UNIVERSITY OF PIRAEUS
Department of International & European Studies
MSc in Energy: Strategy, Law and Economics

Master Thesis

LNG Evolution

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Athens, 2021

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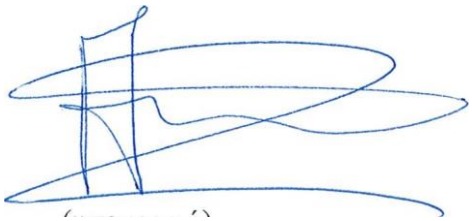

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DEDICATION

This dissertation is especially dedicated to the men of my life, my husband and my two little princes. They are the ones who give me the strength to fight and dream. It was with their support and encouragement that I decided to register in this Master Program. Thank you so very much for being, always, by my side!!!

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Chapter 1: Introduction

As the concern for the environment has been increased, the conversion to LNG fuel assists in reducing the radiations of the gases that create the greenhouse effect, as well as improving the quality of air. This is because natural gas burns in a cleaner way than gasoline and diesel do, which results in less pollution and greenhouse gases to be produced.

Carbon dioxide emissions, which are the fundamental greenhouse gas that contribute to the global warning, are aimed to be reduced by 30% by the use of LNG. Also, when is used as a basic fuel in vehicles, LNG emits up to 95% less nitrogen oxides ($NO_{x)}$. This dissertation, also, aims to present the development of LNG from zero to growth and what is happening to the three fundamental markets, the Asian, the European and the one in USA. In order for this to be achieved, the methodology that was followed involves desktop research through search engines, international energy organizations, major suppliers' reviews etc. This thesis will be divided into seven basic chapters. Chapter 1 will describe LNG's evolution from zero to growth and there will be presented what is going on to Europe, Asia and the USA. Also in the first chapter, the driving forces to renew the interest in LNG will be provided. Chapter 2 will present the production in Europe, Asia and the USA where there will be analyzed, in particular, the market liberalization and competition. In Chapters 3 to 5 there will be presented one by one the above three mentioned markets. In Chapter 6 there will be an analysis of LNG price and market dynamics. Finally, Chapter 7 will present issues involving LNG shipping. Lastly, there will be the conclusion and the bibliography. What will be well comprehended throughout this thesis is how important the contribution of this essay is regarding LNG as a means of energy usage and protection of the environment at the same time (*Environmental benefits of fuelling with LNG*, 2021).

Chapter 2: From zero to growth.

2.1 Introduction

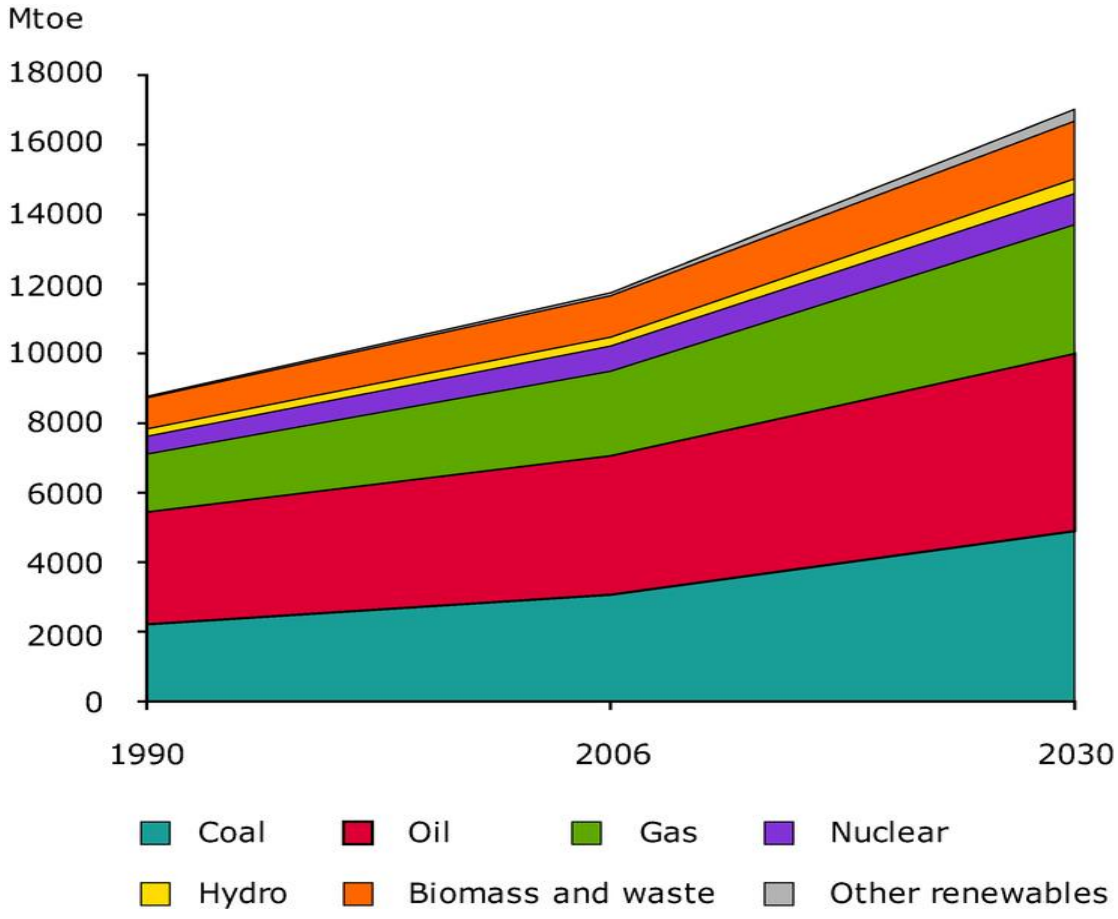
In this chapter there is an explanation provided regarding the increase in consumption in natural gas as part of the overall energy consumption around the world. Moreover, we will investigate the reason why this increase takes place and what prompts the transition to natural gas consumption. As a result, this chapter will be divided in two subchapters. Initially, in the first subchapter an outline of the brief history of LNG in the markets of Europe, Asia and USA will be provided and in the second one the driving forces to renew LNG interest will be shown among which the impact of automation on cost savings which has led to change historical non-profitable trades to more attractive. The thermal efficacy of the traditional steam boilers so that power is generated is limited thermodynamically to about 38%. Finally, how plants have benefited from the increase in competitiveness and efficiency as an effective consequence of increased production and more construction constructors.

2.2 Increase in natural gas consumption

The consumption of natural gas globally increases constantly, both in actual terms and as a percentage of total energy consumption. In Figure 1 we can easily see this progression that relies mainly on the changes in the economic activity patterns, the energy intensity, as well as the substitution of energy. The transition to natural gas from other energy sources, mainly oil, has been the primary catalyst of these changes. Despite the fact that natural gas prices are constantly high lately, also although gas has received no significant privileged attention over other energy sources, demand has remained high as well. Thus, as consumption of gas rises in a global scale, the distinction among regions whose consumption is based on natural gas and regions whose natural gas' supply will turn out to be more pronounced (Ishwaran et al, 2017). Dominant Natural gas import countries are the nations, which are members of the Asian OECD and Europe while the late Soviet Union states, the Middle East, and North Africa are the dominant countries to export natural gas. The disparity between natural gas

output and use is widening, necessitating increased trading rates to get supply and demand back into equilibrium. This need is perfectly described on the following Figure 1., as the consumption of natural gas worldwide is getting bigger as the years go by from 1990 to 2030. Natural gas charges are increasingly freed from their relation to what oil is priced as natural gas supply hubs become more and more reputable. Since the market for natural gas has evolved in the United States and Europe, centers that are providers are adequately liquid for competitive trade, and natural gas is traded on its own terms rather than being linked to oil charges (Ishwaran et al, 2017).

Figure 1 Global Total Primary Energy Consumption



Source: International Energy Agency: Total final consumption (2009)

However, although a center for the trade of natural gas in Asia is not impossible to emerge anytime soon because the markets in this particular region are already dominated by the oligopoly of few larger buyers and sellers and thus liquidity in the

market is limited. Taking into consideration the fact that there are imbalances in supply and demand at a regional level, freight costs and limitations as regards trade, natural gas charges are possibly going to endure having variations by region rather than to unite with unified charges at a global scale (Ishwaran et al, 2017).

2.3 What's going on to Europe, Asia & USA

The first tanker shipment of LNG was made from Lake Charles in Los Angeles, destined for Canvey Island in the UK in 1958 onboard the tentative ship, the Methane Pioneer. Afterwards, the first commercial exchange, the CAMEL project, which was aimed at supplying Algerian gas to the United Kingdom and France, began in 1964. By 1969, three more commercial exchanges emerged: a further transfer from Algeria to France, one from Libya to Italy and Spain, and the first Pacific mission from Alaska's Cook Inlet to Japan (Jensen, 2004).

As the initial shipments from Algeria were relatively short hauls to Europe, deliveries to the United States began in 1972 for a small Distrigas (Cabot) project in Everett, Massachusetts. El Paso Natural Gas started delivering in 1978 for much larger contracts with Columbia Gas in Cove Point, MD, and Southern Natural in Elba Island, GA. They were accompanied by the launch of the Lake Charles Trunkline project in 1982. The early US ventures were established during a time of rapid transition in the global energy markets. The price shock caused due to oil, as well as the extensive nationalisation of foreign oil enterprises' business places within OPEC and the consolidation of the North American gas industry, were all part of this. Although LNG imports into Europe increased, the North American trade almost plummeted, dampening what had been projected to be a significant rise in Atlantic Basin (Jensen, 2004).

With the considerable stoppage in interest as regards LNG in the Atlantic region, the emphasis was put to the Pacific region with Korea and Taiwan meeting Japan as importers. On the contrary, Europe and the United States have risen by 0.76 BCM annually. Since 1996 the Atlantic Basin markets have commenced to set off, so that the average Atlantic growth has been 3.97 BCM per year compared to Asia’s 4.22 BCM. These are roughly equivalent to the capacity of a more modern 3 MMT train. With the Asian markets being growing continuously, the main providers were from the Asia Pacific region – Indonesia, Malaysia, Australia and Brunei. The first Middle East project being launched from Abu Dhabi back in 1977, but there was no important growth until the major new projects from Qatar and Oman in the late 1990s started (Jensen, 2004).

In a similar fashion, the slow progression of European and US markets until lately restricted were the suppliers of Atlantic Basin to Algeria and Libya. With the beginning of the novel liquefaction plants in Trinidad and Nigeria in 1999 the Atlantic Basin providers are now on the brink for sizeable expansion. Indonesia has been the worldwide's leading provider, but Qatar in the Middle East and both Trinidad and Nigeria in the Atlantic Basin are rising their export activities in a substantial manner. Egypt, as not yet being an exporter, there are two LNG services under structure and is seemingly intended to be a major LNG provider (Jensen, 2004).

2.4 Driving Forces to Renew the Interest in LNG

A variety of causes have come together to rekindle interest in LNG. Combined cycle power generation to meet the rising needs for electricity. The impact of automation on cost savings has changed historical non-profitable trades to more attractive. Additionally, environmental concerns that have arisen and, also, support of gas by formerly 'gas poor' economies. Moreover, the increasing concern for conventional supplies as there is potential for growth. Finally, the 'stranded gas' phenomenon (Jensen, 2004).

