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# **Natural Gas and Infrastructure: A Mediterranean Gas Hub in a Critical Geopolitical Context**

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## **Abstract**

This dissertation was written as part of the MSc in Energy Law, Business, Regulation and Policy at the International Hellenic University.

In recent years, the Mediterranean has been a hot topic in international gas markets. The latest natural gas findings in Eastern Mediterranean, according to many analysts, have the potential to transform the region and global energy markets. The transformation of Eastern Mediterranean to a natural gas province will inevitably alter the geopolitical landscape, thus creating new opportunities and challenges for each player in the region. Local economies can reap big economic benefits, once gas become commercial. Regional players from their part should strengthen the energy cooperation, which can also pave the way for a new era of economic and political stability in the Mediterranean. The aim of this thesis will be to provide a comprehensive overview on the natural gas markets and recent developments in the Mediterranean region; and to propose a critical discussion of the gas market opportunities and geopolitical risks related to the potential emergence of a Mediterranean natural gas hub.

Keywords: Natural Gas, Infrastructure, Supply & Demand, Energy Geopolitics.

Eleni Charisi  
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## **Preface**

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## Contents

<b>ABSTRACT .....</b>	<b>III</b>
<b>PREFACE.....</b>	<b>I</b>
<b>CONTENTS.....</b>	<b>III</b>
<b>INTRODUCTION .....</b>	<b>1</b>
<b>FUNDAMENTALS OF NATURAL GAS .....</b>	<b>5</b>
FUNDAMENTALS OF NATURAL GAS .....	5
PRODUCTION COSTS .....	6
NATURAL GAS DEMAND .....	7
NATURAL GAS PECULIARITIES.....	9
PRICE FORMULA .....	9
PRODUCTION AND CONSUMPTION TRENDS IN THE MEDITERRANEAN .....	12
<b>INFRASTRUCTURE.....</b>	<b>23</b>
NATURAL GAS & INFRASTRUCTURE .....	24
INFRASTRUCTURE IN THE MEDITERRANEAN REGION .....	26
<i>Pipelines in the Mediterranean Region.....</i>	<i>26</i>
<i>LNG Facilities in Mediterranean.....</i>	<i>32</i>
<b>ENERGY GEOPOLITICS .....</b>	<b>34</b>
MOST COMMON GEOPOLITICAL RISKS.....	36
THE GEOPOLITICAL CONTEXT IN THE MEDITERRANEAN REGION .....	36
A MEDITERRANEAN NATURAL GAS HUB .....	42
<b>CONCLUSION .....</b>	<b>44</b>
<b>BIBLIOGRAPHY .....</b>	<b>46</b>

## Introduction

In recent years, the Mediterranean has been a hot topic in international gas markets. The latest natural gas findings in Eastern Mediterranean, according to many analysts, have the potential to transform the region and global energy markets. The transformation of Eastern Mediterranean to a natural gas province will inevitably alter the geopolitical landscape, thus creating new opportunities and challenges for each player in the region. The aim of this thesis will be to provide a comprehensive overview on the natural gas markets and recent developments in the Mediterranean region; and to propose a critical discussion of the gas market opportunities and geopolitical risks related to the potential emergence of a Mediterranean natural gas hub.

This thesis will comprise three main sections. The first section will refer to the fundamentals of gas economics such as production costs, peculiarities of gas; and prices formula and contracts; and the supply and demand trends for Mediterranean countries. The second section will concentrate on the infrastructure trends and developments in the Mediterranean. The last section will focus on the geopolitical context of the Mediterranean and the opportunities and challenges that arise when dealing with the creation of a natural gas hub in the Mediterranean.

The countries of the Mediterranean and their neighbors are even more unstable today than even before. The political transition in Egypt, the civil war in Syria, the tensions between Israel and Gaza, the political unrest in Libya, the future of Turkey and the dispute between Turkey and the Republic of Cyprus impede the creation of a reliable natural gas hub in the region. The creation of a Mediterranean gas hub would present great benefits for all players in the region strategically and economically. Until now, “proposals for pipelines and LNG schemes have emerged, they all face problems related to economics or international relations—or both.” Furthermore, “there are other substantial hurdles to overcome, including lack of pricing transparency, as well as market culture and attitude to gas trading” (Tagliapietra, 2013).

Albeit commercial appeal, the creation of an integrated Mediterranean gas hub will depend not only on foreign policy considerations but, also, on domestic policies. “Even in Israel, investors have faced difficulties. Energy security is a sensitive topic in a country that sees itself as a politically isolated in the region. Many Israelis are uneasy

about the country exporting its natural wealth.” (Nakhle, 2016) As for Egypt, the government’s policy to divert natural gas supply for exports to meet demand, the low prices that the government is willing to pay to foreign operators and the inability of Egyptian General Petroleum Corporation (EGCP) to pay off its debts to foreign operators led to investment delays and accelerate investors’ anxiety (EIA, 2015). Except of the abovementioned, “the declining oil and gas prices has amplified the difficulties in the region and brought into question whether developing the fields is commercially viable.” (Nakhle, 2016)

“The politics and economics of Mediterranean energy are rapidly changing. The resources could reshape local domestic economies, frame regional geopolitics and provide an alternative source of gas to Europe, reducing its dependence on Russia” (Nakhle, 2016). Local economies can reap big economic benefits, once gas become commercial. Regional players from their part should strengthen energy cooperation, which can also pave the way for a new era of economic and political stability in the Mediterranean.

The combined resources of Egypt, Israel, Cyprus and Libya advocate the creation of a natural gas hub in the Mediterranean. For the creation of a gas hub in the Mediterranean, establishment of a robust interconnection system, LNG terminals and storage facilities are a prerequisite. But considering the capital intensity of such infrastructure projects, the current pricing and the political dynamics in the region create serious challenges for such immense investments. Therefore, Mediterranean countries should engage diplomatically and cooperate towards the creation of the appropriate infrastructure. For instance, the strategic alignment between Cyprus, Greece and Israel represents a new element in the regional geopolitical landscape. On the other hand, “absent of collaborative vision could represent a potential element of destabilization in the region and, also, a source of new tensions” (Tagliapietra, 2013).

“Gas trade in the Mediterranean is greatly unbalanced, with some countries becoming major exporters (mainly Algeria, Libya and Egypt) and others major importers (both the North and South Mediterranean sub-regions in addition to Turkey).” (Martinez et al., 2013) Egypt, once a major gas producer, is struggling the last years with energy shortages, on the other hand, in some countries such as Cyprus and Lebanon there is an absence of natural gas from their energy mix, since they rely

heavily on oil products. A fact that constitutes a great economic burden for these countries, which are used to pay hefty import bills. Therefore, there is a great possibility for natural gas as an indigenous produced resource to gain significant market share in the future.

For Cyprus and Israel, the construction of export infrastructure and the development of their fields is a crucial problem. Several options for gas export were proposed, from pipelines to Greece or Turkey, and LNG projects in Cyprus, Egypt or Israel. Recently, Israel, Greece and Cyprus announced that they will explore the possibility of building a joint natural gas pipeline to Europe. However, the specific project runs into technical difficulties due to the seabed between Cyprus and the Greek coast; and very high costs. Compared to offshore pipelines, the most prominent and sensible option is to bring Israeli and Cypriot gas to the Egyptian LNG Terminals. According to Tagliapietra and Zachmann (2013) "Egypt's LNG exports dropped from a starting level of about 15 bcm/y in 2005 to almost zero in 2014, leaving the country's two LNG plants completely idle." In addition, the proximity of the three fields Zohr, Aphrodite and Leviathan, allows the development of the fields to be coordinated. This solution minimizes political and especially commercial risk, for instance if the field underperforms. "Consequently, bringing together an underused and scalable export infrastructure with several promising fields could be the key to unlock untapped regional potential." (Tagliapietra & Zachmann, 2013)

Although, there is a high level of uncertainty about the role of natural gas in the future EU energy mix, the European Union has a primary interest on the Eastern Mediterranean natural gas development, as natural gas is projected to become the predominant fuel in the European energy mix. On the other hand, there is a gloomy picture for the years ahead as there is a gas market crisis, underinvestment on gas infrastructure, and the uncertainty regarding the "contradictual" energy policies of the EU. The Roadmap 2050 strengthens this speculation, since there is a great incentive toward the decarbonization of the European economy and the role of gas is projected less important in the following years, which is considered as a "transition energy". Therefore, it is very normal to have different projection on future EU natural gas demand. Some projections show an increasing gas demand, while others show a declining gas demand.

Regarding the methodology, as a primary source this study will use the official documents and statistical of IEA/ EIA/governments, the statements and speeches of statesmen and official representatives of official materials and documents (statements, news releases etc.), information and analytical resources of the official websites of international organizations, national energy ministries. In addition, secondary sources will be used in this study which is reflected in the literature review. The purpose of this thesis is a combination of description and explanation. This thesis will endeavor to examine and answer questions such as 1) A Mediterranean gas hub: is it a dream or a necessity if we take into consideration the current supply & demand database and the gas economics?; 3) Infrastructure: what role do they play in the pursuit of a Mediterranean gas hub?; 4) Which is the role of geopolitics in the pursuit of a gas hub in the region and which are the opportunities and obstacles that arise? This thesis will be of great significance, as long as natural gas continues to play an important role in ensuring our energy needs. Natural gas is a rising star, that is considered to play a crucial role in tomorrow's energy mix along with renewables.

Natural gas is a low-cost energy source with huge unexploited and easily accessible reserves worldwide. In addition, it produces half of the carbon emissions of coal. If we considered that yet a large percentage of electricity today is generated by coal-fired power plants, natural gas has the opportunity to replace coal successfully, since it is the fastest, most efficient and least expensive way to reduce CO<sub>2</sub> emissions, and on the other hand provides a sustainable response to rising global energy demand. In other words, the natural gas can provide backup to renewables when there is no sunlight or wind, or consumption peaks.

Therefore, natural gas has the potential to dominate the global energy mix, especially after the imposition of price on carbon, a fact that will make the natural gas more competitive in relation to coal, which benefits from its low prices and the lack of regulatory restrictions on emissions. The creation of a Mediterranean hub can contribute effectively to energy security of the region, enhance the liquidity of the market and improve competitiveness of gas vis-à-vis coal.

## **Fundamentals of Natural Gas**

Natural gas is the fastest growing energy source in the world. Although natural gas has been known since ancient times, the industry has been marked by high growth in the late 1980s-early 1990s when environmental concerns moved to the forefront of international policy agendas. Especially the last decades, when energy supply security concerns were raised, the attention on natural gas increased due to its high demand and more concentrated distribution of reserves. Natural gas “has taken on an ever-greater role in the world’s energy mix, growing from 16% to over 21% of total primary energy supply in the period since the IEA was created.” (IEA, 2014) In its short history, the gas industry has undergone significant changes due to developments in terms of market structure, technological advances, as well as economic and political dimensions. According to many analysts, natural gas has the potential to dominate the global energy mix, especially after the imposition of price on carbon, a fact that will make the natural gas more competitive in relation to coal, which benefits from its low prices and the lack of regulatory restrictions on emissions. Due to the current general political instability and the insecurity that gives to the pipelines, LNG is a resilient way of delivering mobile gas, that can provide the fuel to a greater number of markets (Saleem, 2014) and especially distant markets, whose access through pipelines is uneconomical and not commercially-viable.

Today, natural gas is the one of the world’s most actively traded commodity, and as other commodities its price experiences wide price swings in times of shortage or oversupply. The birth of the gas market is relatively new, and it started in 1980s with the first move of natural gas market liberalization in UK and US. Generally, there are

two different markets for gas: the physical gas market and the financial gas market. The physical gas market is the typical market, which involves buyers and sellers of a physical commodity. There are many types of physical trading contracts such as base load contracts, firm contracts and swing contracts. On the other hand, regarding the financial gas market we have the future market, where commodities are purchased or sold under contracts at least one month, and up 36 months.

