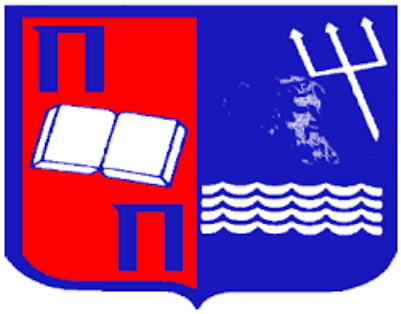
UNIVERSITY OF PIRAEUS



MARITIME STUDIES

MSC in SHIPPING (ΠΜΣ ΝΑΥΤΙΛΙΑ)

THE EFFECTS OF THE ENERGY CRISIS ON LNG FREIGHTS: A THEORETICAL APPROACH

Nikolaos Diomis

Dissertation

Submitted to the Department of Maritime Studies of the University of Piraeus as part of the requirements for obtaining the Master's Degree in Maritime Studies

Piraeus

17 September 2024

The person producing the Dissertation bears full responsibility for determining the fair use of the material, which is determined on the basis of the following factors: the purpose and nature of the use (non-commercial ,non-profit, education, research), the nature of the material used (part of the text, tables, diagrams, images or maps), the percentage and significance of the part used in relation to the entire copyrighted text, and the possible consequences of such use on the market or on the overall value of the copyrighted text.

Nikolaos Diomis

This Dissertation has been unanimously approved by the Tripartite Examination Committee appointed by the Secretary-General of the Department of Maritime Studies of the University of Piraeus in accordance with the Rules of Procedure of the Postgraduate Programme in Maritime Studies.

The members of the Committee:

Dionysios Polemis (supervisor)

Lagoudis Ioannis

Tsioumas Evagelos

Approval the Thesis by the Department of Maritime Studies of the University of Piraeus does not imply acceptance of the author's views.

Πίνακας περιεχομένων

Preface

The pandemic of Covid19 and the Russian - Ukraine war impacted in the global economy. Health crisis led to an energy crisis, and the war pushed the prices even higher. Apart from the economy, the balances in the global map are about to change, with the power game of the companies and the states removing on new levels. Russian's sanctions and pipeline's disruption, led LNG (Liquefied Natural Gas) industry growth. This market is about to expend the next years, because enhance the security of energy supply.

The understanding of natural gas generally and LNG specifically, will permit to understand the future of economy, the update needs of energy and in a way the future human lives. Natural gas even in pipelines or in liquefied form, gain place in the market, in the industry and in our lives, that is the main reason for me to record this dissertation.

At this point, I would like to thank the Professors, Mrs. Dionysios Polemis and Christos Bentsos, as they contributed the most in order to complete this work, as well as the University of Piraeus, which will accept it and publish this work.

Summary

The paper focus on the energy crisis and on the energy market that has been affected by it. In the beginning, the cause of the crisis, the historical crisis, as wall as the demand for energy are presented. The paper then focuses on the LNG market, among other things analyzing the purchase value of LNG, its buyers and suppliers as well as LNG trade routes, and the shipping market for LNG ships. In the next stage, the LNG market is analyzed in two phases, the first phase analyzes the market after coronavirus pandemic, while the second phase analyzes the market after Russian-Ukrainian war. In conclusion, the paper focuses on the effects of the energy crisis, in terms of increasing LNG demand again in two phases, the fist after pandemic and the second after war in Ukraine. Finishing, it can be seen that the LNG market will expand as its demand in the coming years will increase.

Περίληψη

Η εργασία επικεντρώνεται στην ενεργειακή κρίση και κατ' επέκταση στην αγορά ενέργειας που έχει επηρεαστεί από αυτή. Στην αρχή παρουσιάζονται τα αίτια της κρίσης, οι ιστορικές κρίσεις, καθώς και η ζήτηση για ενέργεια. Στη συνέχεια η εργασία επικεντρώνεται στην καθαρή αγορά του LNG, μεταξύ άλλων αναλύεται η αγοραστική αξία του LNG, οι αγοραστές και οι προμηθευτές αυτού όπως και οι εμπορικοί δρόμοι του LNG, και η ναυτιλιακή αγορά των πλοίων LNG. Στο επόμενο στάδιο γίνεται ανάλυση στην αγορά του LNG σε δύο φάσεις, η πρώτη φάση αναλύει την αγορά μετά την πανδημία του κορονοϊού, ενώ στη δεύτερη φάση αναλύεται η αγορά μετά τον ρωσικό-ουκρανικό πόλεμο. Τελειώνοντας, η εργασία επικεντρώνεται στις επιπτώσεις της ενεργειακής κρίσης, ως προς την αύξηση της ζήτησης του LNG ξανά σε δύο φάσεις, η πρώτη μετά την πανδημία και η δεύτερη μετά τον πόλεμο στην Ουκρανία. Κλείνοντας, διαπιστώνεται ότι η αγορά του LNG θα διευρύνεται καθώς η ζήτηση του τα επόμενα χρόνια θα αυξηθεί.