The thermal efficacy of conventional steam boilers so that energy is generated is restricted from the thermodynamical aspect to about 38%. But, by installment of a high-temperature gas turbine on the front end, and then recuperating the high temperature turbine discharge for steam production in a heat exchanger thus creating – a 'combined-cycle' (or CCGT) unit – can accomplish thermal competences approaching 60%. Furthermore, these units have low maintenance costs, are available in smaller, market-friendly models, and have fast preparation lead times. Since the engines are like those used in jet aircraft, the fuel must be natural gas or a high-quality distillate product. For electric markets all over the world, CCGT units have been the preferred power generation system. Technology has assisted in achieving it possibly as a need to build new LNG production services and tankers with significant cost savings in the last five to ten years. As a result, previously unprofitable trades have become appealing. A number of factors have contributed to the lower liquefaction costs (Jensen, 2004).

Plants have benefited from increased competitiveness and efficiency as a result of increased production and more construction constructors. With more diverse sources, the industry has been less concerned about including redundancy – also known as "gold plating" – to ensure operational reliability. However, increased plant sizes and the associated economies of scale have resulted in significant changes. Expansion with one modern 4 MMT liquefaction train will reduce liquefaction costs by 12 percent. As compared to the two 2 MMT trains that were popular ten years ago, the promotion of an international LNG market has increased by around 25%. The costs of tankers have also decreased. Perhaps more of this improvement is due to increased operation and the resulting rivalry for business among shipyards. However, increased tanker sizes have changed economies, but the volume changes have become less pronounced due to the smaller size increases. In comparison to the 125,000 cubic meter tanker that held in a period of time before ten years, a new 140,000 cubic meter tanker could lead to savings of about 5% in costs. Nigeria is a good example of how today's optimism towards LNG economics has evolved (Jensen, 2004).

After thirty years of on-again, off-again industry negotiations about an LNG project, a confederation of Shell, AGIP, Elf, and the Nigerian National Petroleum Company began talks in the mid-1990s on what would become the Bonny LNG project in Nigeria. Initially, the sponsors were unable to show financial viability for a project aimed at the Italian and American markets. They cut project costs at an adequate rate to make it economically feasible by taking very low-cost options on seven laid-up LNG tankers at a period when the price of new constructs was at an all-time peak (Jensen, 2004).

Given the plans, prices, and consumer price demands of the time, it is depicted that the economics that a new Nigerian greenfield project intended for the US Gulf Coast would have faced in 1998. The project was clearly condemned from the outset, as the initial netback from the planned Gulf Coast market price to the liquefaction plant's inlet was negative (-$0.21). The increases in netback as a result of employing new cost forecasts for the initial scheme, as well as the design changes in plant economics as a result of expanded plant sizes – two 3.75 MM ton trains instead of three 2.5 MM ton trains (Jensen, 2004).

The common mid 1990s perspective of relatively low prices for 2010 – exemplified by the 2001 Annual Energy Outlook of the EIA – has been adjusting. The 2004 AEO price projection was 32% higher for 2010. The outcome of these enhancements is

remarkable. From a netback of -$0.21, the alterations have boosted the netback into the plant gate to $1.04. Concerns regarding the environment constitutes evidently a driving force in raising awareness in natural gas and in LNG. Not only is gas fundamentally free of sulphur but also the increasing concern for global warming is a factor which benefits gas consumption. Not only does gas have a higher hydrogen-to-carbon ratio, leading to minimization of CO2 emissions, but also CCGT's higher thermal effectiveness demands less fossil fuel per MWH produced (Jensen, 2004).

Not only does gas have a higher hydrogen-to-carbon ratio, which diminishes CO2 emissions, but CCGTs often use less fossil fuel per MWH produced due to their higher thermal efficiency. Gas-fired CCGT systems can reduce CO2 emissions by around 40% as compared to coal-fired boilers. The fundamental economic progress of several emerging market countries, along with the introduction of gas-fired CCGT power production, has made them point for import activity as regards LNG where natural gas was formerly unjustifiable. This party includes India, China, and Turkey, to name a few (Jensen, 2004).

However, some countries that have previously relied on natural gas are now seeing it as a way to address supply issues or diversify their suppliers. This is unquestionably the case in the United States. This is also so in the United Kingdom. The UK was supposed to be a basic exporter to the Continent as lately as 1998, when the Interconnector Pipeline was launched to link Bacton in the UK with Zeebrugge in Belgium.

Spain, for a separate reason, has sought to differentiate its strong dependence on one country – Algeria – by heavily investing in LNG import markets. The rise of concern over "stranded coal" is another cause which has fueled increased interest in LNG. Companies looking for oil in foreign business places used to regard a gas finding as a "dry pit," abandoning additional exploration. Organizations are far more likely to focus on gas exploration opportunities now that the likelihood of new oil discovery is dwindling in many areas and the inventory of gas discoveries is growing.

2.5 Conclusion

There has been a rise in natural gas consumed because of a shift from the consumption of other energy sources such as oil although the fact that the prices are high. The markets that dominate nowadays regarding natural gas involve countries being members of the Asian OECD and Europe while countries such as Ex-Soviet Union, Middle East and North Africa are dominant in natural gas exports. The prices for natural gas are gradually freed while there is no such possibility as pertains to the formation of a natural gas trading center in the Asian Market. Moreover, across the chapter historical issues explained how the interest was intrigued in the various countries which import or export LNG as well as the driving forces on how interest in LNG can be renewed.

Chapter 3: Production in Europe, Asia & USA

3.1 Introduction

Main emphasis is put in this chapter in the markets of Europe, Asia and USA in which trading gas hubs have started to promote growth of LNG. For example, the gas hubs that were started by UK and other placed across the European continent. Additionally, it will be seen that the interest of Europe will be towards the virtual trading hub rather a trading one. Finally, it will be seen the effect of the prices that were freed as well as the impact of the liberalization of the market in terms of competition.

3.2 Gas hubs

Gas hubs in Europe started in the United Kingdom in 1996 and spread across Continental Europe in the 2000s, however growth has been inconsistent. The National Balancing Point (NBP) was founded in the U.K. in 1996 and is Europe's first gas operating center. Throughout the 2000s, gas trading centers sprung up all over the EU, following the UK's lead. Belgium's Zeebrugge (ZEE) became the first continental gas trading center after the Interconnector pipeline was completed and started operating in October 1998, connecting it to the UK NBP industry (Shi, 2016)

Europe is interested more in creating a simulated operation hub than a physical since virtual trading hubs can lead to trade agreements that are characterized by more flexibility and are more accessible to participants, especially financial players (IEA, 2013). Except for Zeebrugge in Belgium, most European hubs are automated. The Interconnector meets the Belgian distribution grid in Zeebrugge, which serves as a physical node (IEA, 2012). The physical hub needs brokers to transport their gas there however dissuading many traders from doing so (Shi, 2016).

The level of growth varies greatly across Europe's active hubs. The most mature hubs are in Northwest Europe with Central Europe following, and gas hubs in Southern Europe are also in their infancy stage. As it is implied by a report published by the

European Commission in 2013, the share of gas hub trade differed considerably among the specific places. It was 80% of the overall natural gas spent in Northwest Europe. In Central Europe, the figure was slightly lower, amounting around 50%. Southern Europe, on the other hand, relied on gas-to-gas competition for just about 15% of its gas consumption. It should be noted that Southeast Europe is entirely reliant on oil-indexed contracts (Shi, 2016).

Although some European gas hubs have proven to be successful, others have not matured and have even gone stopped operating. Successful hubs include the NBP in the U.K, the Title Transfer Facilities (TTF) in the Netherlands, and the Net Connect Germany (NCG) in Germany. The British NBP and the Dutch TTF are the two most established European gas hubs, according to the measured output of European gas hubs in 2014 and 2015. In the most recent evaluation, the two German hubs as well as the two Belgian hubs improved a lot (Shi, 2016).

German Gaspool and Net Connect Germany (NCG) entered late into the hub-based exchange, but they are both well-renowned for their high trading volume growth rates (liquidity). The other hubs, on the other hand, are less involved. PEGs, CEGH, PSV, and GTF are also in a good state. The gap between hubs is more significant as measured by churn rate, a common predictor of hub performance (Shi, 2016).
As Heather (2015) supports, in 2014, both NBP and TTF had a churn rate of more than 20, which was far above the minimum of 15 that Gazprom allegedly needed for a respectable (liquid) center. The German, Australian, and Belgian hubs, on the other hand, had a stir rate of 3e5, whilst the remainder of the hubs had a churn rate amounting less than 2. The hubs in France and Italy have underperformed.TTF is the only trading price benchmark in the European continent's gas markets, with other hubs charged as premiums with TTF rates. Despite its strong results, ZEE does not serve as a point of reference due to the fact that its charges are highly connected to those of NBP (Shi, 2016).

Despite the fact that many hubs are relatively efficient, only two, NBP and TTF, are considered hubs that constitute point of reference. Despite the fact that the Netherlands' TTF was established after the NBP, it has been the level to which European end-

consumer contracts are measured. TTF has grown rapidly and consistently in recent years and is widely regarded as a success story. NBP had a strong beginning and was competitive, but in 2014, TTF overtook NBP in terms of annual traded volume. Based on monthly transactions, TTF surpassed NBP as Europe's most liquid gas hub in July 2015.

TTF's rise to the top of the gas trading hubs has led to the creation of some opportunities. As Germany started renegotiating its long-term contracts with Gazprom in 2009, Gazprom refused to adhere to Germany's hub rates, claiming that the German's utility sector, which are the main owners of German gas hubs, could exploit them. In the same manner, the German hubs were rejected even by their domestic equivalents. According to expert interviews, NBP rates, as the most liquid market at the moment, were also rejected by Gazprom and the German parties because NBP is priced in Pence, putting continental firms at risk due to currency exchange rates (Shi, 2016).

Instead, despite its relatively low turnover rate of 3.3 at the time, TTF prices are accepted by both Russia and German parties as reference costs for Russian-German contracts since TTF was the most mature trade center in Continental Europe after ZEE and TTF are priced in Euro. TTF prices are also neutral on both parties: German firms were not significant in TTF and therefore did not exploit TTF prices. Companies began to hedge in TTF after it was included in long-term contracts, further increasing its liquidity (Shi, 2016).

After the creation of TTF, other European owners of hubs have shown little interest in improving their hubs due to the fact that they believe that the liquidity in the market is insufficient. In spite of the success in developing numerous centres, there is currently no cross-country regional centre. None of these European centres was transnational as of 2012; they are all national (the United Kingdom, the Netherlands, or Italy) or subnational (France, Germany), and there exist over 30 entry-exit zones in the EU (Neumann & Cullman, 2012).

While market area boundaries do not always correspond with member-state borders, one member nation always has one market area, with one operator serving as the area's Transmission System Operator (TSO). However, as infrastructure improves and market liberalization takes hold, gas prices in various European wholesale markets are

beginning to converge. Different hub output in Europe reflects the complexities of applying the EU-wide system of liberalization uniformly and provides lessons for improving current and potential gas hubs in Europe, as well as future hubs in East Asia (Shi, 2016).