### ***Production Costs***

The gas industry consists of many technically demanding and capital intensive functional activities. "These include production, gathering, storage, pipeline transportation, distribution and supply to end-users" (Julius & Mashayekhi, 1990). Natural gas production involves a set of operations, which are exploration, drilling and production. The gas industry needs to incur a set of costs, which is known as "full cycle costs", in order to find, develop, produce and sustain production of gas; which in most cases are fixed and risky due to the technical nature of exploration and development.

The costs of an exploration and development company start from the very first phase of the exploration, which is considered as a process that involves high risks and significant costs even for areas of good geological prospect. These costs increase with the level of sophistication of the exploratory surveys. "Generally, the least-cost option is used most widely and the costliest option is used most selectively. Gas exploration follows the same methods and techniques used for oil; and often gas is found while searching for oil." (Bhattacharyya, 2011) The main target of any exploration program is to achieve the maximum discovery at the minimum cost. These costs, known as finding costs that a company must cover, are the cost of geological and geophysical work, licensing rounds, signature bonuses and the costs of drilling exploration wells.

Once the discovery is made the next stage is to decide whether to develop the field or not. The final decision is based largely on the size of the discovery. Other issues are proximity to the market, availability of viable consumers etc. Similarly, development of fields and production are also costly activities. Development cost depends on the

number of wells to be developed, well locations, reservoir condition and the surface infrastructure required (Julius & Mashayekhi, 1990).

Production costs also known as lifting costs, generally, are the costs that natural gas industry needs to incur in order to operate and maintain wells and support equipment or facilities. Additionally, economic rents through taxes levied by the government or loyalty systems are also considered as production costs.

The rate of recovery of natural gas tends to be better than oil, and the output from a field is determined by the number and technology sophistication of wells development. “But once peak is reached and depletion starts, it is more difficult to improve production. Enhanced recovery of gas is complicated and expensive” (Bhattacharyya, 2011).

If natural gas prices are above these full cycle costs, the industry has an incentive to sustain investment and activity in the sector, since upstream companies emphasize generally production volume in order to generate profit margins, which are sensitive to commodities market prices. But, the fluctuations in natural gas commodity price can cause volatility in company’s cash flow and if prices are squeezed for prolonged periods, the industry may decide to lower or postpone capital spending, production and reserve replacement (EIA, 2016).

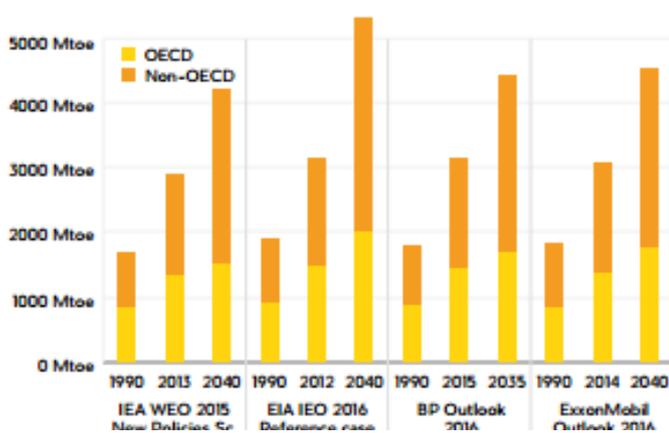
### ***Natural Gas Demand***

The recent low natural gas prices indicate that the demand for natural gas has not grown as rapidly as the growth in supplies. However, many analysts believe that in the future natural gas will play a key role as an energy source, and they point out that low natural gas prices will lead to a substantial growth, mainly in the electric and industrial sectors. As regards the electricity sector, due to low prices and globally emerging environmental regulations; natural gas-fired generation capacity is expected to replace a significant portion of the old coal-fired generation, thus leading to an increase in natural gas demand in the electric sector.

However, new strategies and environmental policies put in place in Europe and in other regions, they do not offer a clear view of future natural gas demand, thus it depends on the future electricity generation mix. The demand for natural gas

correlates closely with general economic growths. The occurrence of recessions or economic slowdowns, like the one that occurred in China recently, has a direct impact on demand for gas. During periods of economic growth, the increased demand for goods and services from the industrial and commercial sectors leads to an increase in natural gas demand. In contrast, economic downturns tend to have the opposite effect. Since energy demand is affected by the level of economic activity, it should also be influenced by interest rates and policy decisions that determine natural gas demand (EIA, 2016).

Another reason that could lead to the decrease of demand is that due to concerns over climate change. A number of countries have adopted a regulation to reduce CO2 emissions and to shift their energy mix from fossil fuels to renewables. Furthermore, weather strongly influences residential and commercial demand. During winter, end users consume natural gas excessively for heating, which consequently increases demand. Hot weather can also generate demand for air-conditioning and subsequently power sector's demand for natural gas. Natural gas supplies that were placed in storage are crucial because they satisfy peak demand; and help to avoid shortages and short-term price spikes. Finally, some large-volume fuel consumers have the ability to switch to other fuels than natural gas depending on the price of each fuel. Therefore, when the cost of competent energy sources decrease, demand for natural gas may fall as well and the opposite.



Picture 1: Gas demand by region and scenario, Source: OME

Although, natural gas demand is projected to grow significantly in the near future, there are no clear estimations in the longer term. This is mainly the result of the highly competitive market between

gas and other alternative energy sources such as coal, nuclear and renewables. Thus, "the cost competitiveness of gas will be a key determinant of the outlook beyond 2020. The price needs to be low enough to sustain and improve the share of natural

gas in total primary energy consumption, but high enough to encourage investment in new gas supply.” (Office of the Chief Economist, Australia Government 2015) For instance, as regards the electricity sector, gas is being squeezed between low cost coal and the growth of renewables that pose a risk at the expected “golden age of gas”.

In the short term, prices for the majority of commodities like oil or gas are projected to remain well below their peaks as market, in the same time, struggles to adjust to a period of growing output but lower demand growth. Since even in the case of a stronger world economic growth, it is unlikely to stimulate a demand-driven recovery. However, any increase in commodity prices in the future, it is more likely to be related with cut in supply as many producers with high break-even prices exit the market or curtail production.

### ***Natural Gas Peculiarities***

Natural gas production in order to be increased and sustained, needs long lead times compared to other products due to the time required for acquiring leases and government permits; conducting exploratory seismic work; drilling wells; and connecting them to pipelines. Therefore, it takes time from minimum six months to years for producers to develop wells, produce natural gas and adjust their supplies according to demand and commodity prices.

Unlike other fuels, natural gas cannot simply be loaded on a ship or train for transportation from wells to consumer markets. In contrast, natural gas transportation requires a costly and complex system of pipelines or “complicated conversion systems that either cool the gas into liquid form, compress the gas to higher pressures, or modify its chemical composition to allow conversion to other products.” (Chandra, 2006) However, technological advances and decreasing costs especially for LNG projects have allowed gas to economically the above-mentioned challenges and enhance its possibilities of becoming the fuel of the future.

### ***Price Formula***

For many years, natural gas and oil were considered as close substitutes by using whichever energy source was less expensive and due to that fact natural gas prices

aligned with those of crude oil (Brown & Yucel, 2008). Additionally, the cost escalation at new projects made imperative for investors to prefer long-term contracts at traditional, oil-indexed prices. The Long-Term Contracts, an outcome of lengthy negotiations between counter-parts, “establish long-term commitments by consumers to purchase minimal volumes of gas and they also ensured a reliable stream of income to ensure that large investments could be financed” (Vavilov, 2015), but after the development of the spot market, this type of contracts became unattractive and not competitive enough. In recent years, due to the development of the spot market and other changes related to supply and demand, provisions of long-term contracts have undergone substantial changes because of their lack of flexibility. The long timeframe of that contracts and especially the famous clause “take or pay”, made long-term contracts unattractive, since they were considered to pass the risk from the sellers to buyers. Additionally, bilateral gas contracts are against the basic rules of a competitive gas market. In a competitive gas market, the interaction of supply and demand determines the movement of prices and in the absence of such a market; it is extremely hard to determine the price of natural gas. Therefore, in long-term contracts they use traditionally the oil market price as a benchmark for contract gas pricing. “The absence of a gas market, both global and even regional, led to rigidity, and a bias in the distribution of gains from trade between seller and buyer that favored the seller. This bias was based on the essential role of power levers in bilateral gas deals. However, recent developments in the market such as the drop-in oil prices and the convergence of LNG and regional natural gas prices since late 2014 are leading the trend away from oil-indexed prices and emphasizing weather and technological advancements as key drivers of natural gas prices.” (Global Natural Gas Markets Overview: A Report Prepared by Leidos, Inc., Under Contract to EIA, 2014)

Generally, there are two simple rules of thumb for natural gas oil-indexed pricing. The first rule is the 10-to-1 rule, under which the natural gas price is one-tenth the price of crude oil price. The second simple rule is the 6-to-1 rule and is based on the energy content of a barrel of oil. For instance, a barrel of WTI contains 5.825 million Btu, therefore natural gas price ought to be roughly one-sixth the crude oil price. However, according to previous researches neither the 10-to-1 nor the 6-to-1 rule

perform well, since the first one consistently under forecasts natural gas prices and the second one over-forecasts (Brown & Yucel, 2008).

On the other hand, spot market developed rapidly and increased its position significantly compared to long-term contracts. The main characteristic of spot market is that inside it gas is traded “right now” at a price based on fundamentals (supply & demand). Spot market is part of the physical market and offers flexibility to all participants that have the ability to sell or buy gas according to their needs at that specific time. The spot markets for natural gas is separated in the Day Ahead, Intraday and the balancing market. The evolution of the gas spot market led to an LNG growth globally, since the participants became able to trade gas on a daily basis. With the recognition of the importance of natural gas supply security and the increased importance of natural gas in the energy mix, various countries attempted to create their natural gas hubs. To be more specific, gas hubs are trading platforms where supply meets demand in order for the prices to be set by the logic of markets; and where physical and/or financial transactions of natural gas take place. Although, gas hubs were related mainly to pipelines, initiatives by various countries to develop LNG hubs, such as Singapore and Japan, changed the situation. The creation of LNG hubs will enable participants to trade LNG at reasonable prices and have access to a great number of suppliers or consumers at any time; thus, it will enhance also the security of supply.

The low oil and gas prices make the gas more competitive and attractive to the consumers. However, the high price volatility poses a high risk to future projects and investors, since it makes financial planning and expectations challenging if the prices for gas go further down. Additionally, many of the countries endowed with gas resources lack a well-developed legal system, a fact that exposes operations in their soil to an increased risk of unpredictable actions by the governments in the future. Finally, the inherent risks of gas operations and human error that could cause an accident and an environmental event, is one of the main threats. This threat except of the negative effect that will have for the environment, it would also tarnish a company’s reputation and subject the company to sanctions and penalties.

“The establishment of price indices which accurately reflect the supply and demand of LNG itself will not only facilitate spot trading but also contribute to stabilizing import

prices through immediately helping to diversify price formulae, which used to be mainly linked to crude oil prices.” (Ministry of Economy, Trade and Industry Government of Japan, 2016) Therefore, the participation of financial service providers or other risk takers in the market is crucial for the facilitation and development of the future markets as well as the increase of the depth of the LNG market. The development and promotion of spot trading will facilitate the establishment of gas price indices which reflect the supply and demand of LNG itself- and enhance their reliability. This change will also lead to a shift from long-term contracts at oil-indexed prices to a new system linked to natural gas hub pricing based on supply and demand trends. Additionally, it is expected that “the need for price hedging utilizing futures trading will further increase and this will facilitate the establishment of relevant price indices through the transmission of futures prices.” (Ministry of Economy, Trade and Industry Government of Japan, 2016) In order for LNG trading to continue to grow it is important to encourage new market players to participate and to develop the adequate infrastructure. As regards the infrastructure, that maybe will be a difficult task since LNG infrastructure is capital intensive and its development until now based on long-term commitments. Therefore, it is clear that the global gas market should develop a liquidity and hub-based structure that will be transparent and will ensure fair access to all participants without discrimination.