1. INTRODUCTION

In the dissertation below it is analyzed, the energy generally and LNG specifically demand and consumption. Main emphasis given in the comparison between the pro-Covid19 and post-Covid19 (includes the Ukraine war in post-Covid19 period). The project begins with a definition of the energy crisis given in Chapter 2. In the Chapter it is analyzed the main reasons and the consequences that leads to an energy crisis. After the previous analysis follows the opposition of the historical crisis in 1973 (oil shock) and the recently crisis of Covid19 and Ukraine War. It continues with the comparison between the pipelines and LNG. The Chapter ends with the demand for commodities, in this part emphasis given at the energy demand drivers and at the energy demand management. In Chapter 3 is presenting the LNG market. This market is analyzed by the LNG value chain in the beginning. As it moves forward it presents the LNGs trade patterns which are North America-Europe, East Asia-North America, Middle East-East Asia, Middle East-Europe, while mane trade exporters and importers the last years are USA, Russia, Middle East, Europe and Southeastern Asia. In conclusion presents the analysis of LNG shipping market. This shipping market involves the new build deliveries and specific characteristics of the LNG carriers, as the propulsion systems, the steam turbines and the age of the vessel. In Chapter 4 is given the Market analysis. Market analysis has two mane periods, the first phase is the pre-Covid19 and pre Ukraine war (2010-2020) approximately, in this theme the analyses has to do with the LNG trade and reports (from 2018 until 2020). The second period is post-Covid19 and Ukraine war (2021-2023), the analyses is given through the new data of energy consumption and the new reports from each year. Finally in chapter 5, are displayed the effects of the energy crisis on the LNG market. The effects separated in two mane phases, in the first phase are analyzed the Covid19 effects, while in the second phase are analyzed the Ukraine war effects.

2. WHAT IS ENERGY CRISIS?

The energy crisis is a broad and complex topic, is a society-wide economic problem caused by a constricted supply of energy, leading to diminished availability and increased price to consumers. In crisis period most people do not feel connected to its reality unless the prices of gas or gasoline reach to their pocket. Energy crisis refers to a period of time when the supply of energy resources, such as electricity, natural gas, oil, or other sources, is unable to meet the demand for energy consumption. During an energy crisis, there may be shortages of energy resources, leading to increased prices, rationing, or even blackouts in extreme cases. This situation can arise due to various factors, such as geopolitical tensions, disruptions in the supply chain, natural disasters, rapid economic growth, inefficient energy policies, or a combination of these factors. Energy-intensive industries, transportation systems, and households may all be affected, potentially causing significant economic and social disruptions.

Energy markets began to tighten in 2021 because of a variety of factors, including the extraordinarily rapid economic rebound following the pandemic. The situation escalated dramatically into a full-blown global energy crisis following Russia's invasion of Ukraine in February 2022, the price of natural gas reached record highs, and as a result so did electricity in some markets. Oil prices hit their highest level since 2008, this high energy prices have contributed to painfully high inflation, pushed families into poverty, forced some factories to curtail output or even shut down, and slowed economic growth to the point that some countries are heading towards severe recession. Europe, whose gas supply is uniquely vulnerable because of its historic reliance on Russia, could face gas rationing this winter, while many emerging economies are seeing sharply higher energy import bills and fuel shortages, because of that some gas-intensive manufacturing plants in Europe have curtailed output because they couldn't afford to keep operating, while in China some have simply had their power supply cut. In emerging and developing economies, where the share of household budgets spent on energy and food is already large, higher energy bills have increased extreme poverty and set back progress towards achieving universal and affordable energy access, even in advanced economies, rising prices have impacted vulnerable households and caused significant economic, social and political strains.[1]

The global recession drove energy consumption lower in 2009 than 2008, the first such decline since 1982, as the world economy contracted for the first time since the Second World War. The global, consumption of oil, natural gas and nuclear power declined, while coal consumption was essentially flat, only hydroelectric output and other renewable forms of energy increased in 2009. For the whole year, prices for all forms of traded energy fell, with the sharpest declines seen for traded natural gas and coal in North America and Western Europe though Asian coal prices fell less sharply in face of strong Chinese import growth. Oil prices declined for the first time since 2001, in 2009, prices for oil and coal in competitive markets hit their low points early in the year, with oil prices recovering first,

[1] Iea.org/global-energy-crisis

while spot natural gas prices in North America and Western Europe continued to decline well into 2009.[2]

2.1 REASONS AND CONSEQUENES

The main reason of the energy crisis is the changes through the demand of energy, from the consumers. That is why in the following, data will oppose from analysts on the range of this demand.

The energy crisis is primarily caused by the limited availability of energy sources such as oil, natural gas, and coal. These energy sources are finite, and their extraction and transportation are expensive and complex. As a result of this, the demand for these energy sources exceeds their supply, leading to energy shortages and high prices. The dependence on these types of energy sources has also led to environmental degradation and climate change, which further exacerbates the energy crisis. The burning of fossil fuels releases greenhouse gases into the atmosphere and that leads to global warming and what we know as climate change. This has resulted in extreme weather conditions such as, rising sea levels and melting of glaciers, which has a significant impact on the availability and distribution of energy. Energy "demand" refers to the energy quantities that people are willing to purchase and/or to pick-up for free in nature. In the countries with supply availability constraints, the potential demand is higher than actual consumption. In this case, energy consumption can increase for the reason that more energy is made available mostly through electrification. Energy demand results from the fulfillment of energy needs in a given energy prices context.[3]

Energy demand describes a relationship between price, or income, or some economic variable and the quantity of energy either for an energy carrier or for final us. Demand indicates what quantities will be purchased at a given price and how price changes will affect the quantities sought. It can include an unsatisfied portion but the demand that would exist in absence of any supply restrictions is not observable. Consumption on the other hand takes place once the decision is made to purchase and consume, it refers to the manifestation of satisfied demand and can be measured. However, demand and consumption are used interchangeably in this chapter despite their subtle differences.[4]

