Journal of Naval Sciences and Engineering
2018, Vol. 14, No.2, pp.71-90
Basic and Social Sciences/Temel ve Sosyal Bilimler

RESEARCH ARTICLE

THE MODEL OF PRICING OF SMALL SCALE LNG BUNKER TERMINAL IN TURKEY

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Date of Receive: 08.06.2018 **Date of Acceptance: 14.11.2018**

ABSTRACT

Turkey has great potential in liquified gas bunkering industry. Early application of liquified gas terminal investments is high likely to generate substantial income for the shipping industry of Turkey and to its economy as a whole. The marine shipping industry is facing challenges to reduce engine exhaust emissions and greenhouse gases (GHGs) from their ships. LNG is a potential solution for meeting these requirements. Progress in the marine fuel industry has become critical to shipowners and cargo owners, since fuel consumption accounts for much of the total cost of travel and can be a significant part of total transport costs. LNG bunker in Northern Europe is advancing, however, worldwide lack of supply is undermining the spread of LNG bunkering. Therefore, providing security of supply in the Eastern Mediterranean could represent an important milestone towards LNG supply chain implementation.

Keywords: *LNG Terminal Price, Marine Fuel, Bunker Alternatives, Emission*

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TÜRKİYE'DE KÜÇÜK ÖLÇEKLİ LNG YAKIT TERMİNALİNİN FİYATLANDIRMA MODELİ

ÖZ

Türkiye'nin doğal gaz gemi yakıtı tedarikinde büyük bir potansiyeli var. Sıvılaştırılmış gaz terminali yatırımlarının erken uygulanmasının, Türkiye denizcilik sektörü ve bir bütün olarak Türkiye ekonomisi için önemli bir gelir yaratması mümkündür. Gemilerin neden olduğu egzoz emisyonlarının ve sera gazlarının azaltılması talepleri denizcilik sektörü üzerinde ciddi sıkıntı yaratmaktadır. Deniz yakıtı endüstrisindeki ilerlemeler, gemi sahipleri ve kargo sahipleri için kritik hale gelmiştir, çünkü yakıt tüketimi toplam seyahat masraflarının çoğunu oluşturmaktadır ve bu durum, tonaj maliyetlerinin önemli bir parçasıdır. LNG bu gereksinimleri karşılamak için potansiyel bir çözümdür. Kuzey Avrupa'da LNG yakıt tedariki çok hızla ilerlemektedir, ancak dünya çapında arz eksikliği LNG tedarik zinciri'nin yayılmasını engellemektedir. Bu nedenle, Doğu Akdeniz'de yakıt arz güvenliği sağlayacak terminal yatırımları, LNG tedarik zinciri uygulamasına yönelik büyük bir eksiği kapatmaya yardımcı olacaktır.

Anahtar Kelimeler: *LNG Terminal Fiyatı, Gemi yakıtı, Gemi yakıtı Alternatifler, Kirlilik*

1. INTRODUCTION

Increased environmental focus on the market today and the simultaneous need for the maritime industry to become more responsible for its environmental footprint is influencing the decisions that the shipment must make in terms of fuel type selection. “In the International Energy Outlook 2016 [8] reference case, transportation sector delivered energy consumption increases at an annual average rate of 1.4%, from 104 quadrillion British thermal units (Btu) in 2012 to 155 quadrillion Btu in 2040.” This amount is more than 50% higher than previously assumed and involves an annual CO2 (Carbon dioxide) emission of approximately 1100 million tones, equivalent to about 4% of global CO_2 emissions. “In addition, marine vessels emit large quantities of SO_2 (Sulfur dioxide), NO_x (nitrogen oxides) and soot PM10 (Particulate Matter), since the standard shipping fuel HFO (Heavy Fuel Oil) contains at present about 2.7% Sulfur, which is very high compared to other transport fuels. “Shipping emissions have been estimated