To conclude, natural gas prices are mainly a function of market supply and demand and changes over a short period may result in large price changes. Factors on the supply side that can determine prices include levels of natural gas production, levels of net imports, and levels of underground storage. On the demand side, there are three aspects that can affect prices of natural gas: the level of economic growth, variations in winter and summer weather and prices of competing fuels-petroleum prices. Generally, price spikes lead to increases in production, imports, and sales from storage inventories.

### ***Production and Consumption Trends in the Mediterranean***

“Gas trade in the Mediterranean is greatly unbalanced, with some countries becoming major exporters (mainly Algeria, Libya and Egypt) and others major

importers (both the North and South Mediterranean sub-regions in addition to Turkey).” (Martinez et al., 2013) Egypt is struggling the last years with energy shortages additionally, in some countries such as Albania, Cyprus and Lebanon there is an absence of natural gas from their energy mix, since they rely almost entirely on oil products. A fact that constitutes a great economic burden for these countries, which are used to pay hefty import bills. Therefore, there is a great possibility for natural gas as an indigenous produced resource to gain significant market share in the future.

Although oil traditionally had the highest production levels in the region; future projections display that production of oil is expected to increase at lower rates giving priority to other sources such as natural gas and renewables, especially after the recent discoveries in the Eastern Mediterranean Region. The discoveries in the region are relatively insignificant on a global scale, but they can transform the future of the countries in the Eastern Mediterranean; and can provide those countries with high economic returns and enhance energy security for years.

Egypt is a traditional natural gas producer that was self-reliant until 2015, when started importing gas in order to meet its subsidized demand (Ratner, 2015). Syria and Israel do also hold significant gas reserves, but those sectors were not developed commercially until the 1980s and the mid-2000s respectively. Jordan had also some natural gas production at low levels since 1980s, which was insufficient to meet domestic demand. Jordan mainly relies on imports until now.

Egypt although it was traditionally a large producer of natural gas, it became a net importer in 2015 and is still facing a natural gas shortage, primarily because of government policies to subsidize domestic consumption and to give low payments to foreign operators. These domestic policies hurt natural gas producers and curbed their interest in developing new natural gas resources, since they were forced by the government to sell a percentage of their production domestically at lower than international prices. Additionally, Egyptian government’s mounting debt to foreign energy companies in combination with political unrest after the Arab Spring had as a result a drop of 27% of the Egyptian natural gas production between 2009 and 2015, while the demand rose rapidly.

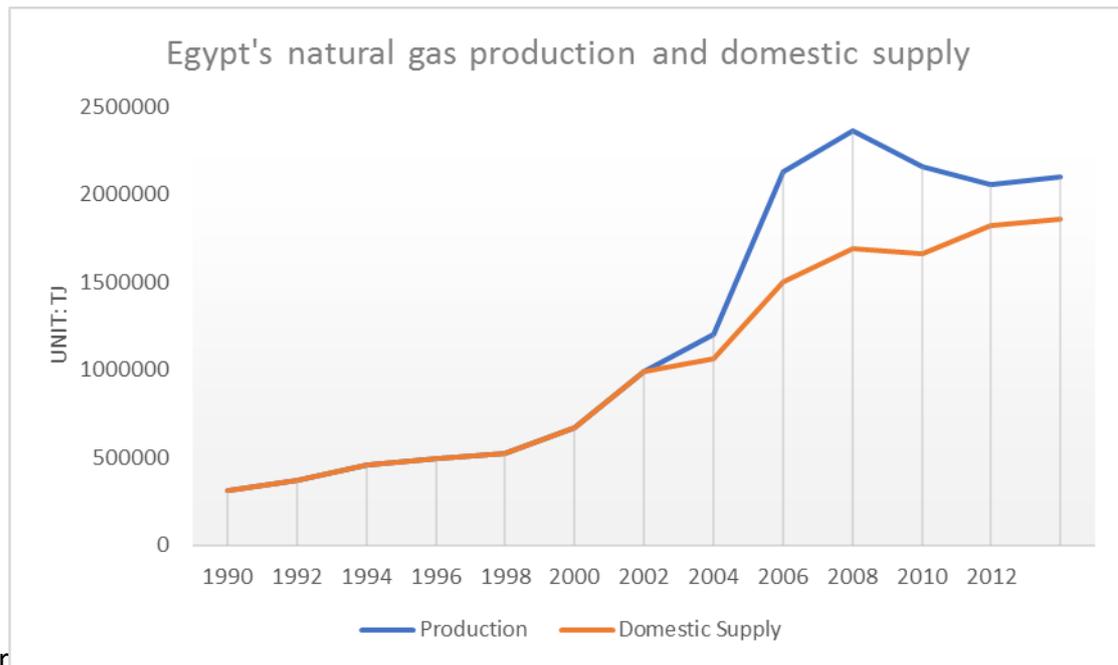


Table 1: Egypt's natural gas production and domestic supply, Source: IEA

Due to that rapid increase in demand, Egypt forced to divert its natural gas supply from exports to the domestic market and began importing LNG in 2015. However, Egypt's situation is expected to change in the future mainly after the utilization of the supergiant Zohr Field, which was discovered by Eni SpA in August 2015. Until now, the Zohr Field is the largest discovery in the Eastern Mediterranean and holds up to 30 Tcf.

In Israel, Noble's discoveries Noa Field (1999), Dalit and Tamar (2009), Leviathan (2010) and Tanin (2011) confirmed the presence of natural gas in the country. Until now, the largest offshore discovery in the country is the Leviathan Field, "located approximately 80 miles off the coast of Israel and situated in water that is more than 5,000 feet deep- which holds 18 Tcf in estimated recoverable resources." (EIA, 2013) Production from the Tamar Field started in April 2013, and production from the Leviathan Field is scheduled to begin as soon as in 2019.

In addition to the discoveries in Israel, Noble Energy discovered the Aphrodite Field offshore of Cyprus in 2011 that was estimated to hold between 5 and 8 trillion cubic feet (Tcf) of natural gas reserves (Oil Daily, 2012). Although, government officials hope to discover between 30 and 40 Tcf of additional natural gas resources and plan to develop the Aphrodite field and begin exporting gas by 2019, Cyprus does not have the

necessary infrastructure; a fact that makes it difficult and costly for the country to utilize gas for exports or even for domestic use.

The successful discoveries in the region spurred additional exploration. Syria and Lebanon hoped to launch exploration program, however, the civil war and the political stalemate accordingly postponed these programs.

Syria was previously considered a leading hydrocarbon producer in Eastern Mediterranean with a production of 316 Mcf per day (EIA, 2015). However, country's natural gas production declined dramatically to less than 200 Bcf in 2013 (EIA, 2015) due to the ongoing civil war that created serious damages or completely destroyed natural gas infrastructure.

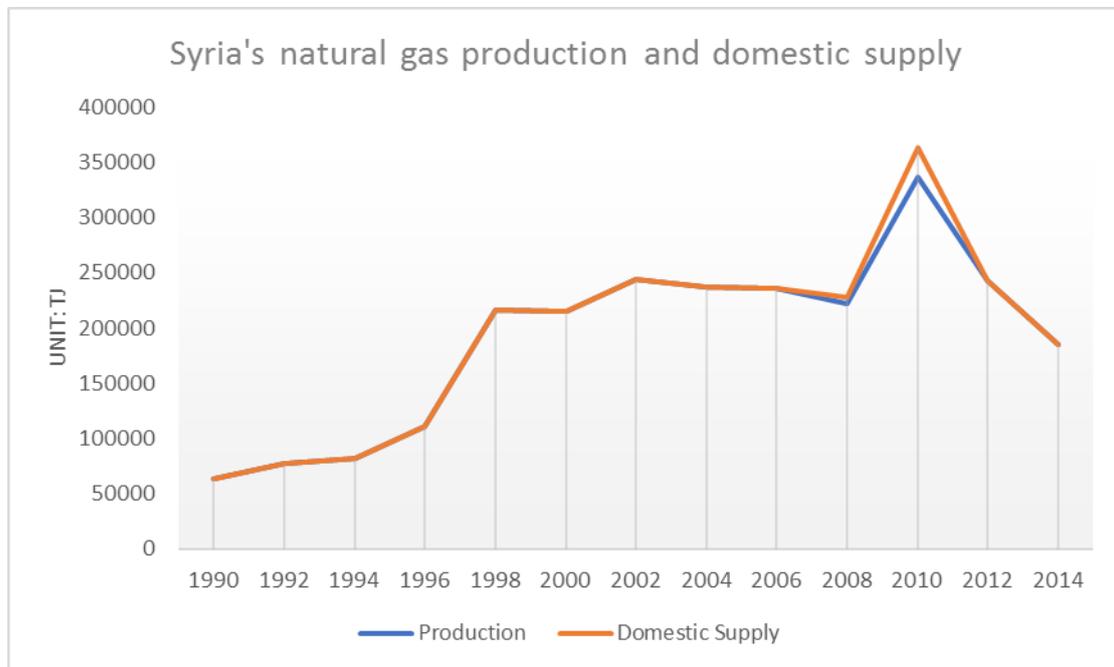


Table 2: Syria's natural gas production and domestic supply, Source: IEA

In the north-African part of Mediterranean, Algeria holds the world's eleventh-largest amount of proved natural gas reserves, according to Oil & Gas Journal the country had 159 Tcf of proved natural gas reserves. However, its production has steadily declined over the last years as its largest, mature field is depleting since its peak of 7.1 Tcf in 2008 (EIA, 2016). In 2014, Algeria's dry natural gas production was 3.0 Tcf of which 1.5 Tcf was exported via pipelines (910 Bcf) and by LNG tankers (578 Bcf) (EIA, 2016). The country's government officials announced several projects

planned to come online in order to increase production levels, but all of them have been delayed.

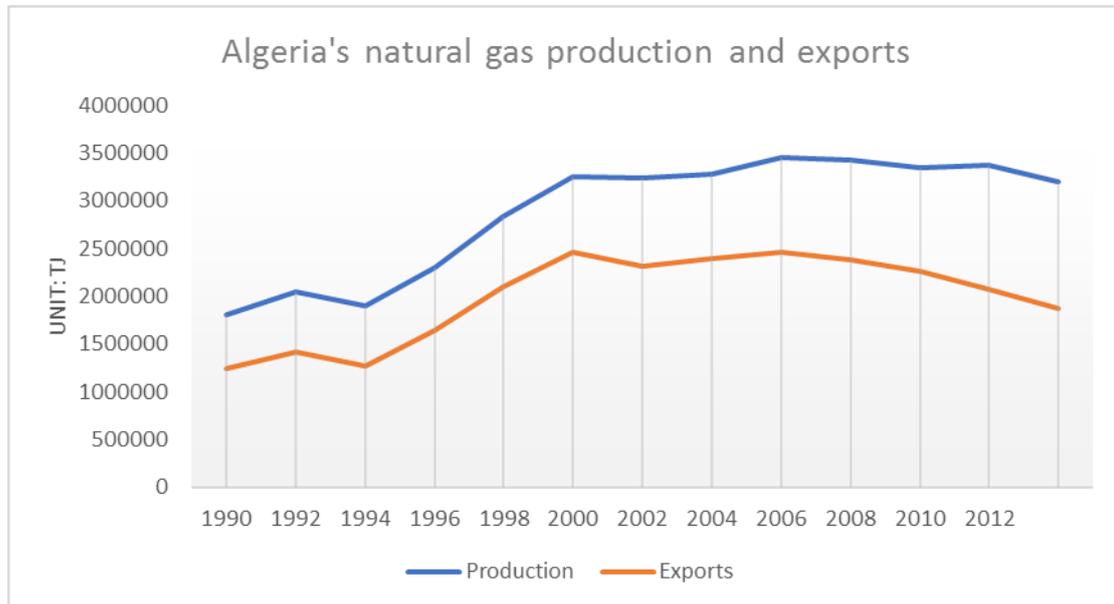


Table 3: Algeria’s natural gas production and exports, Source: IEA

Libya is a member of the OPEC and the fifth-largest holder of Africa’s proved natural gas reserves that were estimated as 53 Tcf. However, although its vast reserves, Libya’s oil and gas production have been significantly affected by the civil unrest since 2011. According to EIA (2015) reports, “Libya’s natural gas industry recovered in 2012, but production still remains below the pre-war level”.