2.2 HISTORICAL ENERGY CRISIS – OIL SHOCK 1973

The first energy crisis began on October 19, 1973, when President Nixon's request for Congress to make available $2.2 billion in emergency aid to Israel for the conflict of the Yom Kippur War. As a result of this, the Organization of Arab Petroleum Exporting Countries (OAPEC) instituted an oil embargo on the United States. The embargo ceased U.S. oil imports from participating OAPEC nations, and since then began a series of production cuts that altered the world price of oil. These cuts nearly quadrupled the price of oil from $2.90 a

[2] bp.com/recession drove 2009 energy consumption lower
[3] The Palgrave Handbook of International Energy Crisis, Energy Demand Drivers
[4] Energy Economics, Understanding and Analyzing Energy Demand

barrel before the embargo, to $11.65 a barrel in January 1974. In March 1974, amid disagreements within OAPEC on how long to continue the punishment and the embargo was officially lifted, on the other hand, the higher oil prices remained. As the chairman of the Federal Reserve Arthur Burns, explained in 1974, the manipulation of oil prices and supplies by the oil-exporting countries came at a most inopportune time for the United States. In the middle of 1973, wholesale prices of industrial commodities were already rising at an annual rate of more than 10 per cent, the industrial plant was operating at virtually full capacity, and many major industrial materials were in extremely short supply. In addition to these cost pressures, the oil industry had a lack of excess production capacity, which meant it was difficult for the industry to bring more oil to market if needed, when OAPEC cut the oil production, prices had to rise because the American oil industry could not respond by increasing supply. Additionally, non-Organization of the Petroleum Exporting Countries (OPEC) oil sources where declining the percentage of the world oil industry, and OPEC was therefore gaining a larger percentage of the world oil market. These market dynamics, matched with the effect of OPEC nations greater participation rights in the industry, that allowed OPEC to wield a much larger influence over the price setting mechanism in the oil market since their formation in 1960.

The devaluation of the dollar, which was experienced in the early 1970s, was also a central factor in the price increases instituted by OAPEC, since the price of oil was quoted in dollar terms, the falling value of the dollar effectively decreased the revenues that the OPEC nations were seeing from their oil. The OPEC nations resorted to pricing their oil in terms of gold and not the dollar, due to the ending of the Breton Woods agreement, which had pegged gold to a price of $35, the price of gold rose to $455 an ounce by the end of the 1970s. This drastic change in the value of the dollar is an important factor in the oil price increases of the 1970s.[5]

The first occurred in 1973, when Arab members of OPEC (Organization of the Petroleum Exporting Countries) decided to quadruple the price of oil to almost $12 a barrel. Oil exports to what we call West World, the United States, Japan, and Western Europe, which together consumed more than half the world's energy, were also prohibited. OPEC's decision was made in retaliation for Western support of Israel against Egypt and Syria during the Yom Kippur War(1973) and in response to a persistent decline in the value of the U.S. dollar (the denominated currency for oil sales), which had eroded the export earnings of OPEC states. With the global economy already experiencing difficulties, these actions precipitated a steep recession accompanied by rising inflation. This forced top economic countries to embark on a process of economic restructuring in order to reduce their dependency on oil and prompted fears that the United States might take military action in order to secure free access to its energy supplies. Although the oil embargo was lifted in 1974, oil prices remained extremely high, and the capitalist world economy continued to stagnate throughout the 1970s.[6]

2.3 PANDEMIC OF COVID-19 AND OIL CRISIS

A global economic contraction driven by the COVID-19 pandemic and an oil market collapse with the benchmark price for United States crude oil, the West Texas Intermediate, briefly going negative for the first time in history, in April 2020. Based on an oil price of USD 30

[5] https://www.federalreservehistory.org/essays/oil-shock-of-1973-74
[6] https://www.britannica.com/money/alternative-investment-types

per barrel, the International Energy Agency projects that oil and gas revenues for a number of key producers fall nearby 80% in 2020, compared to 2019, yet the losses could be larger depending on future market developments. 2021 crisis was happened in the wider context of a structural decline in the market for fossil fuels, driven by a commitment towards decarburization by a number of countries as well as the wider technological changes that are gradually making renewable energies the preferred energy option, the global oil price has become increasingly volatile since the 1970s. The advent of futures trading brought about greater speculation in the market, by increasing the demand in developing countries, as well as rising supply led by new production in the United States, have additionally contributed to fluctuations in recent years. The fallout of the COVID-19 pandemic has taken everyone by surprise, by pushing oil prices to a new low. Such was the turmoil that the benchmark for US crude oil fell into negative territory for the first time ever in late April 2020, and the price of Brent Crude, the benchmark for Europe and the rest of the world, has also fallen significantly.[7]

The current fall in oil prices is limiting the ability of these countries to respond to the multidimensional domestic pressures produced by COVID-19, at the same time when more money is needed to finance service delivery, involving health risks and ease macroeconomic pressure. This would amount to the lowest income received from the sector by these countries in over two decades, and the IEA has cautioned that revenues could fall further depending on future market conditions. Accentuating the challenges, there has been a decline in investor appetite for fossil fuel projects, and with the onset of COVID-19, companies have been shelving new projects and permanently shutting-down high-cost operations in response to the oil price collapse. Smaller or new producer countries are expected to be hardest hit by the drop in discoveries and investments. We have to refer that the energy prices have been rising since 2021 because of the rapid economic recovery, weather conditions in various parts of the world, maintenance work that had been delayed by the COVID19 pandemic.[8]