to induce more than 60,000 premature deaths globally, of which about one third in Europe [2]". "Land based sources have achieved an enormous reduction in air pollution over the last decades. In contrast, shipping emissions have substantially increased over the same time span, along with the gradual growth of marine transport [7]". The combination of liquefied natural gas bunkering and natural gas combustion engines for ships has been presented as one of the three possible ways to comply with the standards established by the International Maritime Organization (IMO) regulating the control of dangerous pollutant in ship exhaust systems. The other two options are continued use of heavy fuel oil (HFO) with exhaust gas purifiers and combustion of low sulfur MGO (Marine Gasoil) / marine diesel MDO (Marine Diesel oil) diesel in ship propulsion systems. "The global LNG industry is approaching its 53th anniversary in 2017. It has proposed a huge amount of new LNG capacity of 400 million metric tons a year, which, if built, would be double 2025 [12]". The growing shortage and price of oil will favor the use of renewable fuels. For a ship, fuel may represent between 50% and 70% of the total ship ownership and ship management costs. Heavy fuel oil , marine diesel oil and marine gas oil are all conventional fuels. Ship-based fuels are a major part of oil consumption and all these fuels are high in the emission rate. The marine fuel oil market consumes about 300 million tons of diesel annually, and oil prices tend to follow price developments. LNG potential as bunker fuel to help reduce ship emissions is remarkable. "The use of natural gas produces the following NO_x, PM and CO_2 reduction of engine exhaust emissions; carbon emissions of about 25%, nearly 100% SO_x, 85% NO_x, 95% PM[13]".

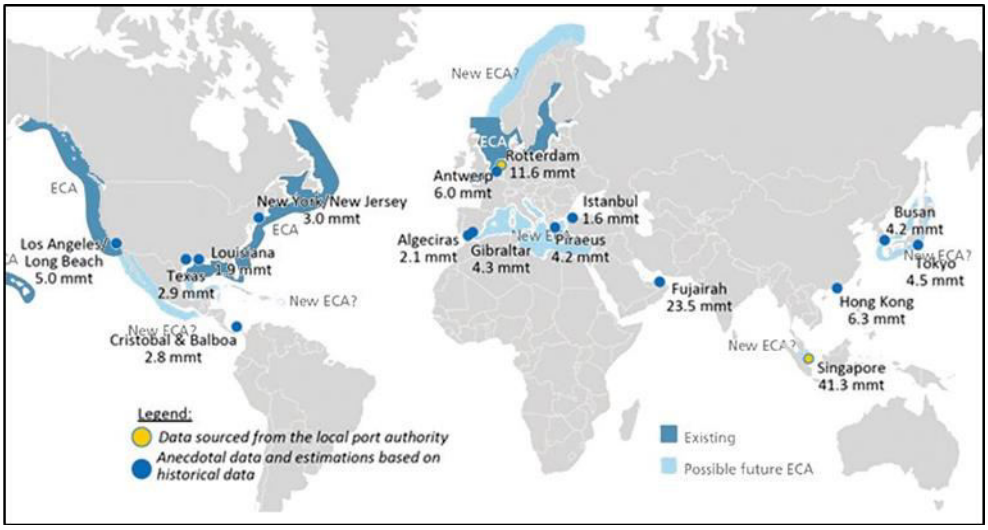

Figure 1. Emission Control Areas (ECA)
Source: DNV GL

In Emission Control Areas, Figure 1. Emission control areas (ECA) for Tier III and possible future ECA as indicated by DNV GL, sulphur limit in fuel used on board is 0.1%. The explanation of 'fuel oil used on board' includes use in main and auxiliary engines and boilers. In addition, there are new rules on ship energy efficiency for owners / operators and cards to be considered, where Liquefied Natural Gas (LNG) can play an important role. However, the main developments of liquefied LNG infrastructure must take place before it can be considered a viable alternative to conventional fuels. As the maritime industry considers alternatives to HFO, a part of the market will move to the MGO, partly to LNG and, where appropriate, liquid biofuels. "Transportation and handling of LNG a cargo on land and sea have been proven for many decades. With new emission regulations, the potential applications for LNG is expanding. Especially attractive for marine vessels travelling set routes such as ferries and tug boats. LNG as main propulsion fuel is no longer a new invention and the technology is already classified as proven. One of the main reasons for exploring LNG is its potential for environmental benefits. "International regulators, such as the International Maritime Organization (IMO) and the national environmental agencies in many countries, have issued rules and regulations that drastically reduce greenhouse gases and emissions from marine source [9]". Offshore ships

typically spend 5% to 6% of their running time on SO_x Emission Control Areas. Therefore, ship owners should consider new fuels and / or technologies to develop the competitive advantage of short sea shipping.

2. LNG BUNKER CONSUMPTION

"LNG consumed as marine fuel will reach 1 million tones by 2020 and rapidly grow to 8.5 million tons by 2025 [5]". Europe and the United States will rely primarily on the national production of natural gas for the making of LNG as marine fuel. Asia Pacific will instead have to rely on LNG imports at fixed prices in the Asia-Pacific market. Several other LNG demand projections as marine fuels have been published and all vary in hypotheses; world activity and shipping and shipping activities, absolute fuel prices, relative Gross Domestic Product (GNP) and natural gas compared to the cost of supplying LNG as fuel, The cost of LNG supply infrastructures and the availability of LNG fuels.