Before the events of 2011, Libya’s natural gas production was extremely high from 194 Bcf in 2003 to 594 Bcf in 2010; especially, after the development of the Western Libya Gas Project in 2003 that accounted for most of Libya’s natural gas production growth. Country’s gas production was almost entirely shut for a long period in 2011, “and production for this year averaged around 277 Bcf, more than a 50% drop from the previous year” (EIA, 2015). In 2012, natural gas production recovered to 431 Bcf. International Oil Companies, operating in Libya, and the National Oil Company announced plans to increase country’s production, however that investment decisions are contingent on the political stability and security in the country.

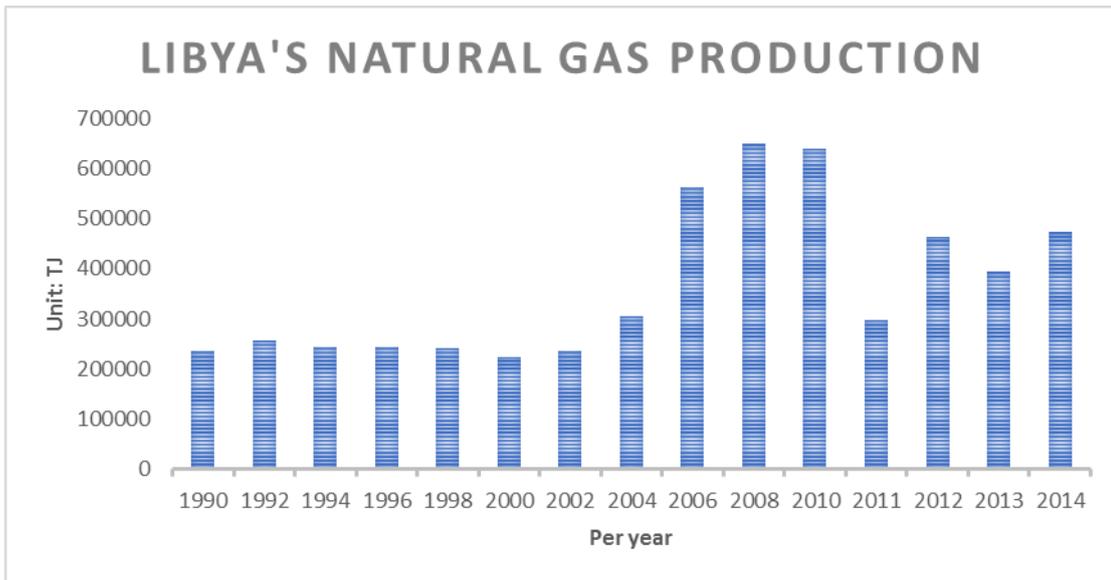
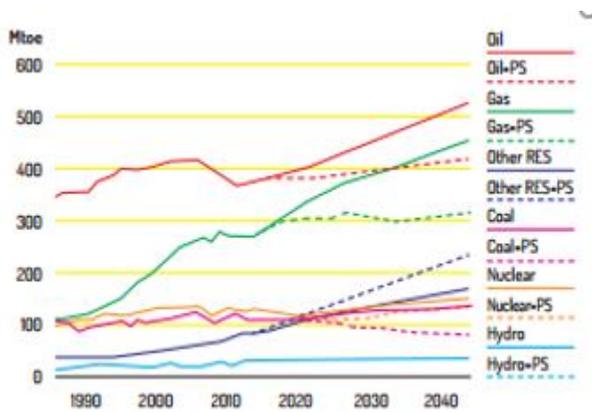


Table 4: Libya's natural gas production, Source: IEA

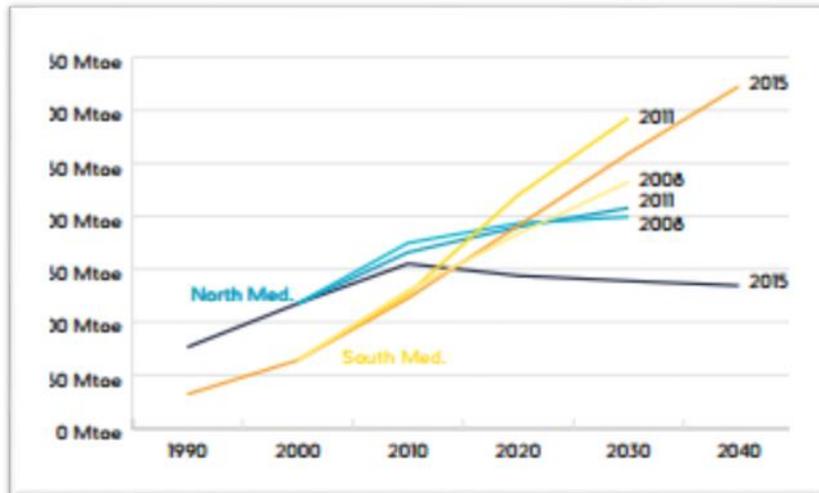
The other countries of the Mediterranean hold small amounts of natural gas but some of them are considered as the largest consumers of natural gas. These countries are Italy, France, Spain and Turkey. Turkey produces a small amount of natural gas and according to Oil & Gas Journal holds natural gas reserves equal to 218 Bcf (EIA, 2015).



Picture 2: Mediterranean primary energy demand by fuel and scenario, Source: OME

According to future projections, while the demand of oil is expected to stabilize in the Mediterranean region, demand for natural gas is forecast to increase. North Mediterranean countries' consumption rates will continue to trend upward with modest increase though. On the other hand, consumption in South and East Mediterranean countries is expected

to experience increase by the largest margins. This trend will be mainly the result of a significant increase in GDP and population in these regions leading to rising electricity and overall gas consumption.



Picture 3: Mediterranean Gas Demand by Region, Source: OME, September 2016

To meet expected growth in demand, countries in the Eastern Mediterranean will need to produce or import additional natural gas supplies. Israel can consider as successful case that managed to develop its offshore natural gas field and transform its energy profile. Israel reduced its dependence on oil imports and achieved a high level of energy security for the next decades.

Historically, Israel had been an importer of natural gas mainly through the Arish-Ashkelon pipeline from Egypt and a small amount from LNG imports since 2013, when a floating regasification terminal was installed. The recent discoveries of natural gas field and their gradually development are expected to meet Israel's rising domestic needs, and excess natural gas resources will likely be exported. With additional production volumes coming online from the Tamar field since 2013, natural gas consumption in Israel grew significantly from an annual average of 10 million cubic meters in 2001 to a peak of 7.98 Bcm in 2014 (CIA, The World Factbook). The domestic natural gas market is projected to grow and to take a predominant role in Israel's energy mix.

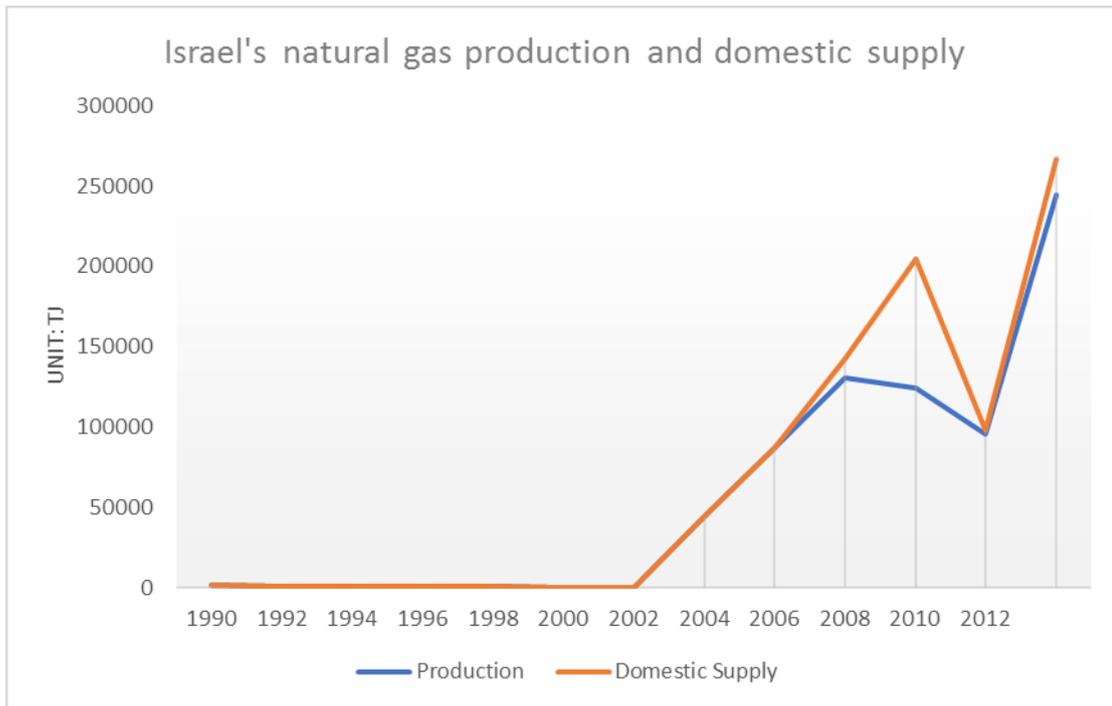


Table 5: Israel’s natural gas production and domestic supply, Source: IEA

Egypt holds vast reserves of natural gas and its international gas transport infrastructure system is composed by two LNG plants -located in Damietta and Idku- and two pipelines -the El Arish-Ashkelon Pipeline and the Arab Gas Pipeline- (EIA, 2015). “Over the last decades, natural gas consumption has soared in Eastern Mediterranean countries. According to OME (2011), in 1990 the regional share of natural gas in the primary energy mix was only 5%, while in 2009 it was 27%. This trend is expected to further increase over the next years.” (Tagliapietra, 2013) Due to that increase in domestic demand, the development of Zohr field will primarily serve the Egyptian domestic market, since Egypt is struggling to meet its domestic demand. And for countries such as Israel and Cyprus that were traditional dependent on oil imports for almost their entire energy needs, the prospect of becoming self-reliant producers of natural gas for decades to come is exciting.

As regards Cyprus, the country does not consume any natural gas and is dependent on petroleum products imports. Lebanon relies also on energy imports, mainly oil products that account for over 90% of total primary energy demand, since natural gas is not part of the country’s energy mix after the suspension of Egypt’s supply through Arab Pipeline (EIA, 2014). Cyprus plans to utilize natural gas from Aphrodite field in

order to decrease its reliance on imports and boost its economy. Except of saving money, the country's economy will not be that exposed to oil price fluctuations. Lebanon hopes also to discover significant natural gas reserves that will provide the country with the necessary supplies to meet increasing domestic demand and enhance its energy security. Subsequently, Lebanon's Ministry of Energy and Water proposed a two-thirds increase of the natural gas share in country's energy mix by 2030 (EIA, 2013).

The continuous interruptions in natural gas flows in the region led many times such as in the period between 2010 and 2011, to decreases in consumption. In this period, the interruptions in flows from Egypt via the Arab pipeline and the onset of unrest in Syria led to a 23-percent natural gas consumption drop in the region due to shortages. Therefore, although the energy demand is increasing rapidly in Eastern Mediterranean, the future of natural gas development depends on the turn of events in Syria, political and economic instability; and delimitation disputes.