The scale of the current oil price shock will vary by country depending on their export concentration, as well as their estimated oil reserves and cost of production. This why for example, Saudi Arabia and Iraq can produce oil relatively cheaply, not needing a price of more than approximately USD 30 per barrel to break even, while the same time countries like the Bolivarian Republic of Venezuela ("Venezuela") and Nigeria depend on a price of over USD 50 per barrel.[9]

LNG trade in 2020 was heavily impacted by COVID-19, as markets, cities and producers across the globe wrestled with lockdowns and a multitude of other disruptions. Significant reductions in levels of economic activity affected demand, which in turn had to be balanced by supply curtailments, a balancing act to reconcile demand shocks with contracting, operational and market dynamics. At the beginning of 2020, Rystad Energy projected LNG trade to grow 8% year-on-year, but the pandemic impact caused it grow only slightly to 356.1

[7] https://www.oecd.org/coronavirus/policy-responses/the-impact-of-coronavirus-covid-19-and-the-global-oil-price-shock-on-the-fiscal-position-of-oil-exporting-developing-countries-8bafbd95/#section-d1e325

[8] https://www.oecd.org/coronavirus/policy-responses/the-impact-of-coronavirus-covid-19-and-the-global-oil-price-shock-on-the-fiscal-position-of-oil-exporting-developing-countries-8bafbd95/#section-d1e325

[9] https://www.oecd.org/coronavirus/policy-responses/the-impact-of-coronavirus-covid-19-and-the-global-oil-price-shock-on-the-fiscal-position-of-oil-exporting-developing-countries-8bafbd95/#section-d1e325

MT, with the total number of LNG voyages growing by only 1% from 2019, however, it was one of the few commodities that showed growth in 2020, demonstrating the resilience, flexibility and reliability of the gas sector. The first impact of the virus was felt when Asian LNG imports started to fall towards the end of February, as Japan, China and South Korea experienced lower economic activity. This was against the backdrop of a relatively warm winter and high inventory levels. As China went into lockdowns, many cargoes were diverted to India and South Korea, supply remained healthy in the first quarter as Qatar and Australia maintained production, and US producers still attempted to ramp up output. This excess supply was absorbed by Europe once many Asian markets went into lockdowns, with buyers taking advantage of low prices, substituting some piped gas with LNG. However, Spain, Italy and France, the largest importers in Europe, soon also announced lockdowns. By the end of March, Europe's storage filled up, and buyers began using flexibility clauses in their US offtake contracts to cancel cargos for summer deliveries, causing Gulf Coast LNG terminals to cut exports.[10]

Reacting to the effects of COVID-19 on European and Asian demand, coupled with seasonal demand fluctuations, US LNG exports fell by 70% from May to August, mostly from curtailments by Sabine Pass and Corpus Christi. Trade flows towards Asia regained some ground in 2020 as demand in China and India outweighed a decrease in shipments to Japan and South Korea. This can be attributed to lower overall utlisation rates in the larger importing nations due to an overall drop in global gas demand, allowing for opportunistic buying. Balancing out the pandemic's negative impact on demand, a very cold Northern hemisphere winter, together with a tighter freight market, spawned an LNG supply squeeze towards the end of 2020.[11]

2.4 ENERGY CRISIS AND UKRAINE WAR

Energy prices have been rising since 2021 because of the rapid economic recovery, weather conditions in various parts of the world, maintenance work that had been delayed by the COVID19 pandemic, and earlier decisions by oil and gas companies and exporting countries to reduce investments. Russia began with holding gas supplies to Europe in 2021, months ahead of its invasion of Ukraine, and then all that led to already tight supplies, because of the Russia's attacks on Ukraine the situation was changed. The United States and the EU imposed a series of sanctions on Russia and many European countries declared their intention to phase out the Russian gas imports completely. Meanwhile, Russia has increasingly curtailed or even turned off its export pipelines, meanwhile Russia is by far the world's largest exporter of fossil fuels, and a particularly important supplier to Europe, for example in 2021, a quarter of all energy consumed in the EU came from Russia.[12]

As Europe sought to replace Russian gas, it bid up prices of US, Australian and Qatari ship-borne liquefied natural gas (LNG), raising prices and diverting supply far away from traditional LNG customers in Asia, that because gas frequently sets the price at which electricity is sold, power prices also soared. Both LNG producers and importers are rushing

[10] World LNG Report 2021
[11] World LNG Report 2021
[12] https://www.iea.org/topics/global-energy-crisis

to build a new infrastructure to increase how much LNG can be traded internationally, but these costly projects will take years to come across, oil prices also initially soared as international trade routes were reconfigured. After the United States, many European countries and some of their Asian allies said that they would no longer buy Russian oil, some shippers have declined to carry Russian oil because of sanctions and insurance risk, while int he same time, many large oil producers were unable to boost supply to meet rising demand, even with the incentive of sky-high prices. While prices have come down from their peaks, the outlook is uncertain with the new rounds of European sanctions on Russia kicking in later this year, because of Ukraine's invasion in February 2022, the price of natural gas reached record highs, and as a result of uses electricity in some markets and oil prices hit their highest level since 2008. [13]