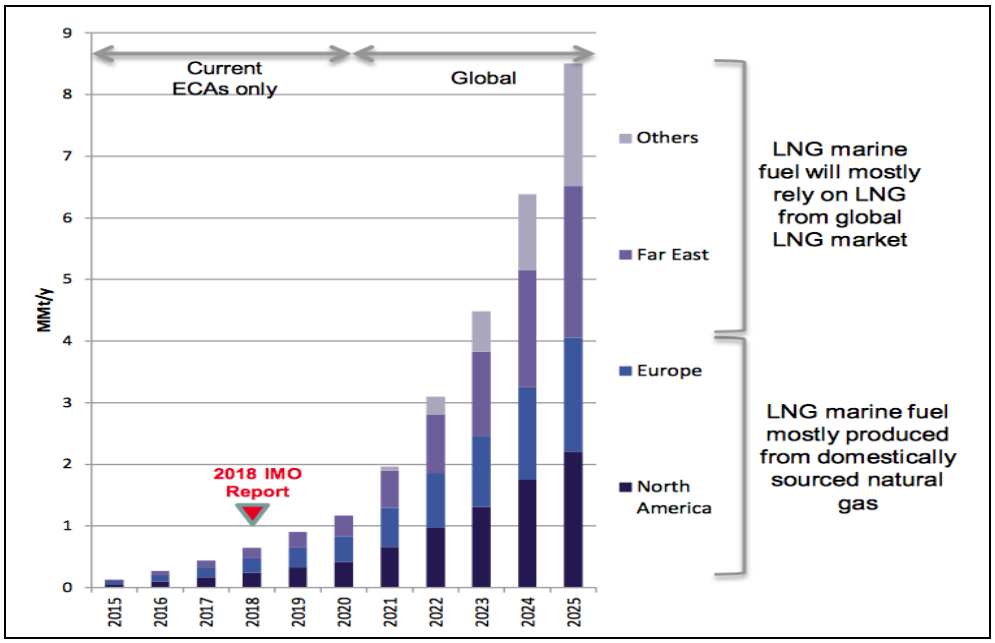

Figure 2. LNG Marine Fuel Consumption by Location
Source: IMO.org

Figure 2. shows that the use of liquefied natural gas as ship fuel has recently gained more attention in Europe, but also in Asia and the USA. “DNV GL recently published the Maritime Forecast to 2050 which analyses the impact of the changing global energy system on the shipping industry through to 2050. The report proposes that by 2050, “only 47% of energy for shipping will be from oil-based fuels. The share of gas in the fuel mix will rise to 32% [3]”. The typical expectation is, from 0.7 to 66 million tons in 2025 depending on the scenario, from 8 to 33 million tons in 2020 according to the scenario, 65 million tons in 2030. Europe and the United States depend mainly on the national production of natural gas for the production of LNG for marine fuels. Asia Pacific will instead have to rely on LNG imports at fixed prices in the Asia-Pacific market. There have been several other LNG demand projections as marine fuels and all vary global business assumptions and subsequent shipping and naval activity, absolute fuel prices, relative GNP and natural gas relative to the oil price, activity Regulating specifically environmental issues, costs to equip conventional ships to use LNG as fuel, cost of LNG supply infrastructure and LNG fuel availability. LNG consumed as marine fuel will reach 1 million tones in 2020 and rapidly increase to 8.5 million tones in 2025. It is expected to meet this demand must be established more than 40 small scale LNG terminals across Sulphur Emission Control Areas (SECA) 2015, integrated by terminals of medium size, tankers and combustion vessels. From an economic and financial point of view, the following recommendations are offered:

- The reference price for LNG bunkering infrastructures should be based on an average internal rate of return on infrastructure investment below 12% to reach a competitive GNP price;
- Are coordinated investment efforts to avoid sub-optimization are needed to establish “least critical" level of LNG bunkering infrastructure to meet demand in 2015-2020;
- Business cases or plans for specific investment projects need to be developed, partly as a result of cluster work in ports or similar;
- Local or regional port clusters should underline the development of the local LNG market, including possible synergies with land demand;

- The European funding scheme is necessary for the development, construction and operation of LNG bunker vessels / barges at the initial stage of the market.