Various European gas centers have shown that some key factors are required for gas hubs to develop. The unbundling of vertically integrated gas companies allows the emergence of the industry participants that are needed. The need for trade and liquidity arises as an outcome of the market that has become liberal and the prices which change. The formation of gas pricing centers and transitions are intertwined. On the one hand, the advent of gas trading hubs, which deliver benchmark prices as alternatives to oil-indexed prices, is a crucial outcome of the pricing shift. However, hub development is a crucial factor which enables the price transformation since hubs can stimulate trade and allow markets that are competitive to work (Shi, 2016).

Furthermore, the liberalization and price process necessitates political will, as well as cultural, regulatory, and governance shifts. To combat the influence of those incumbents who will be harmed by market liberalization and price change, powerful political will is needed. In order to compel officials to distribute pipeline capacity and gas market shares, legislative amendments are often expected. Though authority is much needed, domestic production will ease the transition to a gas hub pricing model, and trading tradition will be beneficial in adopting the model (Shi, 2016).

3.3 Liberal Markets and competition

The liberalization of the gas market in its entirety is a prerequisite to develop hubs. There are three possible causes for this. To begin with, market liberalization is needed in order a competitive climate to be established. A significant impediment to hub growth is the lack of competitiveness in the market. Due to a lack from the government's standpoint and willingness to liberalize their gas markets, the hubs in Italy and France have not grown well. The hindrance of establishment of a liquid hub in Italy was due to the inability to create competition in the middle and downstream areas to the level observed in the Northwest European already liberalized market in the 2000s.

It was contended that until recently, there was no clear need in Italy for an efficient industrial and liquid PSV gas center. In spite of the fact that the Italian government is imposing antitrust ceilings and gas releases, ENI remains the leading player, owning storage, the bulk of supply, and import facilities, and trading at the PSV until lately. Similarly, although the Belgian gas market was liberalizing in accordance with what the EU directives provided, the lack of competition in the early stages of ZEE's growth caused changes to be postponed (Shi, 2016).

Second, market liberalization is a critical step in generating wholesale trade demand, which is the primary motivator and essential function of a center. In a monopolistic market, the consolidated firm can handle the majority of injections and withdrawals, as well as offset ex-post supply or demand shocks, by adjusting its portfolio of contracts, and thus has no need for trading. Deregulation in the gas market, on the other hand, causes fragmentation and hence trade demand. Final gas pricing liberalization prohibits prices from being passed on to customers, necessitating trade and competition. Unbundling allows the participants in the market to make use of the hubs to balance their contracts, control their portfolio costs and as thus manage any risk incurred, and even speculate, thus increasing market liquidity (Shi, 2016).

The creation of NBP took place after the privatization of the British Gas Corporation in 1986 and as soon as the Gas Act was implemented in 1995, essentially brought about competition to the national gas industry. The EU's gas market liberalization reached a

landmark when gas markets being dominated by suppliers were rebalanced to better address customer needs. This is a new accomplishment, as analysts recently meaning 2005e2006 challenged industry conditions in which pipeline operators and brokers were the same firms guilty of market manipulation something which was tackled by the 3rd Energy Package (Shi, 2016).

Additionally, gas hub growth is aided by the liberalization of national energy markets, as utilities are amongst the major consumers of gas and are less likely to engage in wholesale gas pricing if they can pass prices on to customers. TTF's experience demonstrates the value of liberalization for hub growth. TTF and its growth, unlike NBP, did not take off until 2009, when a range of industry shifts were put into force. First, the TSO homogenized traded natural gas in July 2009, effectively obliterated the distinction among high and low calorific gases. Additionally, the TSO introduced "Market Based Equilibrium," a real-time balancing regime, in April 2011.

Third, gas industry providers such as GasTerra, Exxon, and Shell have strongly sponsored hub-based trading. TTF exchange volumes increased by 62 percent annually from 2009 to 2011 as an outcome of these robust policies concerning liberalization. TTF may be considered a mature industry by 2012.

The liberalization process entails the redesign of involved industries' corporate structures as well as the introduction of a governing restructuring plan. Miriello and Polo suggested an evolutionary route for the wholesale natural gas industry, which included the introduction of wholesale trading with the aim to balance an uneven market, another source of gas supply as an alternate to long-term gas in the liquid market, and exchanged fiscal apparatuses to mitigate risks (Shi, 2016).

Liberalized extensive markets and final imposing of the charges, unbundling of vertically regulated gas producers, free and clear third party access (TPA), through the implementation of a common network code, suitable legislation for the competition, and hands-off governmental policies are all main factors in progress. The practicable third-party access and open hub pricing provide customers, especially the large ones, access to a variety of suppliers, resulting in fierce competition for large consumers.

3.4 Conclusion

This chapter has presented how the gas hubs started in the United Kingdom in 1996 and spread across Continental Europe in the 2000s, however growth has been inconsistent. What was Europe's interest was the creation of a virtual trading hub than a physical since virtual trading hubs can lead to more flexiblility in the trading agreements and are more accessible to participants, especially the financial players (IEA, 2013). The level of growth varies greatly across Europe's active hubs. An important issue that was set through the current chapter involved the liberalization process which entails the redesign of involved industries' corporate structures as well as the introduction of a regulatory reform program. Miriello and Polo as it was seen suggested an evolutionary route for the wholesale natural gas industry, which included the introduction of wholesale trading with the aim to balance a fragmented market, a second source of gas supply as an alternative to long-term gas in the liquid market, and exchanged financial instruments to mitigate risks (Shi, 2016).

Wholesale markets that are already liberal as well as the setting of final prices, unbundling of vertically regulated gas producers, free and clear access to third parties (TPA), through the implementation of a mutual network code, proper legislation to control competition, and hands-off policies imposed by the government are all main factors in progress. The practicable third-party access and open hub pricing provide customers, especially the large ones, access to a variety of suppliers, resulting in fierce competition for large consumers.

Chapter 4: LNG market in Europe

4.1 Introduction

The main interest of the present chapter involves how the market of LNG works in Europe, how does it diversify as well as important allies it may have.

4.2 The market in Europe

Another significant market for LNG is held to be the EU as years go by and the natural gas resources have been found to assist an increase in production. However, one of the biggest challenges concerning the EU in the framework of becoming a market that is liberalized is that of its security regarding gas. This aspect is significantly essential as in 2030 the dependency on gas dependency might possibly be nearly 90% according to the IEA's World Energy Outlook (2019). The issue of "Russian risk", for instance the market share Gazprom has in Europe and the risk due to the geopolitical position it would engender, is emphasized as one of the most crucial.

It is in this context that the EU has moved towards a process of diversification of its suppliers, either by gas pipelines (with the opening of a new corridor from the Caspian) but above all through the constitution of a significant regasification capacity of around 205 bcm / year. LNG now plays an important role in its diversification strategy and therefore in securing its natural gas supply. This is particularly important for countries like Poland and the Baltic States which will until then be very dependent on Russia for gas supplies (Devine et al., 2018).

Russia already takes part in the global LNG market doing export activity, and its role will lead to a rise in the years to come, which is essential concerning the geopolitical situation of Eurasia. Russia has also made announcements some LNG export stations for the future. These terminals are anticipated to be constructed within the following fifteen years (Devine et al., 2018).

There are, however, strong regional challenges within the EU (Ruble, 2017):

In the northwest of the EU, the significant diversification of suppliers has made it possible to create a competitive market with hubs (NBP and TTF) which will sufficiently be liquid to allow the emergence of a reference price for natural gas.

This is much less true for Central and Eastern Europe and especially for South-Eastern Europe in the area of the Balkans which have insufficient interconnections between markets (even if substantial development has been made in the near future) and extremely limited regasification. These phenomena constitute powerful obstacles to the diversification of their supply which remains for the most part provided by Gazprom. The liberalization processes of the gas industries are slow compared to the rest of the EU. This is reflected in particular by the weak development of spot markets. For the most part, prices are the result of long-term contracts and price indexing formulas based on the prices of petroleum and petroleum products. However, the EU intends to focus on the development of interconnections between these markets, in order to promote the diversification of their gas supply. New LNG terminals are under construction in Bulgaria or are planned to be constructed in countries like Croatia (De Jong, 2015).

4.3 Conclusion

In the chapter it was seen that Europe constitutes one of the most significant markets for LNG and the natural gas resources have been found to assist an increase in production. The liberalization constitutes an issue which is a major challenge for EU as it is expected that in 2030 there would be major dependency on LNG A significant threat involves the "Russian risk", like for example the risk from the market share stemming from Gazprom in the region of Europe as well as the geopolitical risk that it would provoke, is tinted as one of the most noteworthy. There are other significant challenges regarding the European market involving diversification of suppliers.

Chapter 5: Asia, the world's largest LNG market still under-exploited – USA, a mature LNG market

5.1 Introduction

Amongst the largest LNG market is the Asia market. Being large as a market is due to the high LNG production in the Persian Gulf, which is described below.

5.2 Gulf production

The Persian Gulf constitutes the largest gas field worldwide - the North Dome / South Pars field - with reserves around 8-10% of the world's reserves. A large part of its production is exported by Qatar in the form of LNG, which allowed it to become the world's leading LNG exporter between 2006 and 2018. The tensions that have arisen in this area and the choke-point of the Strait of Hormuz constituted the Persian Gulf a basic area for the balance of the world LNG market.

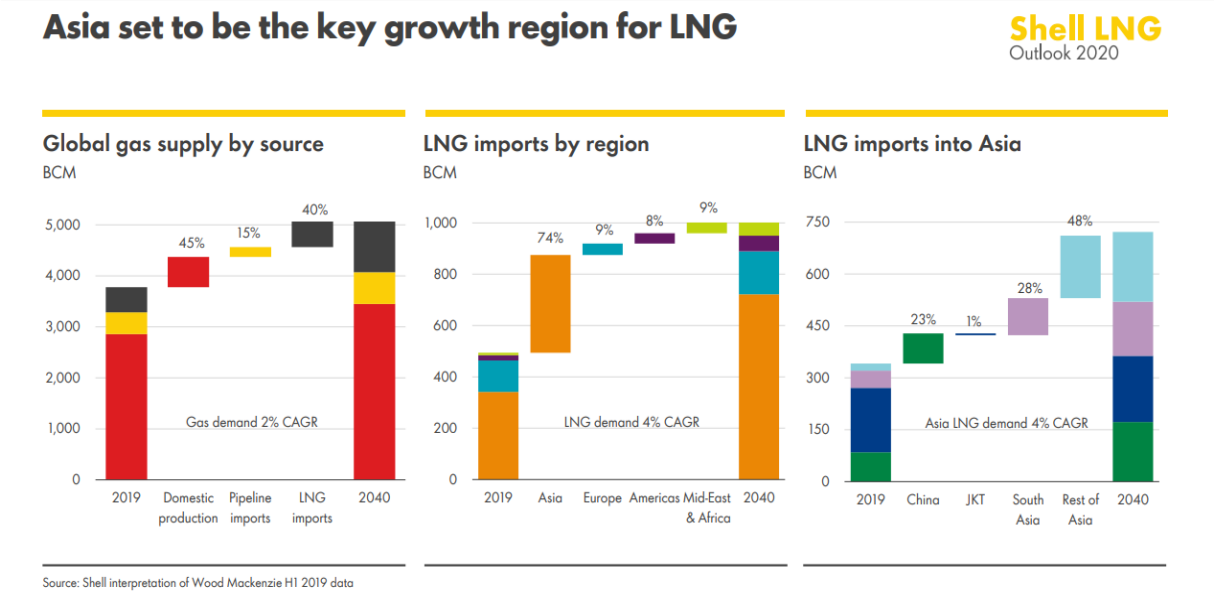
The North Dome deposit represents Qatar's main cause of wealth. Its offshore facilities meant for production as well as the export route through the Strait of Hormuz leave Qatar strategically in a weak position on the contrary to its neighbor Iran in the case conflict arises. It is for this reason comprehendible that the Doha policy during the last years has been depended upon the search of balance among help and military cooperation with the U.S and the maintenance of a cautious approach opposite Iran while keeping the ties, economical as well as cultural amongst the two countries.