Higher energy prices have contributed to painfully high inflation, by pushing families into poverty, forcing some factories to curtail output or even shut down, and slowing economic growth to the point that some countries are heading towards severe recession. Europe, whose gas supply is uniquely vulnerable because of its historic relationship with Russia, could face gas rationing on 2022 winter, while many emerging economies are seeing sharply higher energy import bills and fuel shortages. The fact is that this energy crisis shares some parallels with the oil shocks of the 1973, instead there are many important differences, that because today's crisis involves all fossil fuels, while in 1973 the price shocks were largely limited to oil at a time when the global economy was much more dependent on oil, and less dependent on gas. The entire words economy is much more globalised than it was 50 years ago, and that is why we can refer to this, as the first truly global energy crisis.[14]

2.5 PIPELIINES - LNG

2.5.1 *PIPELINE*

The globalization helps to create and develop the gas pipe line network, which is a transport system that used to transport goods and materials. Throw pipelines are carried various products, such as sewage and water throw many countries. However, other products transported are gases, as biofuels and oils. Pipelines are available for all the countries and vary according to the goods transported, the size of the pipes and the material used in the construction of pipes. Pipeline systems are complex infrastructures that connect energy resources to the users, typically located away from distribution points. Delivery points are usually measurement stations, which are located at production facilities where natural gas is transferred from the producer to the consignor, or measurement stations at the borders of the importing country, some pipelines are built above the ground, while most pipelines are buried underground. Since pipeline gases are very well hidden from the public, many people are unaware of the existence of the extensive network of pipelines. [15]

Gas pipelines serve to transport gas from fixed facilities such as gas wells or import and export facilities and deliver it to various locations such as homes or directly to other export facilities. This process also includes three different types of pipelines systems: collection systems, transmission systems and distribution systems. Similar to the oil collection systems, the gas collection pipeline system also collects raw materials from production wells. It is transported by extensive transmission pipelines that transport natural gas from facilities to

[13] https://www.iea.org/topics/global-energy-crisis
[14] https://www.iea.org/topics/global-energy-crisis
[15] https://yenaengineering.nl/gas-pipeline/

ports, refineries and cities around the country. Finally, distribution systems are consisted of a network that distributes the product to homes and businesses. These two types of distribution systems are the main distribution line, which are larger lines that transport products to places close to cities. Most of the gas pipelines now are made of high-carbon steel. Steel gas pipelines are produced in large factories and the state conducts constant inspection. They are usually 40 to 80 feet long and they are specially designed. Distribution pipelines used to be made of steel, but now more and more plastics or composites are used in this industry. The oldest distribution pipelines were usually made of cast iron.[16]

2.5.2 *LNG (Liquefied Natural Gas)*

The natural gas from large fields is normally transported by one of two means, either by pipeline or in the form of liquefied natural gas (LNG). The production of LNG has risen rapidly as new facilities have been brought online, increasing its share of internationally traded natural gas to 30% in 2011. For the period 2005-2020, LNG production was growing nearby 6.7% per year. The building of new LNG facilities has often resulted in local resistance due to fears over the risk of explosions. Interestingly, however, there has been limited discussion of the environmental impact of LNG in terms of greenhouse gas emissions. This question is becoming increasingly pertinent as natural gas is cast as the transitional fossil fuel for a low carbon world, worse than renewable or nuclear energy, but of course better than coal and oil. LNG is relatively abundant, the necessary technology exists, and much of the infrastructure needed for its exploitation is already in place. If natural gas is part of the medium term solution to reducing greenhouse gas emissions and this is going to lead to increasing amounts of it being moved around the globe as LNG, the emissions aspect of LNG will become increasingly salient. In Norway, for example, the new LNG facility at Melkoya is the country's fourth largest source of greenhouse gas emissions.[17]

Regardless of the mode of transport for natural gas, some of the gas is used to generate the energy that requires transporting the rest of the gas. In pipelines, a portion of the gas is burned in order to run the turbines that force the rest of the gas through pipeline to the consumers. In an LNG plant, a portion of the gas is burned in order to produce enough energy to cool the rest of the gas. When natural gas reaches a low of -161°C (-260°F), it shrinks into a liquid that takes one 600th the amount of space of the gaseous form, becoming that way far more economical to ship.[18]

2.6 Energy DEMAND

Energy demand is usually associated with economic development (Gross Domestic Product per capita) and energy prices. Energy “demand” refers to the energy quantities that people are willing to purchase, or to pick-up for free in nature. In the countries with supply availability

constraints, potential demand may be higher than actual consumption, in this case, energy consumption can increase for the sole reason that more energy is made available. Energy

[16] https://yenaengineering.nl/gas-pipeline/
[17] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3962073/
[18] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3962073/

demand results from the fulfillment of energy needs in a given energy prices context, but no one "needs" energy only for itself, rather for the services that energy provides. Because of technology changes, the dynamics of the "need" for energy services can be different from that of the energy "demand". To sum up, the drivers of energy demand are, first, the socio-economic drivers of the needs for energy services, and second, the technology drivers that convert these needs into energy demand.[19]

A distinction is sometimes made between energy consumption and energy demand. Energy demand describes a relationship between price and quantity of energy either for an energy carrier or for final use, such as cooking. It exists before the purchasing decision is made, once a good is purchased consumption starts. Demand indicates what quantities will be purchased at a given price and how price changes will affect the quantities sought. It can include an Unsatisfied portion but the demand that would exist in absence of any supply restrictions is not observable. On the other hand consumption takes place once the decision is made to purchase and consume, it refers to the manifestation of satisfied demand and can be measured.[20]

2.6.1 *ENERGY DEMAND DRIVERS*

Energy demand drivers do not change over time at the same speed. Their relative contribution to the change of energy demand is very different whether we look at the short term (up to two years), the medium term (two to five years), the long term (up to 30 years) or the very long term beyond 30 years. Apart from those related to the physical and macro-economic environment, all the drivers of energy demand change over time according to the decisions made by final consumers, either in their budget allocation or in their investment choices. These decisions depend on the overall physical and macro-economic context, but also on incentives, regulations and equipment-technology offer, which frame the possibilities of choice.