3. LNG BUNKERING UNCERTAINTIES

There are some uncertainties that affect the decisions of ship owners and bunker fuel suppliers in global LNG growth as marine fuels. Ship owners face three alternatives to comply with regulations with uncertain timing for global implementation. Regional Emission Control Areas (ECA) initiatives will lead to greater use of LNG. This has happened in Scandinavia and seems to be developing in the United States. However, the overall prospects remain slow and there will be a clear choice of fuel, because the ship owners will be able to opt for the flexibility in their navigation commands until finally the time and implementation of Annex VI is established. Given the considerable uncertainty about fuel differentials and fuel prices, a flexibility strategy will be crucial. "About 80% of total LNG sales are made through long-term LNG purchase and sale contracts; The rest is sold in spot and short term. The world market size for bunker fuel equivalent to about 70% of the global LNG market, a significant fuel LNG fuel change would require such an increase in LNG supply [10]". Future fuel price estimates contain a large number of uncertainties. "However, the cost of infrastructure costs to transport LNG from end-user import terminals is important if LNG is a competitive fuel for shipping. In addition, the cost-benefit analysis of the supply chain LNG is characterized by great uncertainties that make companies more sensitive than the estimated return time. In addition, shorter retrieval times are generally required when uncertainties are greater [1]". "It is expected that annual LNG demand will reach 8.5 million meters in 2020 and 14 million cubic meters in 2030 is expected to meet this demand needs to be established more than 40 small scale LNG terminals across SECA in 2016, Integrated From medium-sized terminals, tankers and tanks." From an economic and financial point of view, the following recommendations are offered,

- The price of LNG infrastructure should be based on an average internal rate of return on infrastructure investments of less than 12% to obtain a competitive GNP price;

- Co-ordinated investment efforts are needed to avoid minimal optimization to establish a critical level of LNG infrastructure to meet demand in 2016-2020;
- Business cases or plans for specific investment projects need to be developed, partly as a result of working in port groups or similar;
- Regional port or similar businesses should insist on the development of the local LNG market, including potential synergies with land demand;
- A European funding scheme for the development, construction and operation of LNG vessels / barges is needed in the initial market launch."

4. LNG BUNKERING INVESTMENT MODELS & DECISION PROCESS

There are several ways of quantifying, presenting and analysing LNG investments for storage purposes; conceptual issues with regard to investment analysis and considerations of practical models in this respect. Three main mathematical models for retail LNG to bunkering is

- Asset/ Liability Models,
- Cash Flow LNG Bunkering Investment Approach
- Hub price + cost/profit elements; What matters most is your future and preferred risk management vision.

The investment strategy is the set of basic guidelines in which the investment function operates. The asset/liability area plays a key role in the development of general guidelines or investment strategy. The investment strategy for the LNG bunkering storage process begins with the development of the initial investment strategy. LNG Bunkering investment decision requires;

- Framework and decision-making processes
- Risk and measure of reward
- Use of cash flow or asset/liability model
- Evaluation of alternative difficulties to investment modelling,
- Investment vehicles and hedging opportunities
- Different tools available for coverage - both oil and gas
- Some also choose double fuel as a natural hedge
- It's important to work on contracts to fit your preferences
- Terms, prices, delivery terms and more

- Inland and supply chain requirements
- International standards (IMO, ECA, etc.)
- Other bunkering systems
- Duration and volume goals
- Requirements credit quality requirements
- Location requirements
- Liquidity constraints (short-term cash requirements)
- Parameters of the investment mix
- Cash flow characteristics (MGO versus LNG)
- Performance criteria (total performance, maximum performance).
- Asset / Liability LNG Bunkering Investment Approach; Asset/liability models are a common tool in developing the investment strategy. Asset and liability models are a key tool that investment decision makers can use to measure the parameters associated with investment risk. These include the duration and convexity, liquidity, and cash flow characteristics. Below are some useful tips for proper use of these models.
- Understand the strengths and weaknesses of the investment.
- Project cash flows, if properly adjusted. It gives us a general understanding of the characteristics of cash flow and investment risk. However, the cash flow model does not give us a good idea of credit risk.
- Therefore, you need to understand the strengths and weaknesses of your cash flow models and make sure you do not draw conclusions based on a weak model.
- To have a realistic cash flow model, you need to get the buy-in from the investment area in the investment hypotheses. If this is not achieved, it can mislead LNG investment needs in that region and make it virtually impossible to move from model results to supply.

Finally, avoid complications in the cash flow model. To understand what is really driving the results, you should keep it simple. A complicated pattern can confuse of the results.