In Iran, South Pars was developed to provide consumption domestically. Various projects relating to export activities have been designed as years went by, including pipeline projects towards Turkey and Europe, Iran-Pakistan-India pipeline (IPI) and LNG projects called Iran LNG (with the participation of Chinese and South Korean

companies), Pars LNG (with Total and Petronas) and Persian LNG (with Shell and Repsol). However, their achievements have always come up against difficulties linked to the international context and no project is currently being implemented.

Asia is considered one of the key markets for the global LNG trade. Traditionally, the main importers of LNG in Asia have been Japan (nearly 50% of Asia's imports in 2015), South Korea (nearly 20%), China (11%) , India (9%) and Taiwan (7.8%). But since 2017, China has become (being ahead of South Korea) the second biggest importer of LNG at a global scale (Shell LNG Outlook, 2020). In the below Figure 2. we can see how Asia is the basic growth LNG region:

Figure 2 Global LNG Demand



Source: Shell LNG Outlook 2020

The future of LNG imports from Asia (and therefore the balance of regional natural gas markets) is today, to a large extent, determined by the evolution of demand from the large Asian countries which remain in terms of natural gas from "emerging" countries, namely China and India. Their demand for natural gas by 2030 remains uncertain and will be determined by several factors with contradictory consequences which are the following. Initially, a significant part of the growth in demand will be connected to the climate policies put in place and in particular the strategies for replacing coal with

natural gas in certain sectors. Moreover, the competitiveness of gas compared to other energies (coal, renewable energies), in particular as regards the production of electricity, is central. In many Asian countries like for example China and India, natural gas is not competitive if it must be compared to coal. It should be noted that there are infrastructure issues and there are investments required in order to establish distribution networks, long-distance transport networks and LNG infrastructure. This factor appears to be a stronger constraint in the case of India, as China has already developed a significant infrastructure in the specific area. Last but not least, the economic growth of these countries will also be an important factor concerning their gas demand.

The consequences of the specific uncertainties on international gas markets (so much regionally as well as globally) could be significant and have a profound influence on the volumes that are going to be traded and in this regard on prices (Mishra, 2021).

In Asia, Russia does not have the same competitive advantages as in Europe. On the one hand, except for the Far East, gas production areas remain relatively far from Asian consumer markets something which is impacting transport costs. The development of the Northern Route in the Arctic could enable Russia to limit these costs. On the other hand, Russian LNG exports are sometimes in direct competition with pipeline exports, as has been the case in China since the entry into service of the Siberian Force pipeline. However, this competition between Russian companies could have a negative impact on the level of gas rent for Moscow.

Finally, the Russian LNG penetration into the Asian markets will depend heavily on Sino-American rivalry. The so-called "Phase One" trade agreement between the two countries, signed last January, requires that China commit to buying more than 50 billion US energy goods over two years a fact which will be detrimental for the Russian producers (Mishra, 2021).

5.3 The USA LNG market

Another important market is that of the USA and this is what this chapter deals with. As it is supported in Shell LNG outlook (2020) for nearly a decade, shale gas development in North America has dramatically transformed global gas markets, so much so that the United States has qualified in this market for being a game changer. Thus, for a long-time, net importers such as the United States have also become net exporters of natural gas since 2016. This change in status has had the effect of destabilization of the positions of traditional players that exist in the market such as Russia. Above all, it has fostered the emergence of real competition, so much economic and geopolitical, between Washington and Moscow in the markets in Europe and Asia (Shell LNG Outlook, 2020).

On the European continent, LNG imports from the United States have been welcomed as essential alternatives to pipeline imports from Russia. The European Commission and the Member States have thus embarked on the construction of numerous regasification terminals in the name of European energy security and competition to be played out with Gazprom, which until then enjoyed a significant weight in the offer in Europe. This is crucial for the countries of Central and Eastern Europe (CEECs) and South-East which are heavily dependent on Russian gas. So far, this strategy has paid off if Gazprom's gradual alignment with European spot market prices is to be taken into consideration.

However, despite lacking real market power, especially in Western Europe, Russia can count on a number of competitive advantages over US LNG. Gazprom benefits from relatively low production and transport costs. This is why Washington, under cover of concerns for European security, has embarked on a policy of sanctions aimed at obstructing the construction of new pipelines from Russia. This policy was applied in particular to the Nord Stream 2 gas pipeline which directly links Russia and Germany.

5.4 Conclusion

It was seen in this chapter that the Persian Gulf constitutes the major gas field globally - the North Dome / South Pars field - with reserves around 8-10% of the world's reserves. A large part of its production is exported by Qatar in the form of LNG, which allowed it to become the world's leading LNG exporter between 2006 and 2018. The tensions that have arisen in this area and the choke-point of the Strait of Hormuz led the Persian Gulf to be a basic area for the balance of the worldwide LNG market.

However, there is a need to face the consequences of the specific uncertainties on international gas markets (so much regionally as well as globally) as this would have a profound influence on the volumes that are going to be traded and in this regard on prices (Mishra, 2021).

Russia's part which is in Asia does not have the same competitive advantages as in Europe. On the one hand, except for the Far East, gas production areas remain relatively far from Asian consumer markets something which is impacting transport costs. The development of the Northern Route in the Arctic could enable Russia to limit these costs. On the other hand, Russian LNG exports are sometimes in direct competition with pipeline exports, as has been the case in China since the entry into service of the Siberian Force pipeline. However, this competition between Russian companies could have a negative impact on the level of gas rent for Moscow.

The Russian LNG penetration into the Asian markets will be depended upon the Sino-American rivalry. The so-called "Phase One" trade agreement between the two countries, signed last January, requires that China commit to buying more than 50 billion US energy goods over two years a fact which will be detrimental for the Russian producers (Mishra, 2021).

Finally, as regards to USA LNG Market, the growth of the specific market of Shale gas in the North Part of USA has assisted in the dramatic transformation of the global gas market. The suppliers being ultimately importers and exporters of natural gas, creates destabilization of the position of traditional players that exist in the market such as those of Russia. In the European regime, the imports from USA were welcomed as an

alternative to the pipe imports from Russia. However, Russia is not so strong in Western Europe whereby the competitive advantage is taken by US LNG.

Chapter 6: LNG price and market dynamics

6.1 Introduction

The present chapter deals with the most important aspects of the topic of LNG. In this regard, in this chapter it would be seen the various stages of production in conjunction with the emergence of new players, the ways that LNG is priced, what are the price regulations, how are the prices linked with prices in natural gas and oil, the effect of the demand set by Chinese on the market at a global scale. Moreover, there will be seen three policy scenarios, the impact the Chinese supply and demand creates, as well as the effect on the global energy market.

6.2 Stages of production and contracts

Given the number of stages which are required for the production (in other words the exploration and production, liquefaction, etc.) and sale (transport, regasification, etc.), the LNG value chain requires large amounts of capital. In other words, significant initial investments are required, which will only be amortized after a period of several years of operations. This constraint has long prompted LNG players to enter into contracts included in indices of oil prices in the long-run in order to best distribute risks between buyer and seller. The latter thus incurs the price risk while the buyer commits to a determined volume. This risk sharing was essential to ensure the long-term financial viability of LNG projects. However, since the end of the 2000s, he gradual transformation of these contractual terms has been witnessed (Robertson, 2021).

In North America, in fact, short-term contracts indexed to the prices of the Henry Hub as well as the benchmark gas index in the United States, quickly replaced conventional formulas linked to the price of oil. This development is explained by the depth of the American market as well as by the presence of already depreciated infrastructure, thus reducing the need for a contractual guarantee in the long run. In addition, these infrastructures allow players to obtain gas from liquid markets, which facilitates in the

best way the transition to more flexible formulas based on the prices of gas hubs (BP Energy Review, 2020).

In Europe, these are also the types of contracts that are preferred today, although long-term contracts have not yet disappeared. This preference is the consequence of the liberalization of gas markets decided by the European Commission following the three directives of 1998, 2003 and 2009. The Commission thus encourages the development of spot gas markets which, by stimulating competition, are supposed to neutralize the geopolitical risk posed by Russian gas. The liberalization of the gas sector has also had an effect regarding the entrance of new players, the portfolio players, who have massively contributed to the flexibility of European markets (Robertson, 2021).

Finally, in Asia, spot market penetration proceeds in a much slower rhythm than in the United States or Europe. Transactions are carried out mainly through contracts catalogued regarding oil prices in the long-run and not to spot charges such as the JKM (Japan Korea Marker). However, since the nuclear accident that took place in Fukushima, high prices in Asian markets have encouraged a massive influx of freighters wishing to sell LNG at the spot price (reload). These operations then accelerated, a fact that reinforced the rise of short-term contracts in Asia (Robertson, 2021).

Therefore, despite regional differences, LNG has come to change the terms of gas contracts, thereby promoting the transformation of gas into a commodity which can be freely traded on markets around the world (Robertson, 2021).

- How is the future descrided for LNG

There is an orientation as regards Gas in the global context in favor of transport by liquefaction. As a result, gas is becoming an increasingly easier tradable commodity on world markets, like petroleum products. Natural gas globalization is translated into a convergence of prices between the three major markets of North America, Europe and Asia. However, in order to continue this trend, LNG will need to overcome significant supply and demand barriers (Marketwatch, 2021).

It is projected that the largest importers of LNG by 2040 will be Europe and Asia. Particularly, it is expected that China and India are going to deal with the most part of the potential demand for LNG. One of the basic values that govern the future concerning the foreign policy in China, India, and Europe will be security in terms of

energy and the easy stream of goods regarding energy, which will put emphasis initially on gas and secondarily on oil. In fact, one of the most essential aspects of US foreign policy for the last 70 years, the never-ending flow of oil / energy to their country, will be accepted by all the key importers of energy by 2030. Countries such as China, India, Japan and Great Britain already have or will acquire new airline carriers in the following years, which will be used not only with the aim to promoting military power but also, they will be employed as deterrents of the disruption of the free of charge energy flow and trade to the specific countries.