Industry refers to the production of manufactured goods and it is the most important energy driver. From a final energy demand viewpoint, industrial energy demand does not include the energy transformation sector, nor small-scale producers, which are included in the commercial sector; it is limited to production facilities and does not include energy used for transporting products or also for office buildings outside the factory. At world level, industry consumes around 31% of total final energy consumption. Coal and lignite remain the main energy sources used in industry. The steel and the non-metallic minerals industries, which are very big coal consumers, account for 35% of the total energy consumption of world industry and this share keeps increasing. This explains the high and increasing coal share in the energy mix of the industrial sector, together with the chemical industry, whose share is rather constant around at 16%, these energy-intensive industries account for more than half of total energy consumption (51%). In the remaining 49%, mining and construction only account for 4%.

Another important energy driver is the transportation industry. From an energy viewpoint, the transport sector includes all means of transportation of passengers and freight, this is different from the economic definition of the transport sector, where it includes only the value added of transport companies. In the energy balances, a distinction is made between the final energy

[19] Energy Demand Drivers, The Palgrave Handbook of International energy Crisis
[20] Understanding and Analyzing Energy Demand, Energy Economics

demand of domestic transport and that of international air and sea transport, included under the label "bunkers" in the primary section of the balance. Except for the world, the final energy demand of the transport sector corresponds only to the domestic transport, for the world, it accounts for both. Geography, transport infrastructure heritage and GDP/cap are the key factors differentiating transport energy consumption between countries. On the one hand, the bigger the size of the country, the more important high-speed trains and air transport to accommodate the demand for increased speed. On the other hand, the smaller the size, the higher the population density, the more cost-effective is public transport of passengers by road or rail and the less attractive are private vehicles. Energy prices have a relatively low impact on transport energy demand in the short-medium term, for two reasons, firstly the high share of mandatory or highly constrained passenger travel and freight movement and secondly the rigidity in modal switch for both passengers and freight. In the long term, energy prices influence changes in technology and modal competition.[21]

2.6.2 *DEMAND MANAGMEND*

According the WEO (2008), the global energy demand is expected to reach about 17,000 Mote in 2030 from about 11,500 mtm in 2006, this represents an annual average growth of about 1.6% for the entire period. Oil is projected to remain the dominant fuel with a 30% share of the demand, and is followed by coal with a 29% share, natural gas will occupy the third place with a 22% share. The renewable energies also will see an increase in their share but are unlikely to play a major role. The regional demand shares are expected to change as well with developing countries demanding more energy, the share of the non-OECD economies in global energy demand is expected to cross that of the OECD by 2010 and by 2030, while non-OECD demand will account for 63% of the global energy demand. Asian developing countries, as a regional block, would represent the second most important energy demand centre in the world with a share of 38% of the global demand.[22]

The energy system consists of both supply-side and demand-side activities. In the early days when energy prices were cheap, the focus on the energy sector was on the supply-side, this meant that for any given demand, the objective was to arrange for adequate supply so that the demand is satisfied. The demand-side was considered as given and there was a presumption that the supply-side is easily influenced and managed, perhaps due to less number of actors involved than the demand-side. However, with crisis in the 1970s, researchers, governments and the utilities started to look at the entire gamut of the problem and it became apparent that ignoring the demand-side of the equation was not an efficient way of managing the energy problem. The electric utilities in the USA were the first to experiment with this idea and the concept started to gain importance in other energy industries as well, now the concept is used in the gas industry, transport sector, water industry and elsewhere.[23]

Over the last decades, DSM (Demand-Side Management) has evolved considerably. High oil prices in the 1970s provided justification for efforts directed towards reducing demand, the initial programmes were essentially aimed at energy conservation and load management, although the emphasis was on providing information on energy saving options and better understanding of energy demand through energy audits. This period also saw efforts towards

[21] Energy Demand Drivers, The Palgrave Handbook of International energy Crisis
[22] Energy Demand Management, Energy Economics
[23] Energy Demand Management, Energy Economics

fuel substitution, so that demand for imported oil is reduced by moving towards locally available fuels. The 1980s saw a more systematic use of the DSM in the electricity sector through the least-cost capacity expansion and integrated resource planning programmes. The least-cost capacity expansion programme attempted to identify the cheapest options for the utility considering the supply-side options, systematic use of these options also led to the concern about revenue loss and regulatory treatment of the costs. In the 1990s, as environmental concerns emerged, DSM received further support because of perceived benefits of these programmes. This was also the period of energy sector reform and DSM investments started to decline as the competitive markets started to emerge. The objective of price reduction through competition was in direct conflict with the demand reduction objective of DSM, as energy prices have once again risen, the focus on better utilisation of energy has resurfaced. DSM activities received another lease of life as a result, both energy efficiency and price responsive programmes are now being promoted as new breed of options.[24]

[24] Energy Demand Management, Energy Economics

3. LNG MARKETS

The LNG Market consists of many parameters. All these parameters are examine below, parameters as the LNG value chain, demand and supply for commodities, trade patterns, the LNG shipping market, geographical markets. LNG market description begins.