4.1. Cash Flow LNG Bunkering Investment Approach

Cash Flow LNG bunkering investment model produces results in a number of interest rate scenarios. In general, measure the present value of legal

incomes in each scenario. A risk measure could be the relationship between average and standard deviation. It is often useful to look at different worst scenarios. Usually it can be seen a model in the worst cases that indicate the riskiest environment for that particular responsibility.

4.2. Hub Price Cost /Profit Elements Approach

Cost/ Profit Elements model is the ability of a business to control its costs of goods sold (COGS), along with fixed costs, while revenue optimization contributes to profitability in generating profits. The investment evaluates three levels of profit margin. The first is the gross margin, which is equivalent to the regular gross profit divided by income. In this equation, the key elements of the cost are COGS. These are the costs for the manufacture or purchase of LNG fuel that you sell to generate revenue. Their gross margin shows how their ability to add value to the sale of goods and to pay reasonable prices on them. This is fundamental to the bottom line. In addition to COGS, operating costs also include fixed or general costs that are paid to operate independently of production or revenues. Maintaining operating costs is important to give the LNG fuel terminal an opportunity to use gross profit to cover costs and make money.

With converging prices and a more efficient market, market price definition influences are needs. In this case, it would be necessary to foresee the future bid and the demand for a forward price. In a conservative forecast, with a higher bid than long-term demand due to large projects, a long-term price reduction could occur. This is reflected in the low-priced scenario. The forward price between two parties is usually the difference between the spot price and the forward price. This long useful life for a forward contract poses any risk to the contract issuer. As a supplier, it is important that the forward price is also above the price of the balancing of the delivery costs, in order to make the contract profitable. The current spot price in National Balancing Point (NBP) is 11-12 USD / MMBtu. Meanwhile, the balance price when recording the transport to Milford Haven is 6.8 USD / MMBtu. Therefore, the forward price should be between these two figures. In the low-priced scenario, the price in Europe is 8 at the lowest level. Therefore, let us assume a forward price of 8.5 USD / MMBtu. “The LNG infrastructure price should generally be based on an average internal rate of return on infrastructure investments of less than 12% (corresponding to a

recovery period of approximately 8 years) to obtain a competitive price of LNG, Co-ordinated investment efforts are needed to prevent under-optimization to establish a critical level of LNG infrastructure [14]". Business cases or plans for specific investment projects need to be developed, partly as a result of working in port groups or the like, Conglomerates of local or regional ports or similar should point to the development of the local LNG market, including possible synergies with land demand, The need for funds for the construction of the LNG terminal is established after taking into account the financial resources required for the implementation of the Project and the evaluation of the submitted national and international regulations. The model establishes that LNG Terminal revenue consists of three partitions;

- Fixed cost compensation includes all fixed costs of the LNG Terminal, its infrastructure and the connection necessary to ensure the operation of the LNG Terminal, including installation costs of the LNG terminal, its Infrastructure and connection to the LNG Terminal Y gas transport system is the carrying value of these activities;
- Regasification Rate Revenue; Revenue from fixed-cost compensation and return on investment is included in the security component. The safety component is collected, administered and delivered by the operator of the natural gas transport system under the conditions set by the national authorities.
- The Model provides for the pricing of services of an entity in natural gas liquefying business, which establishes the calculation of an additional natural gas supply safety component in addition to the upper limit of the natural gas transmission price. The need for funds for the construction of the LNG Terminal is established after taking into account the financial resources necessary for the implementation of the Project and evaluating the presented national and international regulations. The Model states that the revenue from the LNG terminal consists from two partitions:
- Revenue from fixed cost compensation includes all the fixed costs of the LNG Terminal, its infrastructure and connection that are necessary to ensure the operation of the LNG Terminal which includes installation costs of the LNG Terminal, its infrastructure and connection to the gas transmission system and is the carrying value of these assets;

- Revenue from Regasification tariff; The revenue from fixed cost compensation and the revenue from return on investment shall be included into the Safety Component. The Safety Component shall be collected, administered and disbursed by the transmission system operator for natural gas under the terms and conditions set by the national authorities.
- According to the Model, the Price security supplement (Mp, Sec) is calculated using the below mentioned formula:

F_{ACOST} = fixed annual cost of the LNG Terminal, its infrastructure which are calculated using the following formula:

$$F_{ACOST} = C_{Maint} + C_{Staff} + C_{Tax} + C_{Admin} + C_{M\&S} + C_O + C_{Term} + C_{DE}, \quad (1)$$

thousand LTL, here

C_{Maint} = Maintenance, repair, technical management and operational costs,

C_{Staff} = Staff costs,

C_{Tax} = Tax costs,

C_{Admin} = Managerial costs,

$C_{M\&S}$ = Advertising and Trades costs,

C_{DE} = Depreciation (amortization) costs,

C_O = other fixed costs,

C_{Term} = Costs of the LNG Terminal,

ROI_d = Return on Investments in infrastructure part

$F^{ADM}_{ACOST\ (t+1)}$ = Forecast for expected tax expenses for the calendar year.

Q_p = Expected quantity of natural gas transmitted through gas transmission pipes, thousand m^3.

5. LNG BUNKERING RECOMMENDATIONS IN TURKEY

We believe that Turkey can be a driving force in the eastern Mediterranean region, and it should involve a number of activities such as research, development and concept design standards, and some early commercial applications, especially when we have very promising and Building Industry Well-structured naval. Turkish ship builders will gain a lot if they see LNG fuel demand on the shipping market quite quickly. The feasibility of LNG

bunkering terminal projects, large-scale terminals, will cover the cost of construction in about 8 years, while small and medium-sized terminals will cover construction costs in approximately 12 years at current rates. This study will help future operators and ship owners in LNG bunkering business and waterfront facilities in Turkey. Of course, it will not be a single solution for ship owners to comply with the new rules. Some factors should be considered to make a decision; the type and age of the ship, its route, its secondary market, the financial strength of the owner, the competition between the ship owners, crew qualification, potential loss of loading), experience of LNG owners, availability of worldwide, regional and local products, etc.

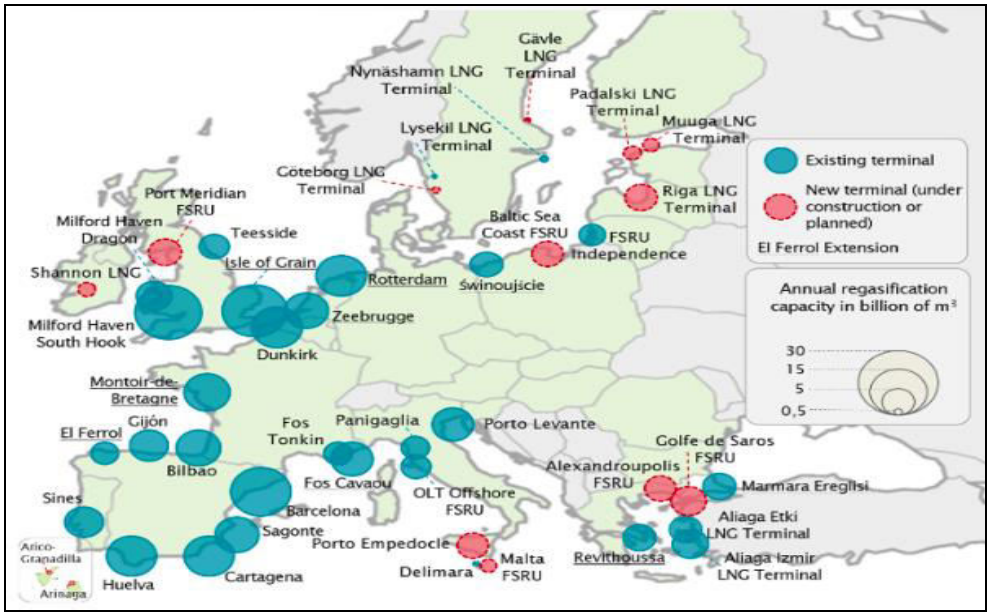

Figure 3. Existing LNG Terminal in Europe
Source: GIIGNL 2018 Annual Report

Figure 3. shows an overview of the large-scale LNG import terminals in Europe today, existing, under construction and planned and the services provided at Europe's existing LNG import terminals. "On the demand side, the LNG market is becoming more diverse and more complex, with a total of 40 countries now importing LNG. Most of the demand growth occurred in Asia, where LNG imports grew by 19.6 MT [6]". The transport sector is

the main contributor to oil demand in Turkey, almost 40% of the current budget deficit caused by oil costs. The ships will be impacted by the regulations and competition among ship owners is strong. This will create a new demand for shipbuilding. “Particularly ECA short-haul boats with fixed routes will develop a high percentage of new construction and RO-RO and a small percentage of new or existing oil tankers. Many land ships will also operate with LNG, which should increase the amount of LNG fuel available in the port to reach a certain scale. Obviously, this will create new opportunities for the naval industry. More than 1,000 new LNG vessels will be ordered over the next 20 years to comply with the new regulations [5]”. The starting point for LNG supply depends on the region and therefore from the availability of LNG or pipeline gas, import or export region, region extension and door density, etc. The requirement to start and build the entire supply chain is seen as a major obstacle to the development of LNG bunkers.

There are a limited number of supply points for LNG liquefied gas in the Mediterranean Sea, although LNG is already available in many places. Further logistics are needed to transport it to the port, keep and retain the ship. Each case must be considered separately, taking into account these characteristics. Turkey has great potential to meet these needs if it acts quickly and well planned. In the long run, some governments around the world have larger LNG plans in the maritime sector. For example, “The European Commission has launched an ambitious plan for the supply of 139 LNG landfill gas inland waterways and inland waterways for the period 2020-2025 [4]”. There is a steady increase in the number of ports that are studying to invest in LNG as fuel in Europe. The main change brought by Directive 2012/33/EU, namely the mandatory use of low sulphur marine fuels in the Baltic Sea and North Sea designated as Sulphur Oxides Emissions Control Areas (‘European SOx-ECAs’), took effect on 1 January 2015. Consequently, the Commission received Member States' first reporting on compliance with the new sulphur requirements in the European SOx-ECAs not earlier than 30 June 2016. The European Parliament and Council a more stable and aggregated overview of the level of enforcement at present-day. There are very few supply points for LPG liquefied gas, although LNG is already available in many places. Further logistics are needed to transport it to the port, keep and retain the ship. There are several

advantages for the first engines in this industry of the shipping industry that provide for supplying or using LNGs as fuel.

The effectiveness of LNG liquidity markets depends on the ability of suppliers to optimize logistics and make it economically advantageous for customers to convert their LNG stock. High-intensity capital infrastructure is much more expensive than similar chains and, consequently, infrastructure costs represent much of the energy cost compared to competing energy carriers. In this relatively new market area there are important investments in the supply chain such as charging plants, small scale liquefaction plants, local terminals and storage facilities, distribution trolleys and ships, bunker barges, operators and security personnel for dealing with substances cryogenic.

5.1. LNG Terminals in Turkey

Turkey has two Liquefied Natural Gas (LNG) terminals, the Aliağa and the Marmara Ereğlisi. The Aliağa has a capacity of 25 mcm of gas transfer per day while Marmara Ereğlisi has 18 mcm. BOTAŞ plans to increase Marmara Ereğlisi LNG Terminal's daily capacity to 27 mcm by 2017. BOTAŞ aims to increase Turkey's energy supply security and diversify its gas sources, and with this aim, the company is working on expanding LNG storage and Floating Storage Regasification (FSRU) units.

Clearly, there will be only one solution for ship owners to comply with the new rules. Many factors have to be considered to determine the best solution; the type and age of the ship, its route, its secondary market, the financial strength of the owner, the competition between the ship owners, crew qualification, potential loss of Load space), experience of LNG owners, availability of global, regional and local products, etc. The transport sector is the most important contribution to oil demand in Turkey, almost 40% of the expenditure. The ships will be affected by the rules and the competition between ship owners is convincing. This will create a new question for shipbuilding. Particularly ECA short-haul boats with fixed routes will develop a high percentage of new construction and RO-RO and a small percentage of new or existing oil tankers. Many land ships will also operate with LNG, which should increase the amount of LNG available in the port to reach a certain scale. Clearly, this will create new opportunities for the naval industry. More than 1,000 new LNG vessels will be ordered

over the next 20 years to comply with the new regulations. The starting point for LNG supply depends on the region and therefore from the availability of LNG or pipeline gas, import or export region, region extension and door density, etc.

5.2. The Major Obstacle of the Development of LNG Bunkers

The condition to start and build the entire supply chain is seen as a major obstacle to the development of LNG bunkers. There are very few supply points for LNG liquefied gas in the Mediterranean Sea, although LNG is already available in many places. Further logistics are needed to transport it to the port, preserve and preserve the ship. Each case must be considered separately, taking into account these characteristics. Turkey has great potential to meet these needs if it acts quickly and well planned. In the long run, some governments around the world have larger LNG plans in the maritime sector. For example, the European Commission has launched an ambitious plan for the supply of 139 LNG landfill gas inland waterways and inland waterways for the period 2020-2025 [4].

The Chinese central government, at the end of 2012, provided guidance on how the development of green ports would be part of its strategy to improve air quality under its twelfth five-year plan. Within the scope, ports will accelerate the use of natural gas to replace heavy fuel oil with ships. “Figure 3 shows that 68% of the bunker LNG infrastructure set is based in Europe primarily in the Scandinavian region according to Lloyd's register [11]”. There is a steady increase in the number of ports reported that are studying LNG as fuel in Europe. The main focus was on ports in Northern Europe, guided by the 2015 deadline for the sulfur-dioxide monitoring zone (SECA). However, there are other ports that are implementing bunkering facilities, such as Rotterdam and Singapore, with further ports in Europe, North America and Asia. There are very few supply points for bunker LNG, even though LNG is already available in many places. The further logistics are required to transport it to the port, store and bunker the ship. There are several advantages to first movers in this segment of marine industry who plan to supply or utilize LNG as fuel. Among the reasons for being first investors to LNG bunkering facilities, include,

- Concerns about the potential supply shortages for ultra-low sulfur diesel in between 2015 - 2020

- A potential price spike due to high demand for ULSD and scrubber installation cost
- Environmental stewardship
- Low cost and abundant supply of natural gas.

The feasibility of many emission reduction technologies depends to a large extent on the different fuel prices and the relative differences. This fact, together with the general importance of fuel prices for the profitability of the maritime industry, makes it vital to monitor the fuel markets and monitor their developments. Analysis of oil and gas trends is expected to show that gas prices and oil and gas dissipation are a turning point that is likely to increase the availability of spot gas in Europe. "According to new standards, low sulfur fuel will be in high demand, which in turn will lead to greater demand for alternative fuels. The future of marine fuels seems to be a combination of fuel types combined with new propulsion technologies and adaptive fuel systems and / or emission systems. The maritime industry will face increasing demands for safety, security, environmental performance and efficiency beyond 2020 [12]". Fuel will remain expensive beyond 2020 and will drive demand for energy-efficient vessels. These will focus on optimum energy utilization and will be designed and managed with alternative fuels such as LNG, energy systems and lightweight construction. Anticipating a growing global demand for natural gas, the Turkish government should see LNG as a promising future for maritime industry. The infrastructure needed for LNG bunkering of ships in Turkish sea and inland ports using special LNG bunkering vessels needs to be explored further. To enable LNG bunkering in Turkish ports, the country needs to build a supply infrastructure before 2020. One quick and efficient method would be distributing LNG via ship to ship bunkering with small vessels LNG carriers, with short term LNG storage provided by port terminals. Finding storage terminal in port location will be challenging task to face with.

6. CONCLUSION

It should be known that great price differences in bunker fuels, and even more so with LNG, can be seen among different countries' fuel markets. Eventually, there will be an LNG bunkering procedure that follows the same pattern as that of heavy fuel oil, customers will expect a similarly convenient bunkering, including an acceptable time frame and guarantees

for the safety of crew and passengers. This is the next challenge to develop a LNG storage system that includes all organizational, security and technical aspects and requirements. Stronger environmental standards requiring reduced $SO_{x,}$ NO_x and particulate emission levels are pushing the shipping industry to use cleaner energy sources. “Reducing technologies, such as recirculation of exhaust gases, scrubbers and catalytic reduction, can generally meet some of these standards. “LNG and biofuel blends will be exploited beyond 2020 By 2020, marine fuels will reach 1 million tones by 2020 and will rapidly increase to 8.5 million tones by 2025 [12]”. Europe and the US Will mainly be from the national production of natural gas for the production of LNG for marine fuel. Asia Pacific will instead have to rely on LNG imports at fixed prices in the Asia-Pacific market. The results of these expectations, LNG demand will rise to 8 to 33 million tons in 2020 and 65 million tons in 2030. Controlling emissions and low LNG prices should be the main engines for LNG development as fuel. Currently missing bunker infrastructures and the regulatory framework for such operations are the main challenge that needs to be tackled soon to make LNG a reliable option for owners in their decision on future ships. Since LNG marine fuel becomes more common, it is necessary to implement regulations and standards along with technical and procedural developments. LNG fuel standards are needed because they guarantee a level of safety and create common reasons for operators, thus facilitating the expansion of the LNG industry.

When deciding on a strategy to comply with emission laws, the important compromise is the cost of low sulfur fuel compared to the cost of a purification system. Regulations and profitability are the most significant reasons for investing in new technologies, while the installation and operation costs and maturity of the technology itself are the most important. Industry will continue to introduce the technological innovations and infrastructures needed to provide the growing LNG market, provided there is an advantage over the costs of using LNG compared to alternative fuels. In recent decades, market focus has focused on technical and commercial issues, but now that technical solutions exist and markets are growing, the industry is looking closely at strategic and regulatory issues. Because of its low cost compared to conventional marine fuels and its ecological nature, LNG is seen by the European Union as an attractive future fuel for ships.

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