink between the level of security, actors inside and outside security complexes, and influence of the global powers: "Processes of securitisation and thus the degree of security interdependence are more intense between the actors inside such complexes than they are between actors inside the complex and those outside it. Security complexes may well be extensively penetrated by the global powers, but their regional dynamics nonetheless have a substantial degree of autonomy from the patterns set by the global powers" (Buzan and Waever, 2003: 4). This could be interpreted in a way that group of states share similar concerns in security issues or have their strong interdependence, so that national security of one country cannot be considered apart from the security issues of neighboring states or the region in general. Therefore, it is very plausible that concerns in energy related issues could be central in this regional security dilemma.

Taking for the point of departure the works of Barry Buzan, the researcher Mikko Palonkorpi goes further and applies the RSCT to energy issues. In his words, "the regional energy security complexes are formed by energy related interaction between two or more states in a limited geographical area, which includes an energy dependency relationship between the states involved and perception of this dependency as a threat (securitization). The energy interaction includes transactions such as production (export), purchasing (import) and transit of energy" (Palonkorpi 2008, p.3).

In fact, unlike many other theories, the RSCT may be used as an umbrella overarching theory allowing applying various approaches and methods, including liberal approach, to analyze the concept and issues of energy security within its framework.

Michael Sheehan in his book “International Security: An Analytical Survey” explains through the prism of the RSCT that security issues immerged in one country very often become topical around neighboring states within a short period of time (2005: 49-50). Therefore, states forming a regional security complex are inter-related with each other by the concern about same or similar security issues. Furthermore, in the words of Lena Jonson and Allison Roy (2001:5) “the actions of one state to advance its security are likely to have consequences also for other parts of the complex” (*Figure 7*).

Figure 7. Regional Security Complex.
Source: Jonson, Lena and Allison, Roy (2001): Central Asian Security:
Internal and External Dynamics, in: Central Asian Security: The New International Context, p.9.



Although each EU member state has its own national policy, in terms of energy security it may be argued that their policies are interconnected. Buzan (2009) defines two components of RSC: distribution of power in the region and the state of the relations between countries, “amity” and “enmity.” “Amity” describes “relationships ranging from genuine friendship to expectations of protection or support” whereas “enmity” characterizes “relationships set by suspicion and fear” (Buzan, 2009: 160). Indeed, it is possible to observe different pattern of relationships between EU member-states. Some of the states have more in common and more likely to establish closer ties whereas others might have with each other more conflicting relations and regard each other with a certain degree of suspicion. In terms of dependency on natural gas from Russia, more dependent are member states sharing the same border or situated in its proximity; countries further to the west have more diversified energy mix, hence less dependent on Russian supplies (*Appendix 1*).

Applying the RSCT to the topic of the current study it becomes obvious that sharing the same views that EU energy security needs to be strengthened, and acknowledging that shale gas has a potential to replace imported natural gas, which will be analyzed further in this study, member-states shall reconsider their attitude towards exploitation of EU reserves of shale gas for the common good of all Community members. Therefore, the RSCT is better suited to shape the direction of the present research, and together with liberal theory will be used to analyze the issues of energy security in EU. Additionally, it helps to formulate hypotheses essential for further advancement of this study.

4.5. Summary of Hypotheses

H1	The more incorporated unconventional energy sources into EU energy policy, the higher the EU energy security.
H2	The better the regulatory mechanisms, the higher the EU energy security.
H3	The better infrastructure within EU, the higher the EU energy security.
H4	The lower risks and costs associated with shale gas production/ import, the higher the EU energy security.

Chapter 5

Case Study: Prospects of Shale Gas Production in EU

In this chapter RSCT is applied to case study of analyzing the prospects of shale gas production in EU. As it was demonstrated earlier in this paper EU own energy resources are insufficient to support growing economies of member states and ensure their competitiveness on international arena. Furthermore, EU dependency on external energy supply pushes it to diversify energy mix, expand the network of suppliers, work towards further integration of internal market, reconsider its energy policy in general, and to have a closer look at the development of new sources of energy to ensure its energy security. When studying the possibility of shale gas production in EU, it is crucial to consider EU energy policy pertinent to this issue as well as the position taken by individual member states. The Treaty of Lisbon gave EU competence to ensure security of supply; at the same time, member-states reserve the right to determine their energy mix and exploit its energy resources.

The choice of the case study was determined by the new élan in the discourse of pros and cons of shale gas, availability of its reserves in Europe, and possibility of its extraction to lessen the dependency from external suppliers in light of recent events in Crimea in order to be prepared to meet the demand in case of disruptions of natural gas supply from Russia.

The case study focus on shale gas reserves in Europe, technology and cost of production, legal framework, infrastructure and environmental impact. These variables are a part of RSCT theory, and were chosen because they can help to understand whether shale gas production can help to ensure EU energy security, and if yes, what conditions will help to optimize the results. The purpose of case study is to show qualitatively what factors determine the possibility of production. To do that, the case study will address the following issues:

- Availability of shale gas in Europe, and the volume of recoverable reserves
- Production technology and associated costs
- The level of development of shale gas infrastructure and legal framework
- And, finally, the impact it has on environment and its compatibility with “green” climate policy pursued by EU

The case study may show to what extent above-mentioned factors affect the production of shale gas in EU, what is the role of different actors be it supranational authority, national governments, major gas companies, or general public. By analyzing the prospects of shale gas extraction in EU, a picture of EU energy policy process in a particular field should be discovered. Where possible public acceptance issues will be addressed.

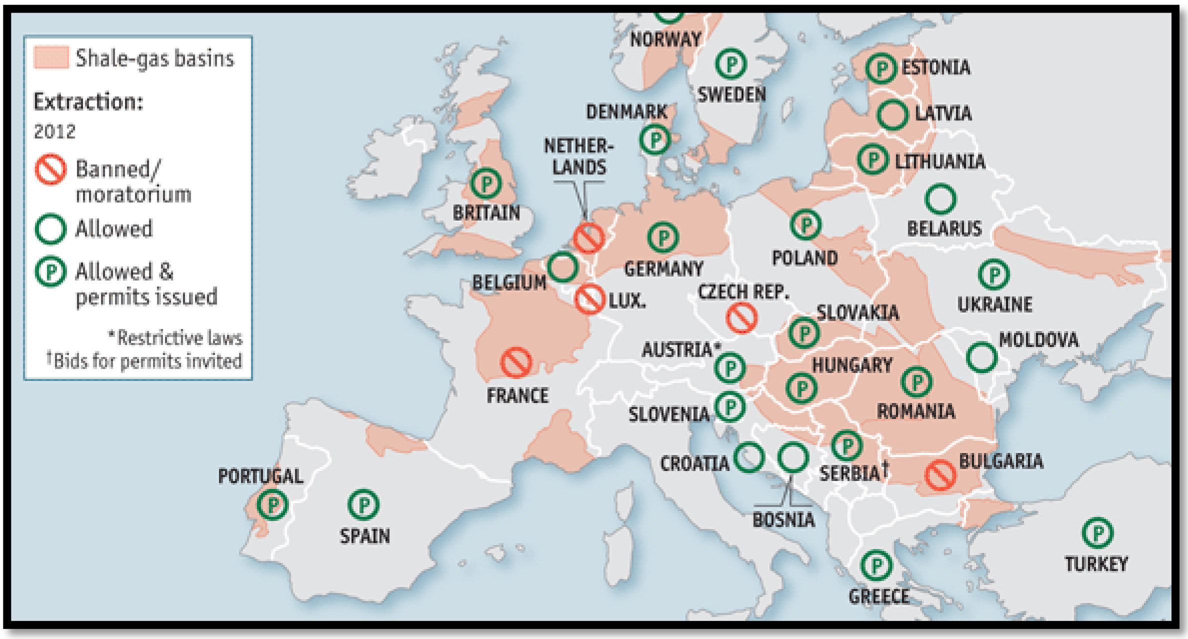
Furthermore, the case study data cannot be blindly applied to other regional organizations whose member countries share energy security concerns. It shall be considered that each region has different set of natural resources and different demand for them. Given the fact that EU is a unique organization of its kind that was entrusted with supranational competences, the policies implemented here differ from other regional formations. Hence, the findings of the case study can only be partially applied to other regional energy security complexes.