3.1 LNG VALUE CHAIN

Gas formation is similar to that of oil. It is an organic matter, which has been compressed and heated for millennia, is the source of all hydrocarbons, including natural gas. At greater depths, both higher pressure and higher temperatures favor the production of gas over oil and this is why gas is normally associated with deep oil deposits and, as the depth increases, so does the probability of finding fields that contain almost pure methane.

Most of the gas comes from 'conventional' fields, which allow the extraction of the commodity using existing cost-efficient technology. However, there are additional 'non-conventional' gas reserves, which are technically more difficult to exploit, such reserves include, deep gas, tight gas, coalbed gas, shale gas and gas hydrates. Shale gas is the one that has attracted the industry, particularly so in the United States, where the take-off of shale gas exploration and extraction has changed the economics of hydrocarbons, not only in the domestic economy, but also on a worldwide scale. The effect of shale gas has been quite dramatic in the energy profile of the US. According to EIA data, shale gas is nearly one-third of gas produced in the US. The immediate effect of this relative abundance was a collapse of domestic gas prices, from a high of ca. $13/MMBtu in July 2008, to ca. $4/MMBtu among the same time in 2013. The secondary, and more important, effect has been that of consumption substitution. Cheap gas has meant that it is now more prices competitive against coal for power generation, as well as against naphtha as feedstock to the chemical and petrochemical industries. More avenues are sought to absorb shale supply, including the use of LNG for powering trucks and perhaps ships also in the near future and, ultimately, exports of gas in the form of LNG.[25]

Natural gas can be measured in many different ways. For trading purposes, volume is important, and the most common measurement units are cubic feet (*cf*) and cubic meters (*cm*), on the other hand gas reserves are quoted in trillion cubic feet or trillion cubic meters (*tcm*). For consumption purposes, gas is measured in terms or BTUs to reflect the amount of energy consumed. For pricing, probably the most widely used unit is the BTU, although pence-term is the price quotation in the United Kingdom. To calculate its equivalence in other fuels, the amount required to produce a standard electricity unit is used instead.[26]

Natural gas has become an important source of energy and now accounts for around
a quarter of total energy consumption. Furthermore, natural gas and its by-products are very important raw materials for the petrochemicals industry. However, the physical nature of natural gas means, that the infrastructure required to transport, store and process natural gas into

[25] Natural Gas, Commodity Trade and Finance
[26] Natural Gas, Commodity Trade and Finance

products for final consumption is more complex and the capital-intensive is compared to other energy sources. This highly integrated supply system is commonly termed the natural gas chain and each element of the chain, from gas extraction and processing to storage, transportation and distribution, and is organized as part of a carefully designed system.[27]

LNG comes from gas liquefaction, which involves cooling gas to a temperature below its boiling point so that it can be stored and transported in its liquid phase. In very low temperatures (known as 'cryogenic' temperatures) are required and these temperatures are achieved through a complex set of industrial scale processes. Once liquefied, natural gas can then be transported on special LNG carriers to destination degasification plants where the degasified product is delivered into pipelines and on to end-users. LNG therefore has a separate and distinct supply chain compared to the more conventional pipeline route to market, but despite its high costs and the challenges of handling cryogenic material, the LNG industry has become an important component in the global gas industry.[28]

LNG is not currently a commodity business and it continues to be dominated by long-term contracts. LNG projects are capital intensive and it is currently harder to make the whole value chain appear profitable in the face of lower prices and projected market over-supply. Fully dedicated shipping is often required, dedicated shipping is capital intensive and project financing depends on creditworthy partners, firm agreements and a reliable LNG value chain. Market uncertainty caused by increasing supply competition, limited demand growth, and competition from pipeline supplies, are driving shippers and suppliers to attempt to sell cargos allocated to term contracts, or new cargos, on spot markets to cover the capital costs of LNG ships and infrastructure.[29]

Numbers of prominent trading hubs are centered on by the natural gas markets, with much of the physical and financial-based trading indexed to or settled against the prices at these Locations. The primary natural gas hub in the United States is Henry Hub and the main pricing point for natural gas transactions in North America. In Europe on the other hand, the most liquid natural gas hub is by far the National Balancing Point in the United Kingdom. Other natural gas hubs have emerged in Continental Europe and continue to grow in importance; these hubs include Zeebrugge in Belgium and the Title Transfer Facility in the Netherlands, in addition to Gaspool and NetConnect in Germany.[30]

[27] Natural Gas and LNG, Project Finance of the International Petroleum Industry
[28] Natural Gas and LNG, Project Finance of the International Petroleum Industry
[29] LNG and Domestic Gas Value Chains, Understanding Natural Gas and LNG Options
[30] Natural Gas Markets and Products, Handbook of Multi-Commodity Markets and Products

3.2 Trade patterns

Global gas demand has increased over the past decade and is expected to grow rapidly into the future with increased interest by governments in clean energy to fuel economic growth. Historically, most natural gas has been sold locally or by gas pipeline to adjacent markets. Liquefaction of natural gas into LNG allows the gas to be transported from producing regions to distant countries, there are vast known global natural gas resources that are considered 'stranded' because companies are not able to economically produce and deliver resources to markets, as the LNG markets evolved over the decades, they tended to develop in regional isolation from each other, due to the high cost of natural gas transportation. Historically, two distinct LNG trade regions developed - the Asia-Pacific region, and the Atlantic Basin region which included North America, South America and most of Europe. Until Qatar began to export LNG to both regions in the mid-1990s, those two regions were largely separate, with unique suppliers, pricing arrangements, project structures and terms. In recent years, the increase in inter-regional trade, as well as the development of active spot market, has tended to blur the distinction between the two main regions.
There are three main global gas markets, the Asia-Pacific region, the European region, and the North American/Atlantic Basin region which includes North America, South America, and Latin America. The Asia Pacific region has historically been the largest market for LNG, that because of Japan, which is the world's largest LNG importer, followed by South Korea and Taiwan, China and India also have recently emerged as LNG importers and could become more significant buyers of LNG over time. The growth of LNG in Europe has been more gradual than that in the Asia- Pacific, primarily because LNG has had to compete with pipeline gas, both domestically produced and imported from Russia, the traditional European importing countries include the UK, France, Spain, Italy, Belgium, Turkey, Greece and Portugal. Another growing number of European countries have constructed, or are planning, LNG import terminals, including Poland, Lithuania, and Croatia.[31]

International gas trade has been regional in nature because of large-scale infrastructure needed along the whole value chain, and especially capital-intensive investment requirements to build transport networks to supply gas to end consumers. Since the 1960s there has been a general trend towards cost reduction due to technological improvements, especially in the whole LNG value chain. In general, the economics of gas trading via seaborne LNG transport are more advantageous relative to pipeline trading, if the transportation distance is more than 4,000km, allowing for shipping super-cooled gas across continents at a lower cost than if using pipelines. In Europe, cross-border trading via pipelines accounts for about 43 percent of total consumption, while only 6 percent is accounted for by LNG and the rest is domestic production. In the Asia-Pacific, where gas demand is expected to grow in the future, due to geography the situation is completely reversed, LNG accounts for 36 percent of total consumption, while pipeline trading accounts for only 9 percent and the rest is accounted for by domestic production, primarily in China. Other regional markets are predominantly either self-sufficient or import gas using pipelines in North and South America. It is important to note that North America is currently the only market with gas trading based purely on supply and demand conditions (market-based pricing), with the Henry Hub price as the dominant spot price index used in this market. Recently, Europe has also begun to transition to market-based pricing, and it is reported that more than 50 percent of the European gas supply in 2014 was linked to European regional hubs, such as NBP in the UK and TTF in the Netherlands.

[31] Global Gas Market, Understanding Natural Gas and LNG Options

The rest of the international gas trade in Europe is still based on oil indexation, this is true in particular for gas coming from Russia, North Africa and Norway. Europe has emerged as a unique market place where two different pricing mechanisms exist, hub-based and oil-indexation pricing, with unclear prospects of moving to one pricing system or the other and when. The Asia-Pacific gas market is dominated by an oil price indexation mechanism, and trade is supplemented by short-term and spot transactions to balance the positions of market players. The pricing of such short-term and spot transactions is believed to resemble market-based pricing and is assessed by price reporting agencies such as the spot index assessed by Platts is called the "Japan Korea Marker", JKM or ICIS Heren called the "East Asia Index", EAX.[32]

In the formative stages of the LNG trade, spot or short-term trading was viewed as an exception to the general pattern due to the overall low liquidity on the market. There is no single accepted definition of what constitutes a spot LNG trade. It can be said that spot or flexible LNG volumes are those sold outside of long-term contracts for delivery within a calendar year. The short-term market is dominated by portfolio suppliers such as Anglo-Dutch oil and gas major Shell and BP, as well as several Japanese trading houses Mitsubishi, Itochu, Marubeni and Mitsui and commodity traders like Trafigura, Vitol and Gunvor. Due to high entry costs and associated financial risks, there have been several instances where companies have ceased LNG trading operations. Short-term LNG trading is very much Asia-focused, more than 70 percent of spot LNG has found a home in the Pacific Basin in 2015. Key markets for spot LNG have emerged in Japan, South Korea, China and India, also important short-term markets have sprung up in Egypt, Jordan, Argentina, Mexico and Pakistan. More countries are expected to start importing LNG over the next years, including Bangladesh, the Philippines, Vietnam and Indonesia.[33]

3.2.1 *EUROPE*

LNG has played a role in European gas supplies ever since the early projects were launched in Algeria. Regasification capacity is concentrated in Western Europe along the Mediterranean and Atlantic coast, the rate of utilization of available capacity is low in all countries except Turkey, whose gas market is very rapidly growing. In 2014 capacity utilization was below 20 percent in Belgium, Greece, Portugal, Lithuania and the Netherlands; and at or barely above 20 percent in Spain and France. The Commission staff working paper reads: "The average rate of LNG terminal utilization in Europe, of total installed capacity has decreased since 2010, from 53% to 25% in 2013, and in 2014 just 19% of the total send out capacity was used, compared with a global average of 33 %."
Is said that Europe have played the role of residual LNG market at the global level. Liquefaction capacity expanded rapidly until the late years of the past decade thanks to investment projects, primarily in Qatar, which were sanctioned on the expectation that the United States would become a net gas importer and require rapidly increasing volumes of LNG. The companies that developed the Qatari projects, notably ExxonMobil, were their own anchor customers, in the sense that they expected to directly market the gas by selling it on the free domestic US market, where prices were expected to increase due to declining domestic production. However, reality evolved in the completely opposite