On the supply side, the Covid-19 pandemic and the drop in global gas prices call into question several investment projects. Australia, the world's largest producer, has announced significant delays ranging from two to three years while in the United States several final investment decisions have been postponed indefinitely. In the case of North American producers, LNG is less attractive as domestic prices are higher than European and Asian prices. In other words, the convergence of world prices drastically reduces the incentive to export. Only Qatar which is the second biggest producer around the world, has announced that it will continue to invest since it benefits from relatively low production costs (Marketwatch, 2021).

Given transportation constraints, natural gas markets have customarily been coordinated as three segmented provincial markets: the North American, the Asia-Pacific, and the European. Every separate market was characterized by particular suppliers and differentiated prices. LNG makes it possible to remove the constraint of transportation even if its cost resulted in the reduction of its development for a long time. In 2000, LNG constituted the 26% of natural gas trade compared to 45% of today, testifying to the ongoing rise of a worldwide natural gas market (Shell LNG Outlook, 2020).

The LNG markets are changing rapidly. Since the beginning of the 2000 decade, the LNG trade has grown strong. In other words more than 80% between 2006 and 2018 to get to 368 bcm of imports in 2018. Recently, there has been a specific rise in buyers (42 countries) and sellers (20 countries). Fundamentally, this results in change in the exchange terms as regards the volume, the geographic areas, and the models employed. As it can be understood there are new configurations present that could lead to important geopolitical implications (Shell LNG Outlook, 2020)

Likewise, LNG faces uncertainties about the level of future demand. While the outlook for the North American market remains fairly stable, this is not necessarily the case for the European market. The European Union (EU) is indeed committed to an ambitious plan, which is the decarbonization of its energy mix by 2050. In the IEA's World Energy Outlook (2019), gas imports should thus increase until 2030 before experiencing a slow but continuous decline. The status of gas as transitional energy will therefore only have a short-term effect, as it is implied by the agency. For LNG, this is a major risk because the European market appears more and more as a market being the last resort, being capable of bringing balance among the markets which are by nature seasonal due to its storage capacities. Europe is indeed in a position to support LNG markets especially during summer months and thus compensate for the sharp drop in Asian residential demand (heating and cooking for individuals) during this period of the year (Marketwatch, 2021).

In the context of an expected drop in European imports from 2030, it is therefore Asia - and especially China - which will provide the largest share of liquefied gas consumption (it is projected to be 70% in 2040 according to IEA). However, the level of Asian demand will in reality largely depend on economic developments as well as the climate policies of the States. For the latter, the issue of energy security, understood as the necessary diversification of their supply strategies, will also increase an additional degree of uncertainty to long-term demand (Shell LNG Outlook, 2020).

The oversupply in the global LNG market will be present until 2023-2025, resulting in worldwide liquefied natural gas (LNG) charges to fluctuate beneath $10 / mmBTU. At these prices, a lot of export gas liquefaction terminals will either be uncompetitive or exhibiting low profits and in a lot of intense instances will not even be able to provide coverage as regards what is charged for the exports. CEDIGAZ also predicts that after 2025 there may be a supply shortage, as a result of which global LNG demand may not be met. This condition will lead in a push in what is charged globally for LNG to soar over $15 / mmBTU. This might be beneficial for potential exporters of LNG (Cyprus, Israel, Mozambique and in part Greece) who plan to start exporting after 2025 (IGU, 2020).

6.3 The emergence of new players

Australia, Qatar and the United States are held to be the top three producers and exporters of LNG in the world. Other countries like Malaysia and Algeria are also leading and long-standing producers in this sector. Since 2017 and the commissioning of the Yamal LNG project by Novatek, Russia has been significantly ambitious in this sector. However, the high prices of the early 2010s encouraged the emergence of new players likely to challenge the traditional hierarchy in the LNG market (IGU, 2020).

Among these new competitors, countries in the African continent are undoubtedly the ones with the greatest growth potential in the years to come. Thus, the African gas sector is comprised of a considerable quantity of reserves not listed though because they are associated to oil fields and generally burnt by flare. Officially accounting for only 2% of world reserves, Africa has untapped the potential of being located mainly offshore. For years, only Nigeria and Cameroon (but to a lesser extent) have exploited their associated gas reserves. Recently, two large gas fields have been discovered, one in East Africa straddling Tanzania and Mozambique, the other on the Atlantic coast in Senegalese and Mauritanian waters (McKinsey & Company, 2021).

These discoveries have thus highlighted the potential for the African continent to become a major player in LNG. Investors are all the more interested as the projects are extremely competitive concerning costs and also benefit from the favorable geographical proximity to European and Asian markets. Several elements nevertheless darken this picture. On the one hand, Africa suffers from problems due to its political and regulatory instability something which creates issues as regards the attraction of international investors. The development of an Islamist guerrilla which tries to rely on the fear of an absence of rent sharing, partly explains the delay in gas exploitation in northern Mozambique. Alternatively, as it is exhibited by Tanzania example, governments prefer to direct gas production to their domestic market instead of exporting it to international markets. The development of LNG in Africa will therefore largely depend on the choice of States and the level of their internal demand (McKinsey & Company, 2021).

Besides Africa, other parts of the world have seen significant gas discoveries in recent years. Thus, the Eastern Mediterranean benefits from special attention from gas companies following several discoveries in Cypriot, Egyptian, Israeli and Lebanese Exclusive Economic Zones (EEZs). The potentially high costs of a gas pipeline to Europe lead in increase in the competitiveness of LNG, especially since Egypt already has the necessary infrastructure for this technology. Uncertainty remains, however, as to the level of domestic demand, which is likely to absorb a significant portion of production.

Also, Iran's capability to start exporting its gas via LNG is questionable. Joint holder with Qatar of the exploitation rights for the North Field -South Pars field, the Islamic Republic of Iran shares with its neighbor nearly 10% of the worldwide's gas resources. On the Iranian side, these reserves are currently poorly exploited and cannot be exported due to Western sanctions. A lifting of sanctions could, however, make Iran a major player in LNG. The Islamic Republic could also have an impact on gas markets, should tensions rise in the Strait of Hormuz, despite the fact that it did not follow through on its threats following the assassination of General Soleimani in January 2020.

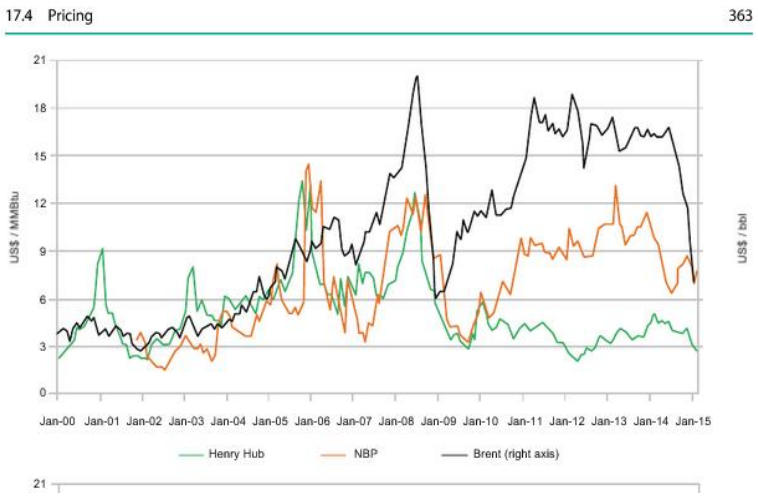
6.4 LNG & Gas Pricing

Prices for natural gas and the processes that set them have changed over time. While long-term contracts connected and highly affected by oil prices used to be the norm, price setting now takes on a variety of forms across markets, with prices varying by country. In a survey conducted in 2014 by the International Gas Union (IGU), 43% of the international wholesale volume based on competitive natural gas charging, also known as gas-on-gas pricing, which was not included in the indices of oil prices in opposition to the 19% that was (Ishwaran et al, 2017).

In comparison to contracts included in the oil-indices, which used to be agreements looking at the long-run, contract terms are becoming more diverse. Prices are increasingly being determined by rivalry between natural gas producers, hubs, or spot markets. Natural gas pricing systems in China, where energy price caps are comparatively strict, vary significantly from those used elsewhere, following a variety of pricing strategies based on gas supply and utilization. China's natural gas charging,

on the other hand, is undergoing adjustment and heading toward national natural gas pricing regulations. Since their primary purpose is the provision of a direct link inside the natural gas market and to promote fair pricing, natural gas hubs play an integral part in natural gas pricing mechanisms. The relation among natural gas and oil prices is broken by natural gas hubs. The dynamic pricing that hub formation makes becomes a kind of strategy regarding substitution for oil-price-linked controlled costs. Furthermore, natural gas hubs are an integral part of the natural gas downstream industries. Due to natural gas market's size in China and rapid growth rates, along with past experience with large-scale foreign trading in other resources, policy changes for China's natural gas market are expected to have a significant effect on global natural gas prices. For that reason, a model has been developed to examine, in particular, China's natural gas demand growth under different situations and the implications for worldwide natural gas markets, involving price, energy mix, and other factors (Ishwaran et al, 2017). The below Figure 3. presents the pricing according to three indices. The Henry Hub, the NBP and the Brent.

Figure 3 Pricing



Source: Ishwaran M., King W., Haigh M., Tao Liang Lee (2017)

6.5 Current Pricing Regulations

Geographical constraints stifle the progress of the global natural gas business, with natural gas pipelines and LNG ships accounting for the majority of international trade. Constraints concerning the geography as well as high transportation costs, the cost of building long-distance pipelines from other countries, as well as the cost of shipping and storing LNG—limit exchanges in trade between regions, allowing the market of natural gas to develop distinctive regional characteristics, particularly in terms of price formation.

Price levels are often significantly different across countries, reflecting shifts in supply and demand for each sector separately. The influential Henry Hub price in North America typically reflects supply and demand patterns in the US, such as seasonal fluctuations, significant events like the hurricane Katrina and Rita, and more developments involving the long- run like the revolution of shale natural gas. In fact, there were times while prices of US natural gas were more than the average LNG import charge in Japan, such as while the market anticipated that the US would require sizeable LNG imports. A lot of natural gas liquefaction ventures all over the globe began having as an objective to export to the US based on the prices that depended on the Henry Hub charges as seen as a benchmark for their plan as regards the export charging, accompanied by the expectation that the United States would be an importer of LNG in the long-run. A large number of regasification terminals have also been proposed in the United States (Ishwaran et al, 2017).

The US was supposed to be an importer of LNG in the long-run, and developers expressed their willingness and ability to charge their export plans using the Henry Hub, which was generally regarded as accurately reflecting US supply and demand fundamentals. In the US, a large number of regasification terminals have been suggested. Prices correspond to shifts in what is supplied and demanded in markets where pricing is primarily based on oil indexes, but not as efficiently as in markets where pricing is based on competition. The supply and demand of oil further complicates the specific process. For instance, new LNG sales and buying contracts in the area of Asia Pacific where charges progressively deviated from oil until about 2005 and slowly withdrew. In the early 2000s project creators in the specific place had to be

entered into markets that were relatively new to LNG imports and were provided with the option of making exports to the US. Cost for constructing LNG project were substantially less than present levels and their oil price viewpoints were secured to the levels which were under $60 a barrel for almost a period of time of 15 years. Following 2005 increased project cost and much higher requirement for natural gas resulted in risen prices in some circumstance which reached uniformity with crude oil prices. The 2011 when the accident of the nuclear power plant took place in Fukushima Japan strained natural gas charges in Asia to rise. At recent times, however, natural gas charges have started to be moderate, in part due to the fact that oil prices are lower, weaker worldwide economies' further capacity so much the full ones as well as the projected assist new projects like US LNG exports to Asia (Ishwaran et al, 2017).