5.1. Shale Gas Reserves in EU

As it is often the case with any other natural resources, shales in Europe are spread unevenly. In EU there are four main onshore gas basins. The first one is located from Eastern Denmark and Southern Sweden to Northern and Eastern Poland. The second Carboniferous marine basin spreads from Northwest England through Netherlands to Northern Germany. The third one runs from Southern England to into the Paris Basin in France; and, finally, the last one is stretched from Slovakia and Hungary through Romania and Bulgaria to the Black Sea (Geny 2010: 48-49, Buchan, 2013: 3). Figure 8 illustrates location of the above-mentioned shale gas basins whereas Appendix 2 provides the list of the most significant basins in Europe.

The potential shale gas production has received little study mainly due to the fact that in the past there was no commercial interest in analyzing this type of resource; hence, little test drilling has been carried out. According to estimates of Ernst & Young (2013: 2-3), shale resources are present in at least 12 EU countries. Unconventional gas reserves in Europe amount to 35 trillion cubic meters (tcm), according to the IEA, with shale gas accounting for almost a half of this amount; it is six times greater than the reserves of conventional gas (The Economist, 2013). Presuming that the gas demand would remain at current level these reserves could procure natural gas for Europe for a period of 40 years. Depending on the source of information estimates of technically recoverable shale gas reserves vary widely with the highest estimate amounting to 17,6 tcm, and lowest at about 2.3 tcm (Buchan, 2013: 3).

Figure 8. Geography of EU shale gas basins.
Source: The Economist (2013): Unconventional Gas in Europe, Frack to the Future.



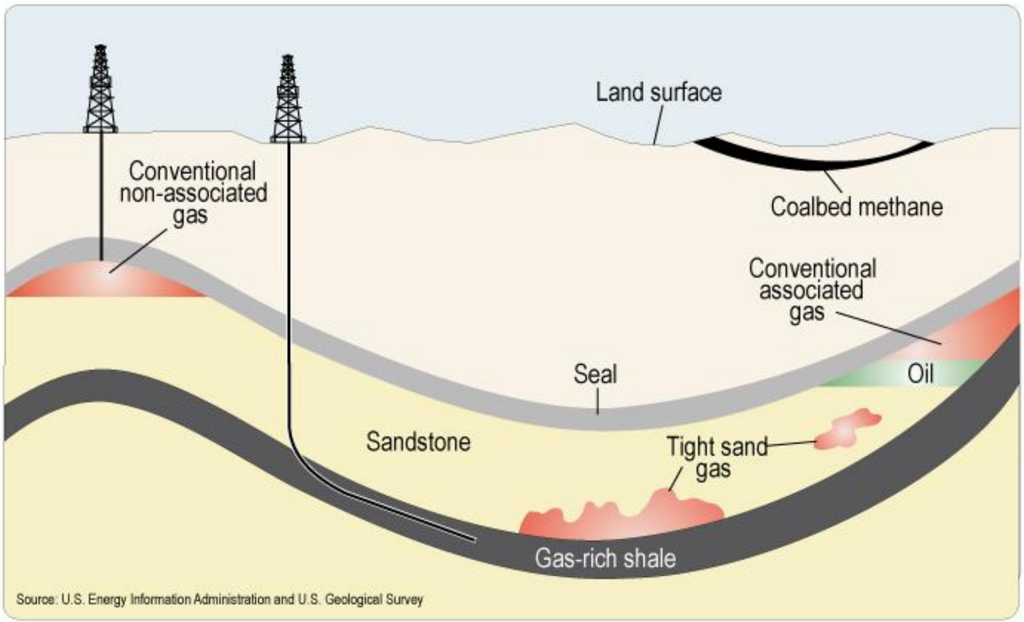
Shale Gas Europe (2014a) website states that currently there is no commercial drilling operations in EU, although some shale gas explorations are taking place in selected EU countries: Poland, Germany, the UK, Romania, etc. This is a necessary step to assess actual shale gas reserves in European Union.

Analysis of this section showed that member states are united not only by concerns about securing their energy supplies, but also by geography of gas shales; thus uniting countries not only in their intention to explore available reserves, but also by necessity to do that by common efforts. Following the logic of RSCT and present day energy security realities, effective exploration and production (E&P) of shale gas reserves in one of EU member state will require knowledge sharing and support of the whole Community: first of all, cost wise – to share expenses related to research and development (R&D); secondly, by need to further liberalize internal energy market to simplify the work of operators across borders; thirdly, in order to harmonize national legislation or to adopt single legal framework, and so on. This shows that the degree of security interdependence between different actors of this regional complex is quite intense, be it national government, multinational corporation, or community concerned by the impact of technology of extraction on environment in general, or on landscape in particular.

5.2. Technology of Extraction

As it was mentioned earlier in this paper, shale gas can be extracted from rock which represents both the source and reservoir of natural gas. This can be done by combination of two methods: hydraulic fracturing and horizontal drilling. Before going into explanation of the methods, it is important to understand the geology of natural gas resources which is well illustrated by Figure 9.

Figure 9. The Geology of Natural Gas Resources. Source: U.S. Energy Information Administration, 2011 (http://www.eia.gov/todayinenergy/detail.cfm?id=110)



Method of economical extraction of shale gas known as hydraulic fracturing[8] involves injecting pressurized fluids[9] to fracture rock or stimulate shale formations. Once water, chemicals, and sand are pumped into well the gas is released from layers of the gas-bearing rock and escapes back into the wellbore and up to the surface where it is collected.

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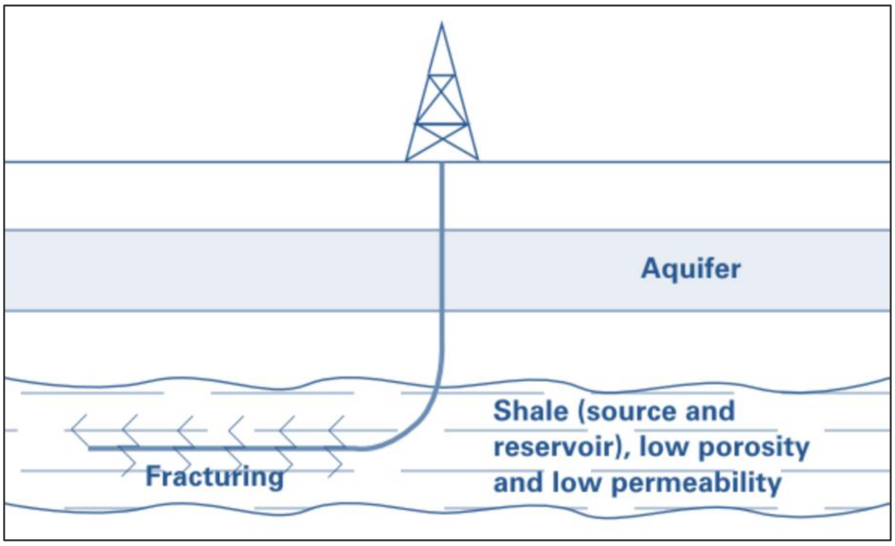
[8] Hydraulic fracturing is commonly called hydrofracturing, hydrofracking or simply fracking or fracing. Author will use any of this term for the current study.