Turkey is a major natural gas consumer in Eastern Mediterranean region. Although, the country does not produce significant amounts of natural gas, it is considered as an important consumer, which is increasingly dependent on imports. Turkey's natural gas consumption has increased rapidly over the past years and has reached a new high of 1.7 Tcf in 2014 (EIA, 2015). Especially, the electricity generation that is mainly based on natural gas, more than doubled from 2000 to 2010. An average of 405 of natural gas consumption is accounted to power generation, while the remaining consumption is split between the residential/commercial and the industrial sector.

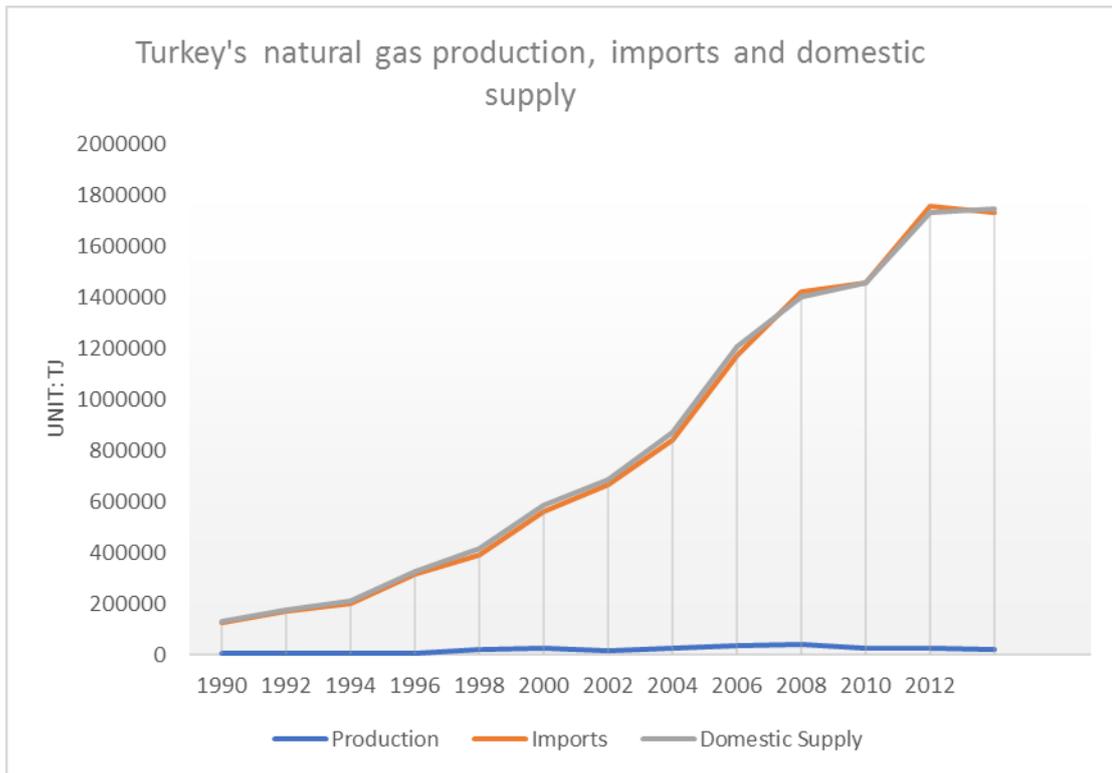


Table 6: Turkey's natural gas production, imports and domestic supply, Source: IEA

In North Africa, Algeria's, Libya's domestic consumption increase steadily. For instance, "in 2014, Libya's natural gas consumption was about 221 Bcf, more than half of what the country produced" (EIA, 2015). In the future, natural gas consumption is projected to rise as industrial sector growth and growing electricity consumption will continue to increase demand for natural gas.

In Europe, Italy is the third largest natural gas consumer with the majority of Italy's total gas supply coming from imports. Natural gas is used mainly for electricity production that one-third of it came from gas-fired power plants in 2013 (EIA, 2016). Whereas, after the economic crisis that hit the European Union since 2008, natural gas consumption declined steadily in Italy. The same trend can be observed in the case of Spain also, which is the seventh-largest natural gas consumer and was once considered as one of the fastest-growing natural gas markets in the Europe.

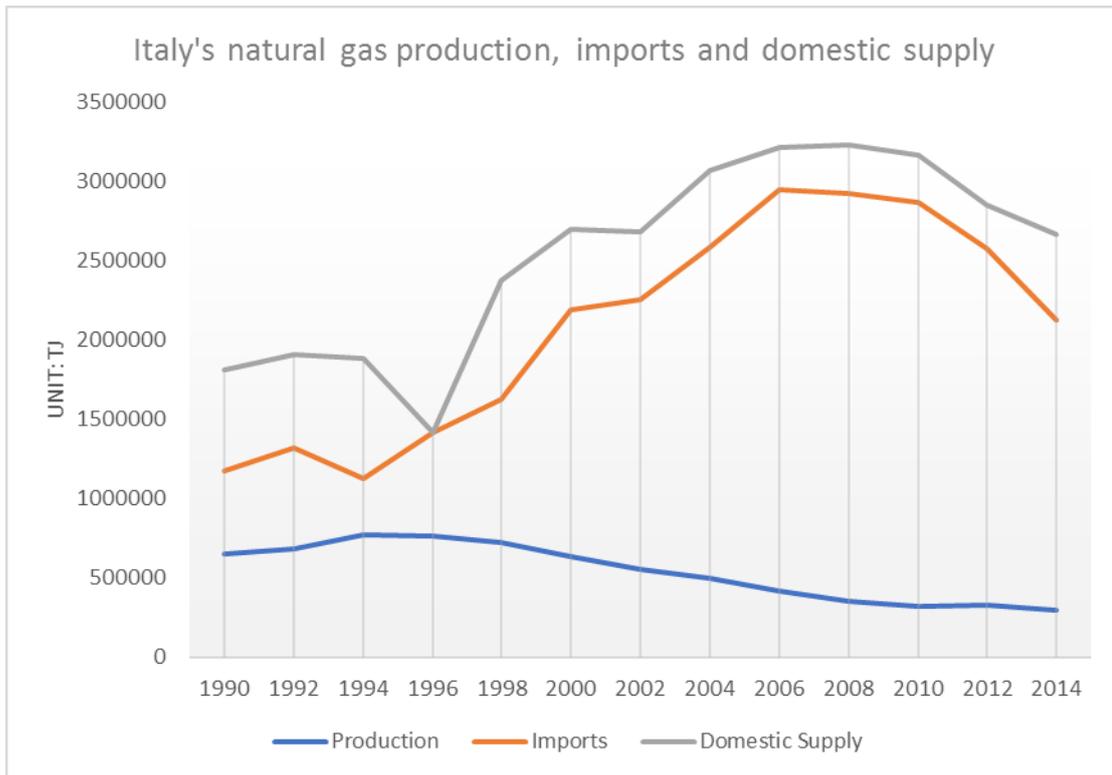


Table 7: Italy's natural gas production, imports and domestic supply, Source: IEA

Finally, in the Balkans, Croatia, Bosnia and Herzegovina, Slovenia and Greece are part of the regional gas trade, although they don't import significant volumes. On the other hand, there are other Mediterranean countries such as Montenegro, Cyprus and Albania, that don't have the necessary gas infrastructure and, thus, they do not consume gas.

## Infrastructure

Infrastructure is a critical issue for the energy sector. Energy infrastructure includes the physical assets that are vital for serving and supporting the energy value chain from production to consumption, comprising services and facilities necessary for the economy to function and meet the needs of society. Mainly, it is costly technical structures that are owned and managed by governments or by private companies. Often the term critical infrastructure is used for energy infrastructure in order to distinguish them; since if significantly damaged, they could cause serious disruptions or even could result in a public safety hazard.

“The main characteristics of energy infrastructure projects are their capital intensiveness, asset specificity, long-life of assets and long gestation period.” (La Sapienza, 2015) Mainly, energy infrastructure tends to be capital intensive, since the initial investment requirement is often high, and has a high degree of specificity. This specificity in combination with the long life of assets increase the risks and uncertainties about the possible costs and benefits in future. Additionally, another significant risk is related to time-lag between investment decisions and realization of a project. This requires that any investment decision should be based on a careful projection of future market conditions and strategies to manage them, since any possible changes in the business environment during the implementation of a project can jeopardize the investment.

More specifically, in the natural gas industry investment decisions require a more careful consideration, since investment requirements are higher infrastructure-related costs and initial investment costs. On the other hand, the benefits are hard to be identified and estimated because there is no a global gas benchmark price and gas producers, generally, are required to define their targeted market and find a large consumer who is eager and in a position to pay a remunerative price for the gas (Battacharyya, 2011).

The investment decisions rely on the cost-benefit framework. Therefore, before any investment decision, an economic analysis is vital in order to identify and select the most economically effective project by identifying and estimating the costs and benefits related to an investment; and comparing them. If the benefits exceed the

costs, the project is considered as acceptable and feasible; otherwise it is not (World Bank, 1996).

### ***Natural Gas & Infrastructure***

For natural gas, there is a necessity of extensive infrastructure that is able to efficiently produce, store, and transport natural gas from producing regions to consume markets. Natural gas infrastructure is mainly consisted of a complex network of transmission, gathering and local distribution pipelines, natural gas processing, LNG and storage facilities (NPC North American Resource Development Study, 2011). Unlike crude oil or coal, natural gas needs a specific infrastructure in order to be transported from producing regions to the market-end users. Natural gas can be transported via pipelines or LNG, but pipeline is the only way to move significant quantities.

The most common method of gas delivery is the transmission via pipelines. Transmission pipelines receive gas from the midstream facilities (gathering or processing facilities) and deliver this gas either to end users, local distribution companies, or to other transmission pipelines for further downstream transportation (NPC North American Resource Development Study, 2011).

There are three major types of pipelines: gathering pipelines, interstate pipelines and distribution pipelines. At the regional level, transmission via pipelines is the most appropriate choice, since it is easy technologically and more competitive in economic terms. However, according to Matteo Verda (2015), “pipeline transport entails two main limitations; the first is the dramatic increase in cost for long distances, especially when offshore sections are required” and “another limit is represented by the strong interdependence between exporter and importer that a pipeline entails: in the case of a problem upstream, the consumer cannot use the pipeline to import gas from other resources.”

There is no typical pipeline as far as cost is concerned; construction costs depend on geographical area, size of pipeline, location, on or offshore, number and size of pump stations or compressor stations and related facilities, and general economic conditions (Kennedy, 1993). Generally, costs for an offshore pipeline are significantly higher than for a pipeline on land.

The cost of building pipelines can be significant, and an infrastructure project must be assessed as feasible and economically favorable before the final decision given the realities of the economic and social environment in which it will operate. “Therefore, “transporting” natural gas through the pipeline must generate sufficient revenue during its operating lifetime in order to justify the upfront capital investment.” (U.S. Department for Energy, 2015) Revenue from pipelines mainly depends on the demand for natural gas and natural gas prices. Natural gas demand is highly seasonal, however during peak periods or due to transmission disruptions gas prices could spike.

“Because pipelines are not moved once they built, new pipelines or modifications to existing pipelines are required when production in a supply basin grows and reaches pipeline takeaway capacity constraints out of the region, or when demand in a market area grows to exceed the pipeline system capacity to deliver into the region.” (U.S. Department of Energy, 2015) Therefore, the development of new natural gas pipelines is determined by the market fundamentals of supply and demand; and natural gas price differentials between two locations or “hubs”.

Additionally, due to the current general political instability and the insecurity that gives to the pipelines, LNG became a resilient way of delivering mobile gas, that can provide the fuel to a greater number of markets (Saleem, 2014) and especially distant markets, whose access through pipelines is uneconomical and not commercially-viable. In this process, gas is cooled and liquefied at -162 centigrade at atmospheric pressure, occupies only 1/600th of its original volume when it is in liquefied form, and can be transported via special tanks. Regarding the quality of gas from LNG, “may be superior to piped gas in terms of energy provided on combustion since impurities are often removed during the processing of LNG.” (Saleem, 2014).