Having an outlook towards the future, natural gas prices and more specifically LNG which was meant to be exported to Asia Pacific markets could become significantly unpredictable as LNG exports started for the United States that are chiefly included in Henry hub prices indices. Corporations hope to become bigger and thus achieve to capitalize on the United States' natural gas growth by proceeding with liquefication of the fuel and trade on worldwide markets as well. A lot of projects have been declared but not all of them will be able to be completed. Generally, charges concerning the American LNG exports is characterized by two components. The first one having to do with Henry hub prices reflecting the feed costs for gas and fuel as well as a fixed component per annum which reflects investing activities in the facilities whereby liquefaction takes place. Depended on purchase and agreement terms which constitutes currently the Henry hub component is on the average 115% of the Henry hub price whilst the other component depends on a fixed total dollar constituting the amount of 15% of this being connected to US inflation rates (Ishwaran et al, 2017).

Buyers achieve supply assortment by the procurement of US LNG exports but at the same time they tend to be under risk. Along with commissioned destination variations which permits the rerouting of shipments to the most advantageous markets US exported LNG provides contribution to a favorable energy supply network that is diversirfied. Although these US supplies of LNG might be facing less competition than the supplies that are under the oil index based on fluctuations of worldwide oil prices and Henry hub natural gas charges among other factors. In comparison to Asia, where natural gas contract charges are connected to oil, exported US natural gas are under a

distinct risk profile. A lot of sales and purchase agreements stemming from US LNG exports are comprised of an alarming agreement part meaning that the buyer is the one who is responsible for the procurement of the natural gas to be under liquefaction process and less plant utilization rates will result in increased unit prices due to the buyer continuing to pay the fixed component except when this doesn't take place in severe instances. Additionally, the purchased is the one who is responsible for purchasing the natural gas to be liquified with the unit charge increasing with less liquefaction facility utilization rates as the buyer constantly pays a fixed fee, something that might not happen, unless there are exceptional cases. Recently, there is a drop in oil prices and prices of oil in the long-run trends are not certain while at the same time current Henry hub prices be experiencing various record troughs something which underlies the connected risk of the US LNG supplied as well as supplies whose charges are connected to oil (Ishwaran et al, 2017).

Despite the fact that natural gas pricing mechanisms are swerving more and more towards the adoption of prices to bring competitive advantage, the formation of a global uniform price cannot, currently, be put into effect. However, the progress in the capacity of the international natural gas trade and also increases in the capacity of trading hubs or spot market natural gas sales are encouraging the formulation of markets that are regional depending on the creative national foundations as in the case of Europe (Ishwaran et al, 2017).

Even though the trade and pricing being competitive was to lead to the promotion of the formation of a worldwide natural gas market the local charges are possibly going to continue to exist however inter regional price variations might even surpass the costs of shipping. This is because the natural gas demand and supply that is local is often not balanced. In this regard, big scale consumers are not always equally big scale producers that are led to sign long-term contracts with the aim to reducing energy security issues that are supposed to constitute the concentration as far as market forces are concerned (Ishwaran et al, 2017).

In the same way the formation of a worldwide uniform price cannot be possible since capabilities of global trade are not flexible and there is possibility not to be sufficient and this will not constitute ability of satisfaction of trade demands that may change at any possible time. Last but not least, 80s still having not known the potential for

recovery from an economic standpoint regarding the conventional natural gas remains. However if there was a possibility to be unlocked at hello price as it was observed in the case of the United States the capacity that would be created would be most possibly to have an effect on charges in the direct area of supply as opposed to other places (Ishwaran et al, 2017).

6.6 The association between charges of natural gas price and oil price

Natural gas, whether transported via pipelines or as LNG, has historically been charged in relation to rival fuels in both receiving and supplying markets for long-run contracts. An illustration includes LNG imports to Japan, which are based on Japan crude cocktail charges, a consolidation of oil prices that is described in general in the framework of individual agreements, or exports from the Groningen natural gas domain in the Netherlands, where pricing adaptations have been linked to what the market charges for three major types of fuel (Ishwaran et al, 2017).

For a lot of years natural gas agreements have been similar to what the oil charges were catalogued. When the only price leads to a change in the charges paid for natural gas alters in the same manner with the employment of a pre- determined formula. Auntie almost 2008 this connection has resulted in prices of natural gas and oil being closely correlated into prices. This correlation was not so tight in some point in time when oil prices showed high instability especially due to oil prices and in this regard not sure natural gas contracts were led to renegotiations (Ishwaran et al, 2017).

Expecting the expression of need for rebalancing the agreements in the long-run some contracts signed concerning natural gas were comprised of closes which allowed the revision of price formulas based on a specific set of parameters. The linkage among oil and natural gas charges started to become looser in 2008 following the variance of Henry hub charges involving oil. This split was in part resulting from the US downturn and then increase in alternative supplies of natural gas in the United States something which that had to do with the fact that the country didn’t need important LNG imports any more (Ishwaran et al, 2017).

In Europe and economic depression also resulted in decreasing natural gas demand something which had as a result to lead to supplies being abandoned which were progressively acquired through the provision from the natural gas hubs without having any linkage to oil prices. Currently, there is a possibility for Russian natural gas supplies, which pass from Ukraine, to be distracted and, consequently, increase market instability. However, prices that managed to recover even as part of the supply to Europe, were decreased. It is interesting enough that the supply decrease was connected, to a large extent, to imports of LNG to Europe rather than being delivered

through the Russian pipeline. Strong demand for LNG in the area of Asia Pacific region has led to the formation of opportunities for arbitrage, and LNG provided to purchasers in Europe was replenished and sold by the purchasers in Asia Pacific (Ishwaran et al, 2017).

In the face of low gas index prices and little demand, both European and Asian consumers elected to profit from gas sales to Asia Pacific clients, resulting in higher pricing. The arbitrage opportunity vanished when oil prices and European natural gas hub prices plummeted. There have been four reasons in favor of connecting natural gas contracts to oil prices in the past. The Benchmark price serves as the foundation for the initial rationales. Natural gas exploration, production, and distribution need a large sum of money, thus the industry typically seeks long-term contracts. Contract charges in general exhibit changes in accordance with a benchmark, and the oil charges have given a clear and robust standard for sharing risk among purchasers and traders (Ishwaran et al, 2017).

Furthermore, many of the expenses concerning the natural gas development, like the oil production rigs and specialist staff, are greater than those of oil and natural gas production, and they are influenced by oil prices. In other areas, however, the fundamentals for pricing oil and natural gas have evolved. In the U.S and some places in Europe, for example, benchmarks are deep enough, and liquefied natural gas benchmarks are now accessible (Ishwaran et al, 2017).

• Natural gas has been a by-product of oil extraction and has been traded on comparable conditions. However, even while co-production is still widespread, exclusivity in the extraction of natural gas is becoming increasingly popular. Natural gas is a by-product stemming from the production of shale oil in the United States, for example. Low natural gas expenses in the United States are partly due to high oil prices, which have provided significant initiatives to developments of shale. Outside the region of the U.S the lower natural gas charging may not be practical or readily replicated (Ishwaran et al, 2017).

• Comparable routes to market: Natural gas and oil have comparable transportation power supplies, and companies that are the same have a tendency to distribute both due to knowledge, dominance in the market, or a combination of the two. Although that, natural gas infrastructure is becoming increasingly self-sufficient.

• Competition for customers: For power generation and heating, natural gas and oil products were employed, and natural gas was frequently priced lower than oil to compete. On the other side, oil products are increasingly being used mainly for transportation, with alternative fuels being used for power generation. As there is evolution of markets, however, only one of these reasons necessitates for benchmark transparency to be applicable, but even in this instance in some markets natural gas hubs have now more capability to provide support in terms of a natural gas benchmark. The underlying commercial basis for the connection between natural gas and oil charges lies upon the hypothesis as far as the economic drivers that are in the wake of oil's value are comparable to those in the rear of natural gas' value. When oil and natural gas were substitute products, for example when they were both employed with the aim to generating power (something which was often a reality), their value would alter similarly. However, oil is now mostly used for transportation, but natural gas is not.

The price of oil no longer accurately represents the worth of natural gas because different forces that lead to the valuation of the market of oil and natural gas. Because the uses of natural gas and oil, as well as their production costs, have changed dramatically, a pricing relationship is unlikely to be re-established, particularly in places where natural gas benchmarks are shifting. China gets its natural gas from domestic sources, LNG imports, and pipeline natural gas imports from former Soviet Union nations. As a result of the unequal handling of various types of resources from diverse sources, a three-strand pricing system was established:
When it comes to imported LNG contract charges and pricing tied to Japanese crude oil mix, a curved-based ceiling structure was first adopted to restrict exposure to oil price volatility. Furthermore, the IGU proceeded with the activation of a bilateral agreement on the price structure for imported pipeline natural gas. For monopoly pricing, agreements taking place inside the government are essential, and there is a large level of uncertainty involved. The pricing inconsistencies that are distinctive of China's charges have resulted in a variety of market junction problems, especially during periods of high prices for oil.

Charges for imported natural gas or LNG should be based on a natural gas indices that provides measurements of the quantity supplied and demanded of the region or nation

which wants it, based on what has been knowledge from the North American and European region. However, a relevant index involving natural gas can only be created if all of the players, as well as the infrastructure and laws, are in place, forming a liquefied natural gas hub that is transparent and widely utilized. The natural gas index must meet the requirements of monetary organizations that offer credit to both creators and purchasers. Once everything is in place, a Chinese natural gas index will be able to give the necessary price signals to attract more imports (Ishwaran et al, 2017).

Although reforms taken place in the market of natural gas in China continue to gain traction, experience gained from foreign transactions suggests that the natural gas hub cannot be built in a short period of time, and interim solutions may be necessary. As China moves forward and implements the initiation of improvements, it will need to enable its natural gas market pricing structures to evolve. The existing practice of delivering natural gas to end consumers at charges which are dependent upon the cost of competing fuels can be continued as a provisional solution. On the other side, this strategy puts importers in peril, particularly importers of LNG. Worldwide factors relating to quantity supplied and demanded would impact LNG imports to China, and China would have to compete with other customers on the market. During this period, potential oil indices would go on to trade, but LNG contracts tied to Henry Hub charges would gain traction (Ishwaran et al, 2017).

If the market is allowed to open up to more competitiveness, the gap between imported natural gas expenses and end-user charging should narrow (Ishwaran et al, 2017).

6.7 The effect of quantity demanded by China on the global market

There will be analyzed three possible cases for quantity demanded by China. The first one involves no novel strategies regarding reduction of quantity consumed or stimulation of quantity consumed for natural gas. The other two possible cases characterize rising replacement of natural gas for cold so much in the energy sector and in the broader financial system (Ishwaran et al, 2017).

The fundamental findings from the modeling are described as follows:

- Natural gas prices. Flexibility regarding worldwide natural gas supply would inhibit any kind of rise in local natural gas charges if more quantity demanded in China puts pressure upwards as far as local charges are concerned.
- Coal consumption. Less Chinese coal consumed would be to a large extent counterbalanced by risen coal employment to other countries, if these countries do not implement related strategies.
- Domestic coal. Strategies which are encouraging only for the energy sector so that they decline coal quantity consumed could lead to less coal charges and a change to call from natural gas in businesses that policies regarding low carbon are not covered. Policies which aim at the reduction of local coal production should be widely applicable so that there is a greater impact.

6.8 The three possible cases

Three scenarios for China were developed to highlight the consequences of a decline in local cold quantity demanded for generation of power and industrial usage in general, as well as to investigate how readily natural gas might be replaced for coal and the impact these kind of changes would have on worldwide markets of energy. The baseline, the sector responsible for generating power, and all sectors scenarios all simulate the consequences of different degrees of coal use limits in China. Each from the instances is different in the rigour of the limitation and the sectors that are aimed:

- Baseline scenario: China does not enter new policy measurements with the purpose of reduction of coal's quantity consumed or stimulation of natural gas quantity consumed. The generation of Coal amount in the power generation sector continues to develop at rates that endured for the 13th 5-year plan whose beginning would have been 2016 and its end is planned to be noted in 2020. It continues a steady growth although at the slower rate after that. This scenario is supported by IEA and EIA research. Given the present drive for change in the energy policy of China, however, it should be considered as a useful baseline for evaluating the consequences of the other two cases rather than a realistic future trajectory. The case, for example, is not accountable for any present LNG project commitments (Ishwaran et al, 2017).
- Power generation sector scenario. China is limiting call usage in the electricity sector, resulting in lower investments in coal-fired power plants and higher coal expenses. As a result of its resemblance to current Chinese policy preferences, this case is seen as one of the most realistic of the choices (Ishwaran et al, 2017).
- All sectors' cases. China regulates quantity of coal consumed in the electricity sector, as it does in the power generating sector, but it also imposes restrictions of quantity of coal consumed in other sectors of the economy, cutting investment in all call-intensive capital assets and raising the effective charges of coal across the economy (Ishwaran et al, 2017).

6.9 The impact on Chinese energy supply and demand

Putting limitations on quantity of coal consumed would raise the efficient charge of coal and reduce the incentives for investments regarding the coal-intensive projects. Under the Power Generation Sector case, quantity of coal consumed would reach its peak in 2020, but under the all Sectors case, it would reach the peak in 2018. The next peak in the Power Generation Sector case exhibits the outflow of quantity of coal utilized from the power sector to other financial sectors, most notably manufacturing, as a result of the restrictions imposed in power sector's quantity of coal consumed. The decline in utilization of coal would be accompanied by an increase in quantities of natural gas and electricity consumed.

Natural gas's proportion of China's energy mix would rise by 2030 in both the Power Generation Sector and All Sectors cases, to 17% in the Power Generation Sector and 21% in the All Sectors cases. Taking into consideration all the cases, natural gas's share of the power sector would rise by around 15%. In the Power Generation Sector scenario, this would represent a 70% rise in natural gas consumption over the Baseline case, and a 100% rise in the all sectors scenario, against a backdrop of rising quantity of energy demanded (Ishwaran et al, 2017).

In both the aforementioned cases, the whole output for China's local natural gas would remain under the quantities that need to be consumed, despite a projected tripling in local production by 2030. As a result, under all cases, the percentage for the improrts of natural gas in the overall quantities consumed is anticipated to rise to over 50% by 2025. Given current and anticipated pipeline capacity, LNG is estimated to accumulate for more than half of all the imports for natural gas. In the all Sectors cases, when LNG imports are anticipated to accumulate for 73% of the whole imports for natural gas, the quantity consumed and produced imbalance would be much worse.

Imposing coal use limitations to the power sector (as in the Power Generation Sector case) would cause coal consumed to seep into other sectors, driving natural gas to replace it. Lower coal consumption in the electricity sector would help other coal-intensive sectors of the economy, such as manufacturing, placing downward pressure on coal charges paid by other sectors. Rising natural gas quantity demanded for power

generation, on the other hand, would raise local natural gas charges, placing other gas-intensive businesses like home heating at a disadvantage due to basic products that are for substitution of natural gas which are electricity and oil (Ishwaran et al, 2017).

6.10 The effect on the worldwide market of energy

According to the International Energy Agency, emerging economies such as China would account for the majority of global energy demand growth over the next two decades, and changes in these economies' energy policies and energy mix would have significant implications for global energy markets. Overall, the simulation shows that if international coal consumption stayed steady, natural gas demand would grow under the Power Generation Sector and All Sectors scenarios (Ishwaran et al, 2017).

(I) Impact on quantity of coal consumed

Dropped coal utilization in China dampens the coal price sufficiently to raise coal quantity consumed at another place in the Power Generation Sector and All Sectors cases, leading to the whole consumption for coal not be affected to a large extent at the worldwide level. Both cases result in a decrease in Chinese quantity of coal consumed, with the all sectors scenario seeing a deeper decrease than the Power Generation Sector case. However, by 2030, total worldwide coal quantity consumed stays constant and is almost comparable to both cases. This is owing to the fact that worldwide quantity of coal supplied is at a large extent inelastic in terms of price, meaning that supply is not relatively affected by falling demand and, as a result, falling prices.

While a drop in Chinese quantity of coal consumed would force prices down, it would not be a significant drop. Cheaper coal expenses, on the other hand, would result in increasing coal utilization in nations that do not have impositions of coal-usage limitations (Ishwaran et al, 2017).

A rise offsets 96% of the loss in China's quantity of coal consumed in the Power Generation Sector case, while an increase everywhere else offsets 89% of the drop in the all Sectors cases. The nature of trade flows in the market of coal in every case is one of the reasons these two cases have differences. In the Power Generation Sector case, some of the coal that China would have been imported in the Baseline scenario

would no longer be needed and as a result it would be used closer to its source. In the all Sectors case, the output for the domestic coal and imports are reversed, and China is anticipated to become a net coal exporter by 2025. Although that, countries that constitute consumers of China's surplus quantity of coal produced would have transport expenses, that would lead to a smaller share of China's coal consumed escaping to other countries (Ishwaran et al, 2017).

The economics of decreased coal prices would promote coal leakage, and neither the Power Generation Sector nor the All Sectors scenario assumes similar coal reduction measures in other regions of the world. This effect would be mitigated if similar coal bans were imposed in other Asian nations. Given the interrelated structure of global energy markets, this research claims that a major reduction in worldwide coal usage can only be achieved by a concerted international policy effort (Ishwaran et al, 2017).

(II) Impact on natural gas consumption.

Natural gas, unlike coal, has a reasonably variable quantity supplied. As a result of rising quantity demanded and expenses, worldwide natural gas supply grows. The supply reaction cancels out some of the price increases, resulting in just a little rise in natural gas hub charges. In both the Power Generation Sector and the All Sectors cases, limits to quantity of coal consumed would trigger a significant shift away from coal and toward natural gas in China. To meet the rising demand, a variety of geographical places' output would be used, including a significant rise in local production. The increased utilization of LNG to fulfill domestic quantity demanded would cause domestic natural gas charges to climb, approaching those of Japanese LNG, increasing this way local quantity output (Ishwaran et al, 2017).

According to the model, while increased Chinese natural gas utilization would increase natural gas charges, natural gas-intensive nations such as the United States would not see a significant decline in their quantity consumed. Thus, in both the Power Generation Sector and all sectors cases, worldwide natural gas quantity demanded would be greater in total, and consumption losses outside China would only be enough to offset around 42% of the increase seen within China (Ishwaran et al, 2017).

(III) Impact on primary energy consumption.

Worldwide energy consumption rises by a net amount in both the Power Generation Sector and the all Sectors cases. The worldwide's total energy bundle becomes more affordable when the charge of coal lowers more than the rise in charges of natural gas. Increased coal utilization overseas would counteract China's decline in the consumption of coal, while China's growth in natural gas consumption would not be countered. In addition, the switch from coal to electricity in China would result in higher overall primary energy consumed (Ishwaran et al, 2017).

(IV) Changes in energy expenses as a result of China's utilization of natural gas as a substitute of coal would have a substantial impact on worldwide charges for coal but a far smaller effect on worldwide natural gas charges. Worldwide coal expenses are predicted to be lower in 2030 in both the Power Generation Sector and the all Sectors scenarios than in the Baseline scenario. In the Power Generation Sector scenario, the difference would be 15%, or $12/tonne, whereas in the all sectors cases, the difference would be 26%, or $20/tonne. One of the main causes for the considerable decline in worldwide coal charges is China's dominance as the globe's largest coal user.

China’s consumption at the moment is more than half of the globe’s coal and the high degree of international integration in the market of coal (Ishwaran et al, 2017).

As an output of risen Chinese quantity of natural gas demanded, natural gas charges would rise worldwide, but only modestly at the major worldwide natural gas hubs: a 3% price rise on average in 2030 across three major natural gas hubs: the NBP in the U.K., the Henry Hub in the USA, and the LNG import charges in Japan. As worldwide LNG commerce rises and average LNG transport expenses fall, there will be considerable gaps among these hub charges in all three cases.

The difference between Japanese LNG charging and the Henry Hub charge, for example, would shrink from more than $12/MMBtu in 2015 to $7–8/MMBtu in 2030, as long-run East Asian LNG charges become broadly equivalent to the Henry Hub charge, plus transport expenses. For a variety of reasons, increases in worldwide natural gas expenses would be significantly less than decreases in global coal prices:

• Because there would be some interchange from coal to non-natural gas fuels that exist in China, the rise in Chinese quantity of natural gas consumed would be somewhat smaller than the decline in Chinese coal usage (Ishwaran et al, 2017).

•China is a bigger participant in worldwide coal markets than it is in natural gas markets, so its decisions on coal would have a bigger impact on world markets (Ishwaran et al, 2017).

• Natural gas commerce is much smaller than coal trade, owing to pipeline bottlenecks and higher LNG shipping expenses, which restrict worldwide trade flows (Ishwaran et al, 2017).

• Due to the fact international natural gas quantity supplied is more price elastic than international quantity of coal supplied, natural gas output would expand to meet higher demand while coal output would stay essentially constant, resulting in a quantity supplied in excess and price drops (Ishwaran et al, 2017).

However, in both the Power Generation Sector and all Sectors cases, the charge of domestic natural gas in China will rise significantly. Domestic charges in the Power Generation Sector cases would reach $12/MMBtu by 2030, and $13/MMBtu in the All Sectors case, compared to $8/MMBtu and $10/MMBtu in the Baseline scenario. The reason for the effect on Chinese charging that was not even, is that when China begins to replace coal with natural gas, the increase in natural gas quantity consumed will be done by increasing imports of natural gas, particularly imports of LNG. As an outcome, natural gas charges in China would come closely towards the East Asian LNG charges (Ishwaran et al, 2017).

6. 11 Conclusion

The present chapter dealt with the most important aspects of the topic of LNG. In this regard, there was seen various stages of production in conjunction with the emergence of new players, the ways that LNG is priced, what are the price regulations, how are the prices linked with prices in natural gas and oil, the impact of the quantity demanded by Chinese on the worldwide market. Moreover, there will be seen three policy scenarios, the impact the Chinese supply and demand creates, as well as the effect on the global energy market. More specifically, in North America, in fact, short-term contracts indexed to the prices of the Henry Hub as well as the benchmark gas index in the United States, quickly led to the replacement of the conventional formulas linked to the price of oil. In Europe, there exist preferable long-term contracts. Finally, in Asia, spot market penetration proceeds in a much slower rhythm than in the United States or Europe. Transactions are carried out mainly through contracts that are included in the long-run entailed in indices pertaining to oil charges and not to spot prices such as the JKM (Japan Korea Marker). However, from the time the nuclear accident that took place in Fukushima, high prices in Asian markets have encouraged a massive influx of freighters wishing to sell LNG at the spot price as a reload.

It is notable that although there are regional differences, LNG has come to change the terms of gas contracts and promoted the transformation of gas into a commodity which can be freely traded on markets around the world (Robertson, 2021). There are three policy scenarios shaped: the baseline, the electricity sector, and all sectors' cases.

A great deal of influence involves the Chinese quantity of energy supplied and demanded that is based on the aforementioned cases. In an according manner there is an effect on the global energy market based again on the scenarios. It was seen that:

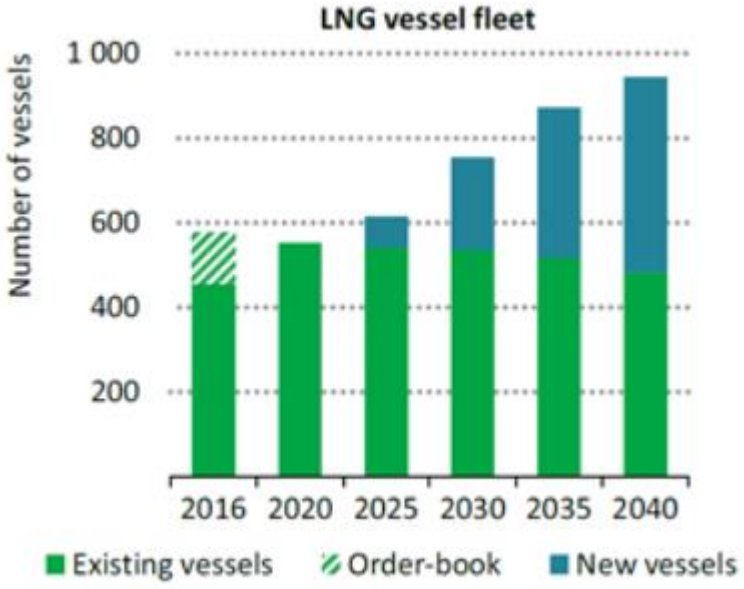
1) There was an impact on coal consumption
2) There was an impact involving natural gas consumption.
3) There was an impact on the primary energy consumption.
4) There were changes in energy prices as regards substituting natural gas for coal in China that would largely affect global coal prices and relatively less the worldwide natural gas prices.

Chapter 7: LNG Shipping

7.1 Introduction

One of the most important contributions of LNG is in the Shipping sector, which will be the topic of this chapter.

Figure 4 Evolution of the LNG Vessel Fleet



Source: IEA World Energy Outlook 2017, p. 364.

7.2 The contribution of LNG to the shipping industry

The employment of LNG in the energy map in an increasingly dynamic manner as well as its availability has surpassed the global sales of coal and crude oil. The map regarding energy is transforming at a global scale and in the specific framework the rise in demand for liquefied natural gas stands out, which is anticipated to launch in the following 20 years, according to economic analysts. In 2030, as shown on Figure 4.,an additional amount of 120 LNG ships will be needed, not counting those that will replace the older ones that will have to be withdrawn. In the coming years the LNG fleet will surpass that of the VLCC (Gkonis and Psaraftis, 2009).

It is more affordable to transport LNG by ships, instead of by pipelines when it comes for distances of over 4,000 kilometers. Ships carrying LNG are specially designed. They usually have a capacity of 125,000-165,000 cubic meters while Qatari ships are larger and their capacity ranges between 209,000-265,000 cubic meters (Gkonis and Psaraftis, 2009).

In 1969 there were only six ships and in 2020 594. In 1969 there were only three shipyards producing LNG compared to 15 today. In 1969 three countries had the know-how to build LNG ships as they are today. In 1969 two million cubic meters were transported and in 20202 362 million. The countries that imported LNG were then three and today they have reached to 44. Those which exported were two and today 20 in number (Gkonis and Psaraftis, 2009).

The fleet of LNG carrier ships is based on the data of January 2021, consists of 594 ships while 118 are being constructed. 37% of the present ships have a capacity of 167-185,000 sq.m. and an overall capacity of 35.1 million cubic meters. The largest capacity, from 185,000-266,000 is 46 percent of the total 11%. As for the construction of the 118 ships, 109 percent 92% is with a capacity of 167-185,000 cubic meters. Technology is evolving and ships are becoming more environmentally friendly, especially ones using LNG (Mokhatab, 2014).

LNG is projected to become a dominant fuel for shipping by 2050. China certainly plays an important role in LNG demand and is now the second biggest ranked importer after Japan. The largest volume of LNG freight flows is presented by Australia and

Japan with the corresponding Australia and China to follow very close (Mokhatab, 2014).

In terms of LNG Carriers supply, the Greek-owned fleet is on top in terms of value - 19.52 billion and surpassed the Japanese equivalent (14.29 billion) due to very high Greek shipbuilding orders. On the other hand, China's fleet is constantly gaining ground with its value now amounting to 5.93 billion (Won et al., 2014).

In terms of shipyards, South Korea's traditional ones are attracting large volumes of orders for LNG Carriers, and after the merger of HHI and DSME, China is coming under increasing pressure. For the coming years, however, Vessels Value estimates that Chinese shipyards will increase their market share of LNG Carriers, and in this way competition will increase among their Japanese and South Korean counterparts (Won et al., 2014).

Japan was one of the first countries to import gas and is still one of the largest today. Carbon dioxide emissions fell dramatically in Japan. Germany, on the other hand, is avoiding to adhere to the law and its only concern is the construction of LNG terminals around the world, so that it can import more and more quantities. The transport of liquefied natural gas is done exclusively by sea through tankers. The interesting thing is that this maritime transport is dominated by another European country, Greece. Every second tanker ordered in Asian shipyards belongs to Greek shipowners. Of the 66 orders, 33 are put by Greek buyers.

Greek LNG tanker shipowners therefore seem to have realized the great opportunities that are opening up in this field, long before their competition in Germany. According to ship valuation firm Vessels Value, no German shipping company has ordered suitable ships to carry LNG this year. This is despite the fact that the country for years owned the largest fleet of merchant ships.

In 2018, Greek shipowners signed orders worth $ 9 billion for LNG tankers. The amount of demand that there exists, can be seen by reading data provided by Vessels Value on the amount of rental of these ships: compared to previous years the rates have increased fivefold. For example, a shipping company demands $ 190,000 a day to transport liquefied natural gas across the Pacific to Asia. Experts support that there is no change expected. Prices have peaked and there must be a waiting time for many

more months at this high. In fact, there is a possibility, as industry experts point out, that in the coming years the existing LNG port capacity will not be sufficient to meet the needs. This automatically means that Germany, as being an importer of LNG, will depend on the capabilities and business strategies mainly formed by Greek shipowners.

7.3 Conclusion

From what can be concluded from this particular chapter, LNG has been developing in the shipping sector at a quick pace as years go by. More and more shipping companies tend to start using LNG and it is forecasted that it will be the domineering fuel of the sector by year 2050. The dominant force in the Mediterranean, the Greek shipping, has ordered $9 worth of LNG. Prices are in their peak and seems to stay there for a lot longer. Important is the fact that in the years to come due to the increase of LNG ships the according ports will not be able to hold the capacity demanded as in the case of Germany which imports LNG and would be highly dependent from the Greek Shipping companies.

CONCLUSION

The worldwide liquefied natural gas (LNG) industry has evolved in recent years, particularly after 2014, and can now be considered as a "mature" international business. With an increasing number of LNG nations which have been developing in exports, it is anticipated that the industry will become a star in the future years in countries such as the United States, Australia, and Russia, where there is an increased tendency of competition between these countries for market share. Of course, it's important to remember that Qatar is the worldwide's biggest supplier of liquefied natural gas (LNG).

In 2016, the worldwide gas market reached 706 billion cubic meters, with LNG accounting for 39% of the total, or 282.4 billion cubic meters of LNG quantity exported. Furthermore, the worldwide gas market is anticipated to reach 1.230 billion cubic meters (1.230 trillion cubic meters) by 2040, with LNG accumulating 59% of the specific total.

Natural gas being able to replace other means of energy like coal and lignite as the principal fuel for global production of power production will grow global gas quantity demanded even more, and it is an unknown factor that might rise worldwide quantity of LNG demanded. Furthermore, this tendency will continue as the number of storage facilities of LNG gas has expanded in recent years. LNG storage tanks will be installed at power plants that utilization of natural gas as the principal fuel, as well as at all modern ports and railway refueling stations, because LNG will be utilized as a potential fuel by modern times railways and liners.

As a result of the massive development of the international LNG business, the worldwide gas market will undergo major rearrangements. These reclassifications, according to the International Energy Agency (IEA), will intrigue worldwide competitiveness between Russia, Australia, the United States, and Qatar to see who will have the largest market share in the world’s LNG market.

Due to the fact that there is intense competition between oil and natural gas, the outcome resulted in the weakness in recent decades when Japan and other Asian importers of LNG believe that LNG charging should no longer be linked to expenses involving crude oil imports. As a result of such a poor market outcome in Asia, Japan has taken a

number of steps to combat the inclusion to oil indices and, as a result, cut expenses on transactions.

First, in order to improve the flexibility in the market, Japan has significantly expanded purchases that were spot and/or short-term of LNG since 2010. Under strict market circumstances, this first proved to be an expensive approach, but it did help Japan replace squandered nuclear power following the accident that took place in Fukushima. With market glut emerging in 2014, Japan was able to negotiate for less spot cargo charges and de-link them from JCC-indexed charging in the long-run due to the fact to the liquidity provided by previously costly spot purchases.

Second, since 2012, Japanese firms have negotiated a slew of long-run contracts with US suppliers, offering to flow large quantities of HH-charged LNG with no destination clauses in the second half of the particular decade. Finally, during late 2011, Japan initiated a collaborative effort with other local importers of LNG. The discussion took place only during summits that are taking place per annum of Japanese and South Korean ministers for energy and gas corporations. In 2013, more local importers were involved, and discussions about practical remedies such as cooperative offering and the creation of a trading hub became increasingly contentious (Vivoda, 2014).

In terms of Eurasia's geopolitical and energy chessboard, the growing prominence of liquefied natural gas (LNG) in the potential European energy mix will provide Europe a competitive advantage over Russia. A good site for the provision of LNG gas to Europe would be the Eastern Mediterranean. As a result of such a move, the EU would meet with Israel and Egypt on a geopolitical level, with Greece and Cyprus functioning as arbitrators.

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