[9] Fracture fluids are primarily water-based, but also can be based on oil, acid, gel, foam or liquid CO2. They also contain additives, such as friction reducer so-called slick-water, biocides, scale inhibitors, and proppants like sand or ceramic beads (Geny, 2010: 109).

Depending on the geologic structure, formation pressure and other factors is decided the composition and volume of injected fluids that combined with sand proppant helps to keep cracks propped open to allow gas flow more freely into the well. For commercial production of gas it is necessary to create a network of connected pores in the source rock (*Figure 10*).

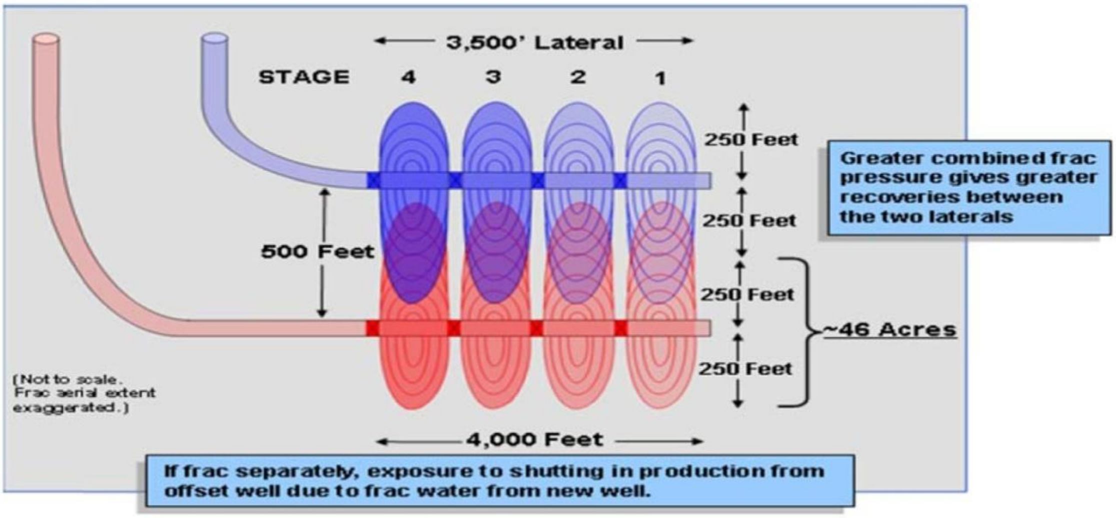
Figure 10. Shale Gas Deposit and Recovery. *Source: Deutsche Bank, European Gas: a First Look at EU Shale-Gas Prospects, 20 October 2011, p. 1.*



Another major technology for shale gas production is horizontal drilling. The shallow section of shale wells are drilled vertically. Typical sediment rock has a low permeability, and requires additional horizontal drilling to expose wellbore to a greater volume of the source rock. Therefore, just above the shale gas formation, the well deviates to follow the shale horizontally several hundred feet from the well. Reinforced with cement steel tubing "casing" is used to keep the well opened, and to prevent any possible leaking of gas, fracking fluids, chemicals, etc. into groundwater reservoirs. Thanks to horizontal orientation of wells, when the hydraulic fracturing takes place intersection of fractures create new pathways that in its turn maximizes the amount of extracted gas. Thus, new pathways can significantly increase gas flow into the well. Distinctive feature of horizontal fracking is its multi-stage technique, and lateral lengths of shale gas wells that may range from 1000 to more than 5000 feet (Geny, 2010: 108) (*Figure 11*).

Therefore, due to horizontal drilling technology, it became possible to extract larger volumes of shale gas through a single well. However, despite technological advances high initial gas flow rates have the tendency to decline over the first several years, and they are higher than for conventional gas wells. To keep up with high production rates it is required repeated artificial simulation of a wellbore.

Figure 11. Example of lateral hydraulic fracturing. Source: Geny, Florence (2010): Can Unconventional Gas Be a Game Changer in European Gas Markets? p.108.



Lastly, an improved understanding of rock properties, prediction of gas concentration and other characteristics of shale reservoir help to significantly reduce risk and thereby increase the level of productivity. In the words of Florence Geny (2010: 26) this last factor is as important as hydraulic fracturing or horizontal drilling technique, but is less recognized because “it is the result of a continuous process rather than of a high-impact new technique.”

The impact of shale gas production on environment and, as a result, public acceptance will be viewed later in this chapter.

5.3. Shale Gas Production Cost

The cost of shale gas production depends on different factors, such as the geology of shale formations, operating and labour costs, infrastructure cost, environment mitigation costs, and many others. As characteristics of shale gas plays and other factors differ from one country to another, and there is little information on shale gas wells in Europe authors of the study undertaken for European Commission “Macroeconomic impacts of shale gas extraction in the EU” generalized the figures and presented the key shale cost assumptions in Table 1 presented below:

Table 1. Shale Gas Production Cost Break-down. *Source: European Commission (2014): Macroeconomic impacts of shale gas extraction in the EU, p.21.*

Cost Component	Estimated Cost
Drilling costs (excludes stimulation)	€952/ metre
Stimulation cost per frac stage	€144,600/ stage
Drilling and stimulation capital costs for a well drilled to 2,420 meters (8,000 feet) vertical depth with 1,200 meter (4,000 foot) lateral and 10 stages	€4,908,000/ well
Other (non-environmental risk mitigation related) capital costs (equipment, geology and geophysics, and lease cost)	€230,769/ well
Basic annual operating and maintenance cost per well	€38,500/ well/ year
Other (non-environmental risk mitigation related) operating and maintenance costs (gathering and compression, gas processing)	€9.50/ thousand cubic metre

Generally, it is assumed that the cost of production of shale gas in Europe is 2-3 times higher than in the US, and range from $5 to $20 million in Europe, and will unlikely be as competitive as in America (Gusev, 2014). Depending on type of well (dry gas or a well with liquids), the price of production could also vary from as low as $5.90 /mmbtu for a shale gas with liquids up to $7.5-15.5/mmbtu. Thus, the average price for shale gas production in Europe, according to Poyry and Cambridge Econometrics (2013: 24) estimates, will be $9.9 /mmbtu. Further Poyry cost assumptions made on the basis of full-cycle costs suggest that "average breakeven for EU28 in 2020 stands at USD 9.1 per mmbtu" (Poyry and Cambridge Econometrics, 2013: 24). Additionally, it will require 5-10 years to make extraction economic viable, and as a result complementary to EU energy mix.

Therefore, several studies conducted by consulting companies, European Commission and scholars, specializing in energy issues, refuted the assumptions about high cost of shale gas production within EU, and demonstrated that in medium and long term perspective shale gas can become competitive to Russian pipeline gas under condition that its cost will remain at the present day level or will become higher (Deutsche Bank, 2011: 5; Gusev, 2014; Poyry and Cambridge Econometrics, 2013: 24).

In any case, the factors that could drive the cost of shale gas down are determined principally by the degree of cooperation between different actors in EU, and to a lesser extent by those outside the region complex, once again proving the ideas put forward by Buzan and Waever that regional dynamics have a substantial degree of autonomy from the patterns set by the global powers.

5.4. Legal Framework.

At present, EU does not have an integrated energy policy; therefore, energy policies are subject to legal interpretation both at EU and national levels. Each member state is responsible for determining its energy mix, resource development programs, and taxation policies related to exploitation of natural resources. For the purpose of this study author will mainly focus on legal acts developed on EU level since given the time constraints it would be quite challenging to study national legislation of each member state.

It is also important to restate that the issue of unconventional gas E&P in Europe is recent, and it is not easy to determine which laws or regulations apply to unconventional gas, and the laws of what level prevail in the event of conflict. Even before an examination of available rules, it becomes clear that complexity and uncertainty in legal framework can become a barrier on the way of attracting investments to this relatively new industry.

EU legislation is mainly based on Treaties that provide legal competences to EU institutions. With regard to energy policy, the most significant are an Energy Community Treaty (2006), and the 2007 Treaty of Lisbon that outlined objectives of EU energy policy, among which security of supply, and combating climate change are the most important for this study. To the secondary law related to shale gas extraction could be attribute the Directive 94/22/EC so-called Hydrocarbon Directive that regulates procedures for granting and using authorizations for the prospection, E&P of hydrocarbons. Not less important are Directive 2000/60/EC related to the water policy, Directive 2006/118/EC aimed at protecting ground water against pollution and deterioration, Regulation (EC) no 1907/2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), Directive 2006/21/EC on the management of waste from extractive industries. Since fracking of shale gas may influence special protection or conservation areas, regulations established by Directive 2009/147/EC on the conservation of wild birds, and Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora shall also be taken into account by operators. Amended in 2013 Environmental Impact Directive 2011/92/EU requires for an Environmental Impact Assessment (EIA) for the exploration or extraction of shale gas by the fracking method. To regulate gas flow optimization, in 2009 was adopted Third Energy Package targeted on liberalization of electricity and gas internal market. Out of five pieces of legislation for this study attention should be given for Directive 2009/73/EC concerning common rules for the internal market in natural gas, and Regulation (EC) No 715/2009 on conditions for access to the natural gas transmission networks. Primary and secondary legal acts as well as shale gas related policy framework are summarized in Table 2.

Table 2. Summary of EU Primary, Secondary Legal Acts, and Policy Framework Pertinent to Production of Shale Gas. Source: Own graph.

EU Primary Law	EU Secondary Law	Policy Framework/ Strategies
Energy Community Treaty (2006)	Drinking Water Directive (1998)	The 2020 climate and energy package (2009)
Treaty of Lisbon (2007)	Water Framework Directive (2000)	A 2030 framework for climate and energy policies (2013)
	Groundwater Framework Directive (2006)	Energy Roadmap 2050 (2011)
	Birds Directive (1979)	Environmental assessment framework to enable a safe and secure unconventional hydrocarbon (e.g. shale gas) extraction (2013)
	Habitats Directive (1992)	
	Mining Waste Directive (2006)	
	Noise Directive (2002)	
	EIA Directive (2011)	
	REACH Regulation (2006)	
	Natural Gas Internal Market Directive (2009)	
	Natural Gas Transmission Networks Regulation (2009)	
	Hydrocarbons Licensing Directive (1994)	

From this it is possible to conclude that there is no specific shale gas enabling legal framework. In 2013 Commission proposed the initiative “Environmental assessment framework to enable a safe and secure unconventional hydrocarbon (e.g. shale gas) extraction" that covers legislative and non-legislative measures necessary to manage risks, and regulatory deficiencies to bring clarity for market operators and citizens (Shepherd, 2013). The initiative revealed drawbacks of EU environmental legal framework related to E&P of unconventional fossil fuels. Studies of national member states legislation conducted on demand of EC in 2012 and 2013 were contradicting: "Regulatory provisions governing key aspects of unconventional gas extraction in selected Member States" final report conclusions demonstrated different approach and legal uncertainties in national legislations; the report prepared a year earlier by law firm Philippe & Partners, on the opposite, attested that given the current scale of operations there were no significant gaps in EU or national legislations, which was supported by EU Energy Commissioner Guenther Oettinger[10] saying that there were no immediate need for changing EU legislation (Hawkins, 2012). Thus, existing diverging opinions among scholars on current legal framework, and the statement of Energy Commissioner lead to assumption that legislation shall be revised if 'not immediately', but quite soon.

In 2014 EC adopted Recommendation and Communication for its Shale Gas Enabling Framework. Recommendation is not legally binding, but provides basic principles to be applied across EU to the E&P of shale gas by means of high volume hydraulic fracturing. It is supposed to be implemented by member states within six months after its publication. Furthermore, in 18 months period it will be reviewed by Commission, and on the basis of this review could be proposed development of legally binding legal acts, such as Directive or Regulation.

Analysis of EU current legislation shows that it does not have a direct impact on shale gas E&P as this competency largely remains within the scope of activity of national governments. The greater impact will have environment related regulations at least for two reasons. Firstly, it is widely believed that high volume hydraulic fracturing has negative impact on environment. Secondly, climate and energy policy frameworks prioritize investments in green energy from renewables.

Surely, cooperation on the level of EU member states can make them less dependent on gas supply from Russia, but as RSCT illustrates it increases an energy

[10] Guenther Oettinger was Vice-President of the European Commission in charge of Energy from 2010 to 2014. In 2014 he was nominated as Commissioner for Digital Economy and Society.

dependency relationship between the member states. Inability of EU countries to create truly common energy policy reveals their unwillingness to completely transfer the competences of energy related issues on supranational level. Considering the interests of individual countries of RSC, it could be argued whether the process of securitization would actually guarantee EU member states energy security they aspire to reach by starting the production of shale gas. Very likely that lack of harmonized legislation and different political will of the member states would represent an important challenge on the way of production of shale gas in EU.

5.5. Infrastructure

The infrastructure associated with shale gas E&P includes pipeline transportation capacity, gas storage capacity, new access roads for site traffic, and amenities for personnel. Furthermore, technology of hydraulic fracturing presumes that there will be access to water supplies and wastewater treatment facilities (Ernst & Young, 2013: 15).

In EU there is an established pipeline and gas processing infrastructure; however commercial production of shale gas implies that the greater volume of natural gas shall be processed through gas transmission infrastructure, hence the expansion of pipeline capacity is required which probably will be very costly and may raise public disapproval. Moreover, the question of land availability shall also be closely viewed especially given the fact that Europe, unlike US, is very densely populated, and most territories are urbanized.

Several challenges shall be addressed in this regard: serious investments for upgrading infrastructure in some member states, and cross-border pipeline connections, access to pipeline capacity is often under control of national oligopolies. Since it will take 5-10 years before the commercial extraction of shale gas becomes reality, it is expected that European gas market will be liberalized as per measures provided in the EU’s third energy package. This legislative package regarding internal gas and electricity markets is expected to change the situation that is currently in place by lifting restrictions on third party access which is required for optimization of conditions for evacuation of produced gas and also reduce uncertainties on pipeline capacity availability.

Thus, from one side the European gas market is conducive for production of shale gas thanks to the established pipeline and gas processing infrastructure; from the other side building the lacking infrastructure, and upgrading the existing one will impose additional time and costs. It will also be required to upgrade cross-border pipeline connections to allow the export of produced shale gas to other countries. However, Ernst & Young (2013: 15) point out that "all of the shale gas produced in Europe is likely to be consumed within the region."

5.6. Environmental Concerns

Production of shale gas in EU raised concerns about possible impact on environment, such as pollution of drinking water, air pollution, community disruption, and cumulative negative influence on communities and ecosystems (Deutsche Bank, 2011: 3). In general, shale gas production related impacts could be divided into two broad categories: subsurface and surface impacts. The first category covers seismic risks and pollution of drinking water by chemicals applied in fracking technology. Depending on geology of the shales, the composition of chemicals differs from site to site. When the well is constructed properly, the risk of groundwater contamination is minimal because the walls of the wellbore are reinforced by cement and steel casings. Therefore, compliance with the standards for construction of wells is crucial to avoid any leakage of water containing chemicals into groundwater. Furthermore, gas-bearing shale is far below underground aquifers which significantly reduces chances of drinking water contamination either by fracking chemicals or hydrocarbons.

Another concern is that shale gas production uses ten times much of water[11] than is required, for instance, for production of conventional natural gas. Much of this water will stay underground; however, part of the wastewater will flow back to the well head once the process of hydraulic fracturing is complete. Flow-back water has to be securely stored, treated for chemicals, and disposed; or in ideal case scenario reused. Otherwise, it can lead to soil and surface water contamination. Water recycling could significantly reduce the demand for surface water as well as expenses related to disposal of wastewater. The drawing below depicts the full cycle of water used for hydraulic fracturing (*Figure 12*).

[11] For one shale gas well it is required around 10,000-25,000 cubic meters of liquid to create pressure for hydraulic fracturing. For conventional gas well, it is needed only 2,000 cubic meters (Buchan, 2013: 6).

Figure 12. The Hydraulic Fracturing Water Cycle.
Source: EPA's Study of Hydraulic Fracturing for Oil and Gas and Its Potential Impact on Drinking Water Resources, 2015 (http://www2.epa.gov/hfstudy).

Comparison of the amount of water used for production of shale gas to other fuels shows that actually it is less than required for biofuels, coal or oil; and is characterized in Table 3 as the medium water intensity.

Table 3. Freshwater Use Intensity by Energy Type. *Source: Geny, Florence (2010): Can Unconventional Gas Be a Game Changer in European Gas Markets? p.71.*

Relative Fresh Water Use Intensity	Energy Production Type
High Water Intensity	Coal (including CCS) Biofuels Geothermal
Medium Water Intensity	Oil Nuclear Coal (without CCS) **Conventional and Unconventional Natural Gas** Solar (concentrating)
Low Water Intensity	Hydropower (net evaporation)
Very Low Water Intensity	Solar (Photovoltaic)

In addition to the substantive use of water resources, to the surface impacts could be attributed obtrusive visual impacts; issues of land and its usage; intensive road traffic for transportation of drilling rigs, and tonnes of water, sand and chemicals; air and noise pollution; the impact of shale gas well pads on the landscape. Shale gas well pad occupies a large space to accommodate drilling equipment, wastewater ponds, storage and pipeline infrastructure, and facilities for staff and contractors, which can become a real problem in taking into consideration the level of urbanization in Europe (Ernst & Young, 2013: 11). One of the ways to reduce geographical footprint is to invest in multi-well pads that have the capacity to accommodate the drilling of multiple horizontal wells from the same pad. According to EPA, other potential risks associated with shale gas production are air pollution, negative impact on ecosystems, seismic risks, and public safety concerns among others (Ernst & Young, 2013: 10). David Buchan claims that hydraulic fracturing is safe if regulation is in place and when necessary enforced (2013: 5).

Certainly, production of shale gas has an environmental impact. For example, shale gas produces more GHG emissions than conventional gas[12]. However, comparing it to production of other fuels, it becomes obvious that it is relatively cleaner. For instance, if coal will be replaced by shale gas, it will have positive impact on climate by reducing carbon emissions by 41-19% (Buchan 2013, 5). Even if shale gas produced in EU supplants imported conventional gas, there will not be carbon leakage resulted from transportation over long distances. Since the gas would be consumed closer to where it is produced, reduction in GHG emissions could reach up to 10%. Analysis of environmental concerns demonstrated that there is a need for investments in R&D, and, as a result, technological progress to overcome the existing challenges.

Undoubtedly, this will be one of the prerequisite for successful E&P activities in EU. To face energy security issues, EU institutions commissioned a number of studies under the EC initiative "Environmental, Climate and Energy Assessment Framework to Enable Safe and Secure Unconventional Hydrocarbon Extraction": "Macroeconomic impacts of shale gas extraction in the EU" (2014) aiming to assess the impact of different environmental risk management policies on the energy system and economy; "Mitigation of climate impacts of possible future shale gas extraction in the EU: available technologies, best practices and options for policy makers" (2014) aiming to assess the baseline and alternative policy measures for mitigating the GHG impacts of shale gas extraction and their associated costs; "Technical support for assessing the need for a risk management framework for unconventional gas extraction" (2014) to assess the baseline and alternative policy measures for mitigating environmental risks and impacts on air, water, biodiversity, noise, seismicity, etc.

The Deutsche Bank (2011: 3) report presents a series of recommendations to mitigate environmental impacts and improve public opinion:

- Create open access national database on shale gas development and production;

[12] There are two main factors that cause greater GHG emissions when producing shale gas: (1) use of heavy machines for drilling and pumping of fracking fluid; (2) the emission of encapsulated gas that rises to the surface with the flow-back water, and as a result methane, one of the GHG gases evaporates in the air (Buchan, 2013: 6).

- Improve air quality by capture of methane emissions and replacing diesel by more environment friendly fuels for oil-field equipment;
- Protect water quality by improving water cycle management and proper disposal of wastewater;
- Disclose the list of chemicals used in fracturing fluids

Although geographically different, EU member states could apply best practices and lessons learnt from shale gas production activities of the United States where shale gas is already commercially produced. It is important to consider water efficiency issues, maximizing gas production on a smaller size areas by increasing the number of wells per pad and the size of fracking, and improving hostile public opinion. Public concerns about environmental risks and impact that shale gas operations may have on local communities can prevent from development the shale gas E&P activities in EU. It would be forward looking to invest in infrastructure and logistics, like building water pipeline instead of delivering it by trucks; or, regulated by the member states, to make a regular practice to drill multiple wells on one site. These measures can significantly reduce environmental footprint from shale gas production.

In this section to a greater extent than in the previous ones, author could observe that actions of one state to advance its energy security are very likely to have consequences for other countries of the complex as the environmental impact is more perceptible and could cover large areas.

Case study illustrates that being part of one RSC EU member states share similar concerns with regard to energy security issues which make them jointly consider the possibility of E&P of the 'new' fuel. This chapter proved that in order to decrease EU dependence form external energy suppliers, the degree of interdependence between member states shall become more intense in all the aspects mentioned hereinabove. Furthermore, the section devoted to geography of shale gas reserves showed that not all countries of this regional complex have this natural resource; hence, even greater energy interaction between the states is expected when it comes to export, import or transit of this energy carrier. Finally, RSCT showed that pursuit to decrease dependency from external suppliers could lead to a greater dependence of countries within EU. Positive aspect of this kind of 'dependence' is that it could result in further integration of internal energy market.

To conclude, the case study accomplished its goal of identifying the availability of shale gas reserves in EU, learning technological aspects of production, approximate cost of the gas extracted from European shales, determining the level of development of EU gas related infrastructure, current state of legal framework as well as expected environmental impact and what influence it may have on public perception. The next chapter will provide the main findings of the current study, including the findings base on case study.