As weaknesses of LNG, we can consider the high cost of such projects especially regarding the development of liquefaction plants, specially designed ships, regasification terminals; and the rise of piracy on high seas. In the past, LNG tankers were constructed in line with the specific characteristics of each project and were designed only for specific LNG receiving terminals. But the creation of a global LNG market mainly due to spot trading required more efficient and safer operation of LNG tankers, a fact that increased the cost. However, nowadays the main disadvantage is

the low oil prices that create a risk of postponing or even cancelling investments in new LNG export projects.

Rational economic behavior and perfect foresight on future demand and prices are two prerequisites for a successful investment. But a variety of barriers may lead to outcomes that differ from those expected by previous analyses and studies, since it is extremely difficult to anticipate credible the potential future market disequilibrium between supply and demand.

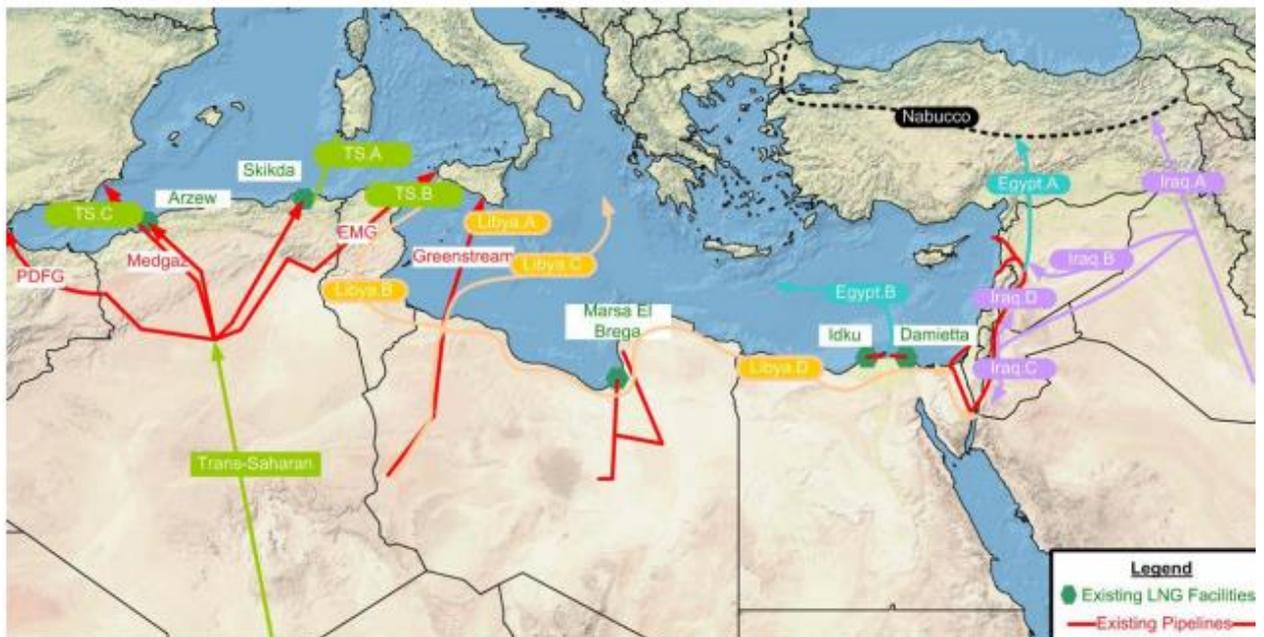
Increased natural gas demand may intensify the need for high-deliverability storage mainly for the natural gas electric power generators. Storage facilities are located close to both production and market areas and they are subjected generally to geological limitations and market forces. Three types of underground storage facilities exist: depleted oil/gas reservoirs, salt caverns and aquifers; and the finding of such sites with the combination of specific characteristics such as geological features, pipeline proximity, and the ability to obtain land, rights and permitting; is extremely challenging. These facilities are designed to meet demand peaks and possible supply disruptions. “Storage helps mitigate pipeline imbalance charges and daily and seasonal price volatility.” (European Commission, 2015) Additionally, in cases when production of natural gas is in excess of demand, storage allows producers to continue production without interruptions that could permanently pose a risk to wells’ integrity. There are three types of underground storage facilities: depleted oil/gas reservoirs, salt caverns, and aquifers. Lack of access to storage can dramatically lead to increased price volatility, thereby many states oblige national or international companies to construct storage facilities in order to enhance security of supply and offer a physical tool for handling any imbalances may occur.

### ***Infrastructure in the Mediterranean Region***

#### **I. Pipelines in the Mediterranean**

Gas trade in the Mediterranean region separates the region into three corridors or three trade zones: Western, Eastern and Central Mediterranean. The Western gas trade zone is stretching from Algeria to Portugal and France via Spain. In the Central

Mediterranean zone, it is Italy, a transit and consumer country, which is interconnected to Balkan countries. However, the situation is not the same for the Eastern Mediterranean zone, which is less interconnected than the others. In this region, Egypt was considered to be the main exporter until 2015, with a pipeline route to Syria, Jordan and Israel. Turkey is becoming also a significant transit country, that has the potential to be transformed into an energy hub in the region.



Picture 4: Natural Gas Infrastructure in the Mediterranean, Source: European Commission, 2015

In the Western Mediterranean, there is a regional gas market among Algeria, Morocco, Spain, France and Portugal. Algeria is a major supplier of LNG and pipeline gas to Morocco and southern Europe. However, according to Darbouche (2011) “a combination of subdued upstream gas development and growing domestic consumption has left the prospects of Algerian gas exports in a worse position than initially intended”.

Algerian gas is transported to Spain via two submarine pipelines. The oldest one is the Maghreb-Europe Gas Pipeline that came online in 1996, has a capacity of 11.5 Bcm per year and runs 1,620 kilometers from Algeria to Spain via Morocco. The latest project between Algeria and Spain, MEDGAZ inaugurated on 1 March 2011 and is stretching 210 Km onshore and offshore with a capacity of 8 bcm per year. The deep-water gas pipeline begins from Beni Saf on the Algerian coast to Almeria in Andalusia. Then the Spanish network forwards the remaining Algerian gas to Portugal and France.

The Spanish system is interconnected with Portugal via the Tuy and Badajoz pipelines; and via the Irun and Larrau with France. However, due to their limited capacities, from 0,1 to 4,2 Bcm, the penetration of Algerian gas in Portugal, France and other European countries' energy markets is extremely restricted. Except of the existing interconnections, there are other two proposed interconnection projects. The first one "Val de Frades" project, a 162-km length pipeline is supposed to come online in 2019 and will have a bidirectional flow with a capacity of of 2,36 Bcm per year from Spain to Portugal and 1,67 Bcm from Portugal to Spain. The second one is the Midcat project, a 25-km long pipeline that will connect Spain and France from 2020 and onwards; and will have a capacity of 2,5 Bcm per year from France to Spain and 7.3 Bcm per year from Spain to Algeria (MedReg, 2015). Supplementary to the new interconnections that will boost natural gas import-export capacity and foster energy trade in the region, increase in the capacity of existing interconnections is also a crucial issue regarding the development and success of the regional natural gas market.

Regarding the Central-Mediterranean part, there are two major gas suppliers Algeria and Libya; and one main consumer Italy. The most significant interconnection of the central Mediterranean is the Trans-med/ Enrico Mattei, a 2,475 kilometers long pipeline, which became operational in 1983 and has a capacity of more than 33.5 Bcf per year. Trans-med pipeline stretches from Algeria to Italy through Tunisia with an extension to Slovenian borders.

The second important subsea interconnection in the region, is the Green Stream pipeline that begins from the the onshore Wafa Field and the offshore Bouri Field and reaches Gela in Sicily. From Gela, the natural gas flows onward to the Italian mainland. The pipeline came online in 2004 and runs 520 kilometers with an annual capacity of 11 Bcm. Because of the political unrest that hit Libya in 2011, the Green Stream pipeline was shut down, but reopened shortly after. Northern Europe and Russia are also major natural gas suppliers of Italy via interconnections with Austria and Switzerland.

Gas Pipeline	Route	Operator	Length	Capacity	Completion
Trans-Med / Enrico Mattei	Algeria- Tunisia- Italy	Sonatrach- Eni	2,475 km	33.5 Bcm/y	1983
Maghreb- Europe	Algeria- Morocco- Spain- Portugal	Sonatrach- Kingdom of Morocco- Enagas- Transgas	1,620 km	11.5 Bcm/y	1996
Medgaz	Algeria- Spain	Sonatrach- Cepsa- Iberdrola- Endessa- Suez GDF	757 km	8 Bcm/y	2010
Greenstream	Libya-Italy	Eni- National Oil Corporation	520 km	11 Bcm/y	2004
Arab Gas Pipeline	Egypt- Jordan- Syria- Lebanon	Egas- ENPPI- Petroget- Gasco- SPC	1,200 km	10.3 Bcm/y	2003
Arish- Ashkelon	Egypt- Israel	Egyptian General Petroleum Corporation- EMI-EGI LP- Merhav- Mediterranean Gas Pipeline- PTT	100 km	7 Bcm/y	2008

Table 9: Most important natural gas pipelines in the Mediterranean Region.

In the Balkans, Slovenia and Croatia have formed a kind of gas trade, since Slovenia is interconnected with Italy with a bidirectional pipeline and Croatia, in turn, is

connected to the Slovenian network. On the other hand, Bosnia & Herzegovina is not a part of this trade scheme, but relies heavily on Russian gas imports. Finally, the other two Balkan countries, Montenegro and Albania don't possess the necessary gas infrastructure, and consequently, natural gas is not part of their energy mix.

"Various ongoing projects have the potential of diversifying trade routes and sources and introduce natural gas to non-gas consuming countries through the region." (MedReg, 2015) In Italy, the Galsi project (Gasdotto Algeria- Sardegna Italia) will strengthen country's central position and will allow the penetration of Algerian gas to the Sardinia Island. The proposed pipeline will run 861 km long with an annual capacity of 8 Bcm through a direct flow.

In the Balkans, two other significant subsea pipeline projects are under construction. The first one, the Trans-Adriatic (TAP) project, whose construction started in 2016 will have a capacity of 10-20 Bcm per year and will transport Azeri gas to Europe. The 870 km-long pipeline is expected to come online in 2020 provided that the Shah Deniz II. field and the TANAP projects will simultaneously develop. The IGI-Poseidon is an offshore pipeline that will connect Greece with Italy. The pipeline is supposed to transport approximately 10-14 Bcm of natural gas per year coming through Turkey via the ITGI pipeline from the Caspian, East Mediterranean and Middle East. Taking into consideration these three projects, Galsi, TAP and IGI-Poseidon, Italy has the potential to become a Central Mediterranean gas hub by 2020.

The natural gas market in the Eastern Mediterranean part is highly fragmented. There are two main gas markets, those of Egypt and Turkey, which are not interconnected. Turkey is the most well-interconnected country in the region, as it receives gas supplies from Azerbaijan, Iran and Russia; and imports LNG gas from 2 different entry points. However, Turkey's exit capacity is limited, as it has only one export point to Greece with limited capacity of gas flow (MedReg, 2015).

Egypt is considered the main natural gas supplier in the Eastern Mediterranean through the Arab Gas Pipeline that starts from Egypt, passes through Jordan, Syria and ends in Lebanon. In 2008, an extension of AGP was built in order to transport Egyptian gas to Ashkelon in Israel. Until now, the lack of alternative sources and limited interconnections set a barrier to the formation of regional gas market in Eastern

Mediterranean. However, the recent natural gas discoveries have the potential to transform the region.

An essential step towards the creation of regional gas market in the Eastern Mediterranean would be completion of the Arab Gas pipeline by connecting Syria with Turkey. Thereby, Egyptian gas will enter Turkey's natural gas market, while regional countries will be able to import gas available in Turkey coming from other regions such as Russia or Caspian. Unfortunately, due to the ongoing civil war in Syria this project is impossible.

In Turkey, the most important under-construction investment projects are the TANAP and the Iraqi interconnection. TANAP is scheduled to transport gas from the Shah Deniz II. and connect to the TAP in order to bring Azeri natural gas to Europe.

As a game changer in the region is considered the recent gas discoveries in the Eastern Mediterranean. These offshore sources have the potential to transform the energy outlook of the region since their development will enable some countries like Egypt, Cyprus and Israel to have their own indigenous production and even to generate extra revenue from exports.

Several investment options for gas exports were proposed, including a pipeline to Greece or Turkey and LNG terminals in Cyprus, Egypt or Israel. However, most of them are running economic or technical difficulties and the most developed one until now is a pipeline from Israel to Jordan, which is scheduled to come online later this year.

"The Mediterranean energy sector has a high degree of interdependence, both for electricity and gas" mainly in the Western and Central Mediterranean that possess sufficient cross-border interconnections (MedReg, 2015). Therefore, close ties and adequate infrastructure are necessary in order to guarantee security of supply in the region.

On the other hand, in Eastern Mediterranean, interconnections are limited and not sufficient to guarantee the formation of an integrated regional gas market. In the near future, though, there are projections that due to energy security uncertainties and the crucial need for supply diversification electricity and gas interconnections will improve along the East corridor paving the way for the creation of a successful regional energy market.

## II. LNG Facilities in Mediterranean

Algeria has four LNG units at Arzew and Skikda with an annual design capacity of 44 Bcm. The country was the world's first LNG producer in 1964 and as for 2014, was "the world's seventh-largest exporter of LNG, exporting about 5% of the world's total exports." (EIA, 2016)

LNG terminal projects have the ability to foster gas trade in Western Mediterranean. On the demand side, France is constructing a new LNG terminal, the Fos Faster terminal with an annual capacity of 18,25 Bcm; while it upgrades the capacity of Dunkirk and Fos Cavaou terminals. Spain, also, started the capacity upgrade of its LNG terminal on the Northern Coast. These three projects only, is expected to bring an additional capacity of 22 Bcm of natural gas per year to the West Mediterranean energy market (MedReg, 2015). On the supply side, Algeria is upgrading the capacity of its Arzew terminal, which will have an additional liquefaction capacity of 6 Bcm per year.

In the Mediterranean, there are liquefaction plants in Algeria, Egypt and Libya; and several regasification plants in Spain (Huelva, Cartagena, Barcelona), France (Fos, Montoir de Bretagne, and soon, Dunkirk), Italy (Panigaglia, Rovigo and Livorno), Greece (Revithousa) and Turkey (Marmara, Ereğlisi), (MedReg, 2015)

Nowadays, Italy has been involved in a great number of LNG projects with six different LNG regasification terminals. The country aspires to bring additional 49 Bcm of natural gas per year to the Italian LNG network in order to lower energy costs. Finally, Malta's LNG terminal in Marsaxlokk Bay became operative in January, when it received the first cargo of LNG that transformed the country into a new natural gas consumer in the region.

In the region, there are only a few countries that possess the desired characteristics in order to serve as a regional gas hub, notably France, Italy and Spain. Greece and Turkey have expressed also their interest, however they both face serious political, commercial and logistical problems that constitute their transformation into energy hubs almost impossible. In addition, according to Oxford Institute (2015) "it is more feasible that South-eastern Europe will have gas priced at a differential (i.e. higher) to that of the other regional hubs, such as Italy, central Europe and even eastern Europe due to lack of competition". Competition is an important indicator driving the

development of the market and its success, since it indicates the willingness of the traders to choose the specific hub and, also, how easy it is for them to participate and trade on this platform.

As regards the infrastructure perspective the creation of a regional hub requires the establishment of a robust interconnection system, LNG terminals and storage facilities. But, under the current low prices and other uncertainties in the energy market, it is projected that the selection of projects will be based mainly on quick and healthy paybacks. The Eastern Mediterranean's transformation into an energy hub, since the region doesn't possess inadequate infrastructure, should start with initial export targets that will be local, flexible and commercially viable; and will not pose high risks.

## Energy Geopolitics

Geopolitics is the battle for space and power played out in a geographical setting (Kaplan, 2014). Cohen (1973) argues that “geopolitical studies the relations between international politics and the geographical base (space), on which these politics is carried out”. According to Leigh (2014) “Traditionally ‘geopolitics’ is founded on the view that international political developments can be explained or predicted by reference to geographic variables. These include the location and size of a country, its population, resources, and degree of technological development. In its classic form, geopolitics is a deterministic theory in which some combination of these variables produces political outcomes.” (Leigh, 2014) The Geopolitics of energy, specifically, investigates and analyses the interaction between energy, security and international relations by observing how energy markets shape international politics and vice versa. Since both are not static, developments in the energy markets are changing the geopolitical landscape that strongly correlates with the national security interests of all countries. Conversely, political decisions lead to changes in the energy markets and global consumers. The main aim of this subfield is to provide knowledge for the conduct of state policy and provide ways of addressing and averting energy security risks.

Nation states are the principal actors in the geopolitics of energy, which possess power and authority to promote self-defined national interests. Central to this tradition is the geopolitical struggle for natural resources. Modern industrial societies are heavily dependent on cheap and abundant fossil fuels for providing the energy essential for modern living and economic growth. As Shaffer (2009) supports “a country’s ability to access energy supplies and the way in which it uses energy crucially determine the state of its economy, its national security, and the quality and sustainability of its environment”. Natural resources have long gained a strategic importance; have shaped the international arena by determining great powers, alliances and outcomes of wars; and have feed geopolitical anxieties. “Whereas the Age of Coal and Steam was the backdrop for the British Empire in the 18<sup>th</sup> and 19<sup>th</sup>centuries, the Age of Petroleum has been the backdrop for the American Empire from the end of the 19<sup>th</sup> to the early 21<sup>st</sup> centuries.” (Kaplan, 2014) Except of financing

wars, natural resources have been considered as an important motive behind several wars and conflicts such as the Gulf wars of 1990-1 and 2003; while also being the focus of inter-state rivalry and strategic denial of access. Michael Klare (cited in Scholvin, 2016), that employs supply, demand and some characteristics of resources in order to explain conflicts among states, argues that “national power in the 21<sup>st</sup> century is determined by the vastness of a country’s resources and its ability to generate other sources of wealth to purchase resources”. Meanwhile, resources are presenting high geographic concentration and uneven distribution underneath a comparatively small area of the world’s surface (Task force 3, 2012). Clearly, access to energy resources is a major determinant of international developments and because of their “territorial” character; they usually generate more territorial stakes than any other economic sector and could affect political stability in both exporting and importing states. Finally, the political environment in which decision on the use of resources are taken is also an important factor that should be taken under consideration and research.

Except of the control of resources, control of commodity networks and trading routes is also a prerequisite in order to achieve an effective exploitation of them and their advantages. Such advantages are large financial rents coming from the control of resources and provide a crucial link between the economy and politics that differs from country to country based on the institutional context in which they are exploited. That becomes more apparent in the case of natural gas, where pipelines crossing regional or sub-regional borders, a fact that indicates the need of a diplomatic approach rather than a merely economic one. As Kandiyoti (2008) points out, “the vital nature of fuel transmission ranks among key geopolitical elements that now regulate relations between states.” And continues that “it is also important to keep an eye on hydrocarbon transmission through international pipelines that may be prevented from functioning in case of conflict or disagreement.” Thus, states choose routes to export or import energy commodities according to their interests by examining and taking into consideration the different ramifications of various route options.

### ***Most Common Geopolitical Risks***

States that possess energy resources used to employ a strategic behavior to promote their national interests and better position themselves in the international arena. That becomes evident in many cases, where states driving by geopolitical competition sacrifice the potential of capturing economic rents from companies along the natural gas chain value; and implement policies that are geopolitical rather than economic (Task force 3, 2012). As Mackinder (1904) notes geopolitics is “the usage of territorial determined comparative advantages in the balance of power between states”.

On the other hand, energy is an important good for all the states that need it to function. Thus, the geopolitical interests of all states are affected by the developments in energy sector; and countries with demand-driven economies for energy resources play an important role and have the capacity to intervene in the energy markets. Recently, a structural shift from the dominance of suppliers to consumers is evident due to the gas oversupply and the growth of LNG trade. Oversupply and supply diversification favor consumers, that are considering now as key players in the international gas markets (Task Force Report, 2013).

The uneven distribution of resources generally has two consequences; it can foster more robust ties and cooperation between states due to economic interdependence or can generate conflicts. Additionally, countries’ foreign and domestic policies play a crucial role in whether a number of gas projects are realized and come online especially as regards pipelines, since they can put in risk huge investments.

Nowadays the greatest geopolitical issue that poses a serious and existential threat to all national states is the climate change. This challenge in order to be tackled successfully requires cooperation from all parts and commitment.

### ***The Geopolitical Context in the Mediterranean Region***

Mediterranean is considered a region that displays a great diversity in terms of population, languages, religions and economic growth; and a big part of it can be characterized as a crisis-ridden region, prone to conflict and fraught with complex geopolitics. Nowadays, Mediterranean has become more dangerous and political

unstable due to a series of conflicts; the “Arab Spring”, the strong presence of Sunni extremist groups, the sectarian war between Sunni and Shia; and a lagging economy in Europe. Another destabilizing factor in the region is the terrorist group known as the ISIS that has taken over several Iraqi and Syrian cities, and threatens to spread terrorism in Middle East through its network. Additionally, the still-unresolved Palestine problem, and the dispute between Turkey and the Republic of Cyprus impede the creation of a reliable natural gas hub in the region. The creation of a Mediterranean gas hub could act as a key source and route for supplying gas to Europe or more distant markets and would present great benefits for all players in the region strategically and economically. Until now, “proposals for pipelines and LNG schemes have emerged, they all face problems related to economics or international relations— or both.” Furthermore, “there are other substantial hurdles to overcome, including lack of pricing transparency, as well as market culture and attitude to gas trading” (Tagliapietra, 2013).

The major conflicts in the region are the Israeli-Palestinian conflict, the division of Cyprus, the civil war in Syria and the ongoing conflict between rival groups in Libya. Although, some of these disputes have lasted for decades and posed significant challenges to national and regional politics; the Syrian conflict is the most prominent nowadays, that threatens to redraw the region’s interstate boundaries.

The Mediterranean, mainly the Eastern part, has become a hotspot for the oil & gas industry after a series of giant natural gas discoveries in Israel, Cyprus and Egypt since 2009; leading many analysts to consider the region and its vast natural gas resources as a “geopolitical game changer” (Leigh, 2014) that has the potential to transform the region and global energy markets. The transformation of Eastern Mediterranean to a natural gas province will inevitably alter the geopolitical landscape, thus creating new opportunities and challenges for each player in the region. These three countries have the potential to create a new natural gas basin, whose exports can enhance the region’s role in the global energy landscape, strengthen energy cooperation in the region and pave the way for a new era of political and economic stability in the region.

Egypt hopes to become a center of regional natural gas development, but the country has been struggling the last years to balance rapidly growing domestic demand due to increased population growth and natural gas subsidies that keep natural gas

prices low. Although, the majority of new discoveries in Egypt are going to be consumed domestically, Egypt has the infrastructure needed for exports and a massive consumer market; two characteristics that made it a vital partner for the development of region's natural gas sector.

On the other hand, the large discoveries in Cypriot and Israeli territorial waters can transform the countries from importers to self-reliant producers of natural gas; and can present a supply for adjacent markets by monetizing further resources through exports. The water depth at the field locations though, increases the costs for their development. Additionally, decisions on natural gas export projects in the Mediterranean are especially likely to be affected by political considerations. Regional geopolitics is the factor that will ultimately determine the development of the region, which has a long history of strained relations. "The lack of agreement on maritime borders and the relatively immature state of development of their energy policies make investment in this region riskier." (Darbouche, 2012)

Israel hoped to export natural gas to Egypt and improve its relationships with neighbor countries such as Egypt and Jordan. Noble made a non-binding agreement with Dutch/Shell to send 7 Bcm every year, for 15 years to the LNG facility at Idku, since the existing Arab Pipeline has only one-way flow and negotiations about its reversion have hit a snag. However, the giant discovery of the Zohr field by ENI thwarted these plans.