Chapter 6

Findings

The purpose of this study was to study EU energy policy, more specifically energy security policy; and to investigate whether production of shale gas in EU member states can lessen EU energy dependency from energy suppliers thereby making it more resistant to external energy shocks. To achieve the set goals author had defined what energy policy is, identified objectives of EU energy policy and its energy security challenges. To find an answer for the research question author investigated prospects of shale gas production within EU. By undertaking single case study author aimed to determine whether production of shale gas could help to secure EU energy supply, to what extent are EU's legal framework and infrastructure prepared to accommodate new to Europe source of energy, and how projected costs, environmental concerns and public opinion could influence possible production of shale gas in EU member states.

6.1. <u>Analysis of EU Energy Policy</u>

Analysis of EU energy policy showed the close interrelation between energy and climate policies, intricate interdependence between three main objectives: sustainability, competitiveness and security of energy supply. It demonstrated that EU set very ambitious goals in terms of climate policy to ensure sustainability which to certain extent has an influence on two other pillars of its energy policy. In pursuit of the 20-20-20 targets, and other energy and climate goals outlined in 2030 framework and 2050 Roadmap, EU puts itself in sort of disadvantage vis-à-vis other global economic players who do not have a burden of drastically reducing GHG emissions by adding cost to energy sources, and thereby making the economies less competitive. However, EU sees the way out in further integration of its internal market, optimization of its internal infrastructure that would allow reducing the cost on energy through open and transparent competition between large corporations and smaller gas and electricity companies. The difference of EU member states energy mix, and in general different approaches to deal with energy security issues makes the situation even more complicated.

Considering EU significant natural gas dependence on supplies from Russia, and current instability in Ukraine, RSCT brought about interesting finding that countries sharing the same border with Russia or situated in its proximity are more dependent on Russian gas supplies and have less diversified energy mix than their western counterparts. Analysis also revealed that key ingredients of sound energy security policy include overall reduction of energy consumption across EU, integrated internal energy market, increased internal energy production, diversified energy suppliers and routes, unified external representation of EU interests. Technological shift was identified as the key factor, driving force that would help to attain EU energy policy objectives.

Talking about EU as supranational body, at all the stages of the research project author had to refer to national policies, legislation, etc. Sovereignty is of particular importance for member states when it comes to energy issues. Rising energy demand, scarcity of resources, rising international energy prices, and geopolitical instability make each member state be very cautious while retaining their power and protecting their national interests. Maybe this is the main reason why the third energy package was not implemented by some EU member states. Because if energy market will become opened for competition the competence of regulating availability of affordable energy supplies will automatically shift from governments to market. However, to remain competitive, EU member states sooner or later will have to overcome existing financial, technological and social barriers, and to complete internal energy market which will lead to increase in GDP, more jobs, reduction of dependence on import and price volatility, and so on. Today, considering all the steps that were undertaken since the creation of EU it is possible to say that it is in the middle of its way to implementation of effective and efficient energy policy; yet more joint efforts will be required from each and every member state to achieve truly common policy and meet the set objectives.

6.2. Analysis of Shale Gas Production in EU

In this study prospects of shale gas production in EU were examined through the prism of RSC theory. Shale gas was regarded first of all as an alternative source of energy to ensure energy security of EU, and also as a possible means to meet triple objective of EU energy policy.

6.2.1. Shale Gas Reserves

Study of unconventional gas geography proved the availability of shale gas reserves in Europe, although without substantive preliminary studies, presently, it is difficult to identify the amount of recoverable shale gas. What is certain, that shale gas could be found in at least twelve countries, its overall amount according to preliminary estimates is six times higher than that of conventional gas, but only one fraction of it most probably would prove commercially recoverable (Ernst & Young, 2013: 2-3; The Economist, 2013). However, unlike in US where shale gas is produced on commercial scale, European gas containing shales are situated far deeper, quite often under densely populated areas that could represent a major problem for its exploration and possible production.

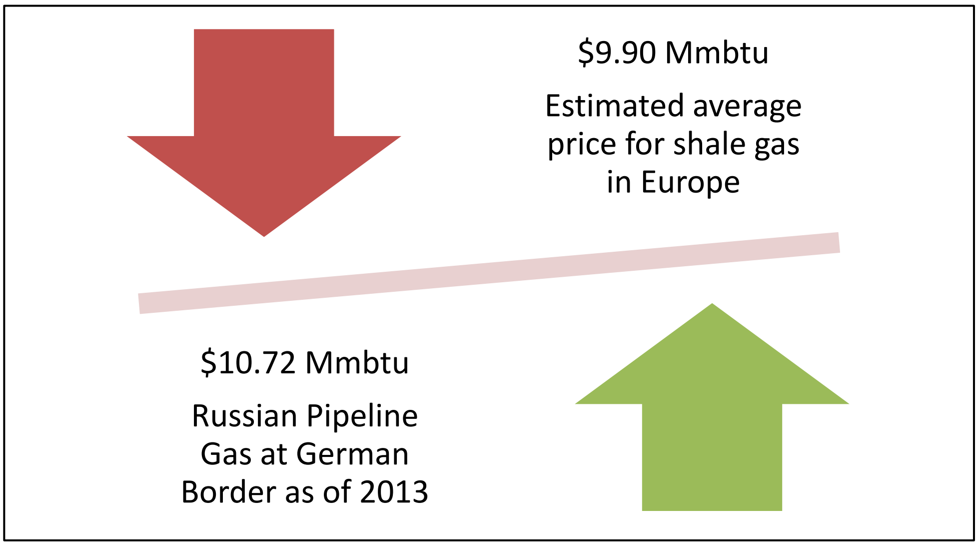
Uneven distribution of resources shows that commercial production of shale gas could change the relationship with Russia and neighboring EU countries only for some EU member states, like Poland, Romania, Germany, Hungary or France (Geny, 2010: 50). Referring to Appendix 1, we may presume then that for other states vulnerable in terms of gas supply dependency on Russia, like Czech Republic, Austria or Greece, shale gas production would not be a game changer.

6.2.2. Cost of Shale Gas and Technology

Case study has demonstrated that there are four main factors that could influence the cost of shale production in EU: geological depth of shale gas reserves, cost of renovating existing and building missing infrastructure, cost of services, and regulations. It is usually assumed that production of shale gas in EU would not be economically viable. This assumption is based on misleading comparison of shale gas production in EU and in the United States. Indeed, the cost of production in the US will be lower. However, considering the scope of present research, and when comparing the prospective cost of shale gas to the present day cost of imported Russian pipeline gas the result is quite surprising. Once the extraction of EU shale gas would reach the commercial scale, then its cost in EU will be lower than for imported Russian gas. Surely, the production cost of shale gas is higher than that of conventional natural gas. Given that shale gas will be consumed in EU member states, its transportation cost will be significantly lower than for natural gas from Russia (*Figure 13*).

Therefore, based on above data, it is possible to draw conclusion that production of shale gas will be profitable for EU from the economic point of view considering that in the long-term perspective all the investments will pay off; but also in terms of energy security making EU less dependent from external suppliers. However, this will be possible under condition that member states and operators join their efforts in order to save time and money needed for R&D to define or develop the best technology for extraction of shale gas in EU. As this study showed the geology of shales varies from country to country, and particular technological approach has to be developed in each particular case.

Figure 13. Cost of EU Shale Gas and Russian Conventional Gas.
Source: Created by author, data from PB Statistical Review 2014, p.27, and Poyry and Cambridge Econometrics, 2013, Macroeconomic Effects of European Shale Gas Production, p.24.



6.2.3. Legal Framework and Infrastructure

Shale gas production and energy policies of EU member states are subject to legal interpretation at EU and national levels. Today EU does not have unified energy policy, and as a result there is not legal framework relevant specifically to shale gas production. Given the urgency of the topic, in 2014 EC released a non-binding recommendation that provides basic principles for E&P of shale gas. On EU level exists an array of directives, regulations, and other legal documents that have direct or indirect relation to shale gas. The analysis revealed that most of these normative acts are related to climate change or environmental impact. Thus, EU environmental legislation covers the majority of possible side effects related to technology of extraction of shale gas: directives on water protection, air pollution, biodiversity. EIA Directive stands out among others as it provides the assessment and consultation procedures to be carried out for individual projects which in fact allows to forecast cumulative effects of shale gas exploitation (Buchan, 2013: 5).

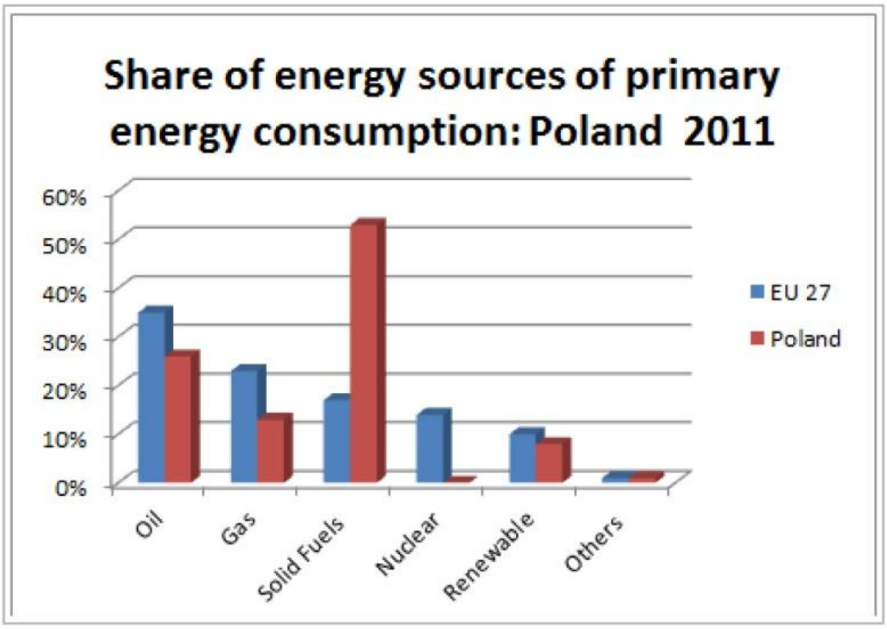
Legislation on a national state level was not thoroughly studied, but general conclusions could be drawn from the fact that each country has its own energy related legal framework. That represents a major problem for energy companies that will have to overcome legal barriers in form of different national standards, and safety requirements to meet of every member state when they will be required to operate across borders. Considering different energy supply structure of EU member states, and, as a result, different position towards production of shale gas in EU, it is least likely that they would ever agree on a common pan-European regulation. It seems unfeasible to reconcile Poland’s enthusiasm for shale gas, and France’s reluctance for exploration of its reserves (Shepherd, 2013). Therefore, the main finding of this section was that EU member states are ready to cooperate to meet immediate energy security needs, but mainly on the level of creating common frameworks for climate or environmental policies. They are not ready to fall into interdependency from each other by commonly determining the energy mix of the region at whole, harmonizing resource development or energy related taxation policies, among others. Availability of energy resources determines economic power of individual states and the influence they have on their counterparts within the region.

Deficiencies in legal framework and existing infrastructure constitute the major imperfections of EU natural gas market, which thanks to pipeline grids and gas processing infrastructure look very promising for development of shale gas. However, deeper analysis shows that geological specificity coupled with technological challenges make the situation less attractive. Considerable funding will be required to upgrade existing gas infrastructure, and build new segments required for extraction and transportation of shale gas.

6.2.4. Shale Gas Associated Environmental Risks

There is no unique position on shale gas among environmentalists, politicians, or citizens. As in case of extraction of any natural resource, it entails certain environmental risks. Technology of hydraulic fracturing may have effect on contamination of ground and underground water, increased output of methane emissions, seismicity, etc. In this study author in addition to enumerating possible risks viewed them under different angle by comparing it to production of other energy sources. For instance, coal mining or production of biofuels requires greater water intensity, and respectively is considered dirtier in terms of water pollution. In the words of energy economist Dieter Helm “coal is about the most environmentally dangerous stuff there is for energy” (Platts, 2012). Poland which energy mix is dominated by coal, justifies its desire for prompt exploitation of shale gas using both environmental and energy security arguments (*Figure 14*). Replacing coal by shale gas means reducing nearly twice carbon emissions; production of natural gas will make strongly dependent on Russian gas supplies Poland, less dependent or completely autonomous (*Appendix 1*). Further use of coal means leaving a greater carbon footprint for generations to come.

Figure 14. Poland’s Share of Energy Sources of Primary Energy Consumption as of 2011.
Source: Jopp, Mathias (2014b): Energy and Climate Policy: the EU’s Approach: Work Package 2: Competences, Actors and National Interests, EUCAIS online course content.



This research revealed polarization of existing opinions about environmental impact of shale gas production: polluting versa clean energy source, economic benefits versa environmental disturbances. Lack of advocacy and public availability of data on environment impact may result in cessation of new drilling operations, or calls for increased regulation of shale gas production. This situation is not unique for densely populated EU; it is quite common in US. For example, fearing that during a process of hydraulic fracturing the chemicals may contaminate water supply of New York city, the legislators passed a bill to block drilling operations within five miles of New York watershed (Geny, 2010: 43). Due to high rate of urbanization, quite plausible that in EU it will not be an easy task to overcome hostile public opinion. To this end author agrees with conclusion of David Buchan (2013: 5) that EU has shale gas potential, but is “environmentally anxious about exploiting it.” However, field-based R&D, technological improvements, compliance with established standards, and application of all regulations and EU specific fracking designs can minimize pollution risks, render shale gas production environmentally less disruptive, and contribute to energy security of the region in general.

6.3. Contribution to Current Literature

As analysis of English language literature revealed, the most research papers about EU energy policy focused on historical path, legal framework of EU energy policy, energy security challenges of individual member states, or the role of internal market in ensuring EU energy security. The study was undertaken to fill the gap in literature on alternative energy sources to be developed in EU member states to help meeting ever growing energy security challenge, especially in light of recent Ukrainian crisis that may have a direct impact on EU natural gas supply from Russia. More specifically, author aimed to complete the 2010 research by Florence Geny who set out to examine whether unconventional gas produced in EU could have an impact on EU gas market structure; and the 2013 study by David Buchan who assessed the potential of shale gas to transform EU’s energy landscape. Geny was one of the first to conduct in-depth analysis of potential of shale gas production in EU. She analyzed EU’s energy policy and regulations, prospective extraction cost, and existing operating practices by juxtaposing them to shale gas production experience of the United States. The point of departure for her research was to reveal the success factors that made production of shale gas in North America so successful. Through her method of juxtaposition of existing policies, operation practices, geological differences and historical path in general Geny aimed to see whether US revolutionary experience could be replicated in EU, and to what extent that would affect global energy market. Buchan’s study was more precise and quite plausibly written for academic and larger audiences as well. Buchan principally focuses on the role that shale gas could play in EU energy policy, the different approach and lack of unanimity between EU member states, and on environmental impact of shale gas E&P. However, neither of these papers studied the effect of shale gas production on EU energy security by applying RSCT.

This study was focused on the role that production of shale gas could play to ensure energy security of EU as a RSC. In continuation of Geny's and Buchan's reasoning, RSCT was applied to analyze different components of shale gas exploration, production and distribution cycle. Author has chosen her variables in accordance with her assumptions about the most decisive factors that could determine the future of shale gas in EU. Examination of those factors revealed that the bottleneck of shale gas production may lie not only in technology related challenges or high cost of the final product which is possible to solve through further R&D. This study draws attention to environmental side of the issue which widens the cleavage between EU energy and climate policy. In fact, the pollution risks could be avoided, but the general disruption is subject for acceptance for local communities. Little public awareness and, as a result, negative stance towards E&P could hinder further development of shale gas in EU. Furthermore, following the logic of RSCT shale gas could help to meet EU's energy security needs, but at the cost of creating higher interdependence between the member states themselves. This was not the main focus of Geny's or Buchan's research. In this respect, this paper contributes to the current literature by identifying the role of shale gas as a source of energy that has a potential to make EU less dependent from external energy supply, especially from natural gas imported from Russia; and also as a an energy source that could create greater energy interdependence between EU member states which is subject for acceptance of respective governments forming RSCs.

Chapter 7
Conclusion

7.1 Summary of the Study

The purpose of this study was to investigate whether unconventional sources of energy, like shale gas, could help to meet EU energy security needs. The analysis of energy security concept showed that to sustain economic power EU needs uninterrupted availability of energy at an affordable price. Energy policy, in general, implies a way that government or group of governments decides to address the issues of energy production, distribution and consumption; triple objective of EU energy policy covers such issues as sustainability, competitiveness and security of energy supply. In case of EU each member-state has chosen to pursue their national policies depending on their national priorities and needs, and additionally to have common energy and climate policy to face challenges that could be possible to address on regional level only, such as to withstand possible disruptions of energy supply or creating trans-European energy networks. To strengthen EU energy security, EC proposed different measures, like to reduce overall energy consumption, to strengthen external relations, to make technological shift, to further integrate internal market, to diversify export routes, and to increase energy production within EU. The recent tensions between Ukraine and Russia coupled with negative experience of past years, made EU member states and Commission to have a closer look at the possibility of production of unconventional gas within EU in order to avoid disruptions of gas supplies from Russia.

To this research was widely applied RSCT, especially when analyzing the dependence on Russian gas of countries within EU as well as interdependence of member states in the regional complex. RSCT showed that states in the RSC are inter-related by the concern about the same or similar topic, and the actions of one country to strengthen its security may have consequences on other states within the complex. This correspondent to the current state of affairs of energy security issues of EU member states.

To answer the main research question to what extent could unconventional sources of energy secure EU energy supply the author has undertaken the case study of prospects of shale gas production in EU. Balancing positive and negative aspects related to extraction of shale gas in EU member states, author aimed to learn whether it will be rational to use this new for Europe energy source to complement the energy mix of EU member states, and reduce their dependence from natural gas suppliers. To this end author has operationalized such variables as geography of gas containing shale formations, technology of production, cost of final product, legal framework, natural gas infrastructure and environmental concerns. The case study accomplished its task in identifying the main challenges for production of unconventional sources of energy in EU member states, and demonstrated how it could help strengthen EU energy security and meet its climate goals. The study corroborated that EU is not a typical regional organization; nevertheless, its example of increasing internal energy production by introducing unconventional sources for energy security purposes could help other energy security complexes worldwide to ensure their energy security supply.

The findings proved that more work from EU institutions and more concessions from EU member states are to be made to reach a common EU energy and climate policy, and to solve existing energy security problems. Heterogeneity of EU member states, different energy supply structure determines their position on shale gas which ranges from Poland's optimism to France's fierce opposition. Shale gas formations are not spread evenly across EU, and their geology is quite different from one reserve to another. This requires field-based R&D, and fracking design on case by case basis. To accommodate additional flow of gas, the existing infrastructure shall be upgraded and complemented with new segments. More work is required from the legislators to create comprehensive pan-European shale gas framework that would smoothen each country specific subsurface, taxation, and other shale gas E&P related regulations. To reach the scale of commercial production stronger cooperation between EU member-states' governments and gas operators would be required. Therefore, E&P reforms, operational flexibility, technological break-through may help to address one of the major problems as lack of space in EU. The study also revealed that environmentally shale gas is not as "dirty" as coal, biofuels or oil. Surely, some environmental disruption will occur, but it is subject of acceptance for local communities that has influence to block any E&P in their states. It was interesting to learn that cost-wise shale gas could compete with natural gas imported from Russia, and in the long term totally replace it.

7.2 Limitations of the Research

Given the fact EU distinguishes itself greatly from other regional organizations and keeping in mind that many regions are endowed with shale gas formations, more case studies are required to test the potential of shale gas production to ensure energy security of a particular region. RSCT framework has its own limitations since it is more focused on interdependency of states within energy security complex with less emphasis on interaction of countries at a global level. Presently, energy could be exported over long distances by different means: pipelines, by sea or land, which increases energy dependence between different regions and due to globalization and technological progress this will more likely to become a tendency.

Furthermore, although the origins of EU energy policy could be traced from the middle of the last century, due to strategic importance of energy and increasing heterogeneity of EU until present the member states could not agree on common energy policy. However, energy security becomes a topical issue for all members of EU, and triggered by the recent tensions between Ukraine and Russia, most of the countries acknowledge the need for common energy policy that is still in the works. In the last decade EU energy policy has been transforming rapidly, and current findings might need to be complemented soon.

Additionally, due to the time limitations case study was mainly based on the available in English academic articles. Interview questions were prepared, and sent to three oil and gas companies, but respondents could not submit answers in due time as only one weak was given to collect replies. All those limitations might have negative influence on the objectivity and rationality of the research findings.

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Appendices

Appendix 1:

Russia's Share of Natural Gas Exports to Some EU Member-States.

Weak Dependency **20 - 40%** **(Western Europe)**	**Medium Dependency** **40 - 80%** **(Central Europe)**	**Strong Dependency** **80 – 100%** **(Eastern Europe)**
Italy 32,6%	Greece 55,6%	Poland 81,3%
	Czech Republic 58,6%	Slovakia 83,5%
	Slovenia 60,2%	Hungary 100%
	Austria 71,6%	Bulgaria 100%
		Romania 100%

Source: Created by Author, figures from Sharples and Judge, 2014.

Appendix 2:
The Main Shale Basins in Europe.

	Country	Basin
1	Sweden	Fennoscandian Border Zone
2	Switzerland, Austria	Molasse Basin
3	Spain	Campo de Gibraltar Zone
4	Spain	Pyrenean Foothills
5	France	Paris Basin
6	France	Bresse-Valence Basin
7	France	Western Alps Foothills
8	France	Aquitaine Basin
9	France	Languedoc-Provence Basin
10	UK	Bowland Basin
11	Poland	Baltic Depression
12	Poland	Ketzyn Terrace
13	Poland	Danish-Polish Marginal Trough
14	Poland	E European Platform Margin
15	Poland	Podlasie Basin
16	Poland	Lublin Trough
17	Germany, Netherlands	Northwest German Basin
18	Germany, Poland	Northeast German-Polish Basin
19	Netherlands, UK	Anglo-Dutch Basin

Source: Geny, Florence (2010): Can Unconventional Gas Be a Game Changer in European Gas Markets? p.111.