Recently, energy has played role contributing to the improvement of bilateral relations between Greece and Israel after their convergence of their interests in major areas and mainly in the Eastern Mediterranean. The prospect of development of Eastern Mediterranean resources has brought also Cyprus and Israel together. Although, these three countries didn't have a dispute, the Greek and Cypriot stance was always pro-Arabic, while the Israelis were close allies with Turkey until the Mavi Marmara incidence when their diplomatic ties were disrupted. However, in June 2016 Israel and Turkey have finalized a deal to end the six-year diplomatic rift and paved the way for a possible major natural gas deal since Turkish companies expressed interest in Israeli gas. Right after, Cyprus Energy Minister Georgios Lakkotrypis, and Egypt's Minister of Petroleum and Mineral Resources Tarek El Molla signed a deal on 31<sup>st</sup> of August 2016 paving the way for further negotiations on a submarine pipeline from

Cyprus' offshore fields to Egypt in order to be used either for domestic consumption or re-export to energy-starved neighbors such as Jordan (Offshore Energy Today Staff, 2016).

Athens, Jerusalem and Cyprus share significant energy interests; and they are committed to implement the 1982 UN Convention of the Law of Sea to facilitate the exploration and exploitation of the seabed. In contrast, "Ankara has not signed on to UNCLOS and favors a settlement in the Aegean and the Eastern Mediterranean that would take perceived Turkish interests into greater account" (Karagiannis, 2016). The strengthening of ties with these countries created a new geopolitical bloc in the region. In this light, the cooperation of those 3 countries and their shared interests make Athens to announce in 2014 an international tender for the preparation of a feasibility study of an Eastern Mediterranean pipeline that will carry Israeli and Cypriot gas to Europe via Crete and the Greek mainland. Later, the European Commission has included the proposed pipeline in its list of "projects of Common Interests" that could receive financial support by the EU. Greece has as an ultimate goal to assume the role of a regional natural gas hub and act as a gateway to South East Europe, however, the domestic economic instability and the lack of inadequate infrastructure such as storage facilities work against this aspiration. According to some analysts, "the plans and ambitions of small and problematic players such as Greece will easily be smashed." (Stambolis, n.d.)

On the other hand, Turkey initiated recently the formalization of its diplomatic relations with Russian and Israel based on a specific interest, namely energy. Turkey aspires and has the potential to enhance its role in the region as an important energy player that constitutes a transit country between the East-West and the South-North axes. Turkey believes in the creation of a natural gas basin in the Eastern Mediterranean and supports the construction of a pipeline that will transport Israeli gas to Europe through Turkey; since geopolitical tensions between Cyprus and Turkey constitute the creation of a pipeline between those two countries unlikely. The construction of a pipeline passing through Turkey will enhance its strategic importance

as a transit country, will satisfy its energy needs<sup>1</sup> and promotes its policy of becoming a natural gas hub. In the same time a pipeline transporting gas to Europe will contribute to continent's energy security and diversification process. This project has cost-benefit advantages and is considered economically and technologically feasible, in contrast with the proposed East-Med pipeline that runs into technical difficulties due to the seabed between Cyprus and the Greek coast; and very high costs. But first, Turkey has to adapt its natural gas market laws in compliance with the principles of free market competition and liberal pricing policies; and, in the same time, has to upgrade its LNG and storage capacity.

From 2012, Syria has seen the total suspension of activities involving the exploitation of oil and gas fields following the conquest of the country's main wells by the Islamic State. Energy companies, active in the country, forced to abandon Syria with the imposition of international sanction in 2012 (EIA, 2015).

Algeria, Libya and Tunisia, on the other hand, due to the enduring political instability have long been risky operating environments for oil and gas operations, since regional physical assets and personnel have been targeted -mainly by terrorist organizations- and come under threat. These incidents have made investment decisions in the region extremely difficult for energy companies because these specific infrastructures are extremely costly and highly distributed, some of them in remote areas constituting their protection difficult.

Sectarianism has become, nowadays, the biggest threat to region's stability. A sectarian strife between Sunni and Shi'a- a war ranging across Lebanon and Syria- desires to revive the structure of the regional order. These clashes and proxy wars have elevated concerns about infrastructure vulnerability and other subsequent political risks.

Albeit commercial appeal, the creation of an integrated Mediterranean gas hub will depend not only on foreign policy considerations but, also, on domestic policies. "Even in Israel, investors have faced difficulties. Energy security is a sensitive topic in a country that sees itself as a politically isolated in the region. Many Israelis are uneasy

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<sup>1</sup> The Turkish economy is dependent on fossil fuel imports. The main denominators of Turkish energy consumption are coal, oil and natural gas. However, except of coal that is domestically available in significant amounts, the other two are coming mainly through imports.

about the country exporting its natural wealth.” (Nakhle, 2016) As for Egypt, the government’s policy to divert natural gas supply for exports to meet demand, the low prices that the government is willing to pay to foreign operators and the inability of Egyptian General Petroleum Corporation (EGCP) to pay off its debts to foreign operators lead to investment delays and accelerate investors’ anxiety (EIA, 2015). Except of the aforementioned, “the declining oil and gas prices has amplified the difficulties in the region and brought into question whether developing the fields is commercially viable.” (Nakhle, 2016)

Egypt appears to have the largest offshore capacity in the region, yet most of its production will probably be exploited and commercialized in the domestic market. Egypt is the only country in the region that possesses the required infrastructure and can commercialize its production through exports mainly in the form of LNG from its LNG terminals at Idku and Damietta. Also, Egypt could use the Arab Pipeline; however due to the Syrian civil war, the terrorization of the Sinai region and gas developments in Israeli, LNG provides country with access to more distant and better-positioned markets. Egypt’s LNG exports dropped from a starting level of about 15 bcm/y in 2005 to almost zero in 2014, leaving the country’s two LNG plants completely idle (Tagliapietra & Zachmann, 2013). In addition, the proximity of the three fields Zohr, Aphrodite and Leviathan, allows the development of the fields to be coordinated by bringing Israeli and Cypriot gas to the Egyptian underused LNG Terminals -both terminals can be expanded and provide a flexible outlet. This solution, according to many analysts, is the most prominent and sensible option that minimizes political and especially commercial risk, for instance if the field underperforms. “Consequently, bringing together an underused and scalable export infrastructure with several promising fields could be the key to unlock untapped regional potential.” (Tagliapietra & Zachmann, 2013)

Lebanon although there are serious indications that possess vast natural gas reserves, had been stuck in a political stalemate since May 2014, when the parliament failed to elect a new president after the end of Michel Sleiman’s term; until recently in October, when General Aoun managed to secure the support of enough parties. This political stalemate has halted for years the country’s once-hopeful energy potentials and dented investor confidence.

### ***A Mediterranean Natural Gas Hub***

“The politics and economics of Mediterranean energy are rapidly changing. The resources could reshape local domestic economies, frame regional geopolitics and provide an alternative source of gas to Europe, reducing its dependence on Russia” (Nakhle, 2016). Local economies can reap big economic benefits, once gas become commercial. Regional players from their part should strengthen the energy cooperation, which can also pave the way for a new era of economic and political stability in the Mediterranean. The combined resources of Algeria, Libya, Egypt, Israel and Cyprus advocate the creation of a natural gas hub in the Mediterranean. For the creation of a gas hub in the Mediterranean, establishment of a robust interconnection system, LNG terminals and storage facilities is a prerequisite. But considering the capital intensity of such infrastructure projects, the current pricing and the political dynamics in the region create serious challenges for such immense investments. Specifically, the Eastern Mediterranean region in order to develop its energy sector economically and physically, first has to resolve crucial political constrains, long-standing disputes, regular corruption incidents and governance issues.

Therefore, countries should engage diplomatically and cooperate towards the creation of the appropriate infrastructure. For instance, the strategic alignment between Cyprus, Greece and Israel represents a new element in the regional geopolitical landscape. On the other hand, “absent of collaborative vision could represent a potential element of destabilization in the region and also a source of new tensions with Turkey” since the creation of this energy axis is opposed to Turkey’s objective of becoming a regional natural gas hub.

For this role, Italy is considered one of the most prominent actors in the region to assume a leading role in this project with the support of the European Union that desires to create a Mediterranean gas hub in the South of Europe in order to diversify its energy supplies and routes. In order this project to complete successfully, it requires strong cooperation between European countries, increase of interconnectors

and a strong diversification policy that could trigger infrastructure investments from Africa and the Middle East moving away from their traditional major supplier Russia.

Finally, regarding infrastructure, the creation of an energy hub in the region requires vast investment in regasification terminals, storage facilities, pipelines and shipping vessels. Except of the physical market, countries must adopt their energy laws in compliance with market rules such as third party access, removal of destination clauses and the unbundling of companies that trade gas, operate pipelines or LNG terminals; and distribute gas to consumers.

## Conclusions

Today new resources create new geopolitical opportunities and challenges, and as climate issues move to the fore of the global agenda the situation is becoming more complicating for policy makers and the industry. Therefore, there is a growing need for countries to engage in international cooperation in order to deal successfully with energy issues and tackle subsequent security challenges. “Political will is needed to resolve conflicts and to bring about strategic realignments.” (Leigh, 2014).

In the Mediterranean region, the energy sector generally indicates imbalances since some countries for instance Algeria, Libya and Egypt hold vast fossil fuel reserves; while others mainly in the North part of Mediterranean are the largest consumers of natural gas (i.e. Italy and France). Except of the previous, there are also countries in the region that do not use natural gas as fuel such as Albania, Cyprus and Lebanon. Therefore, the region has “the potential to become the marketplace where two significant amounts of supply and demand meet” (MedReg, 2015). However, geopolitical or environmental drivers are likely to play a critical role in the pace of gas development and substitution in power and transportation if a transformation is to occur in the region.

The combined resources of Egypt, Israel, Cyprus, Algeria and Libya advocate the creation of a natural gas hub in the Mediterranean. For the creation of a gas hub in the Mediterranean, establishment of a robust interconnection system, LNG terminals and storage facilities is a prerequisite. But considering the capital intensity of such infrastructure projects, the current pricing and the political dynamics in the region create serious challenges for such immense investments. Therefore, countries should engage diplomatically and cooperate towards the creation of the appropriate infrastructure.

As a result, the resources could reshape local domestic economies, frame regional geopolitics and provide an alternative source of gas to Europe, reducing its dependence on Russia” (Nakhle, 2016). Regional players from their part should support energy cooperation, which can also pave the way for a new era of economic and political stability in the Mediterranean.

However, the development of an energy hub is not an easy task and requires time and strong commitments of governments, suppliers and system operators. It requires, also, inadequate infrastructure and significant levels of capital investment, which is affected by the fluctuating levels of supply and demand, two indicators that produce prices signals that elicit a subsequent infrastructure investment response. This requires that any investment decision should be based on a careful projection of future market conditions and strategies to manage them, since any possible changes in the business environment during the implementation of a project can jeopardize the investment. Future anticipations are extremely difficult to be made, since disruptive technologies, policies, disasters, conflicts and environmental concerns can impact market uncertainty and alter dramatically the supply and demand projections; and only if existing infrastructure is effectively used the level of investment could be lower.

The Mediterranean region has the potential to transform into an important natural gas hub and towards this direction the Mediterranean countries should support trade, encourage new market players to participate and develop the adequate infrastructure. Except of the infrastructure task, it is crucial that the regional gas markets should follow the rules of the market; and should develop a liquidity and hub-based structure that will be transparent and will ensure fair access to all participants without discrimination, if they fulfil the appropriate industrial and economical standards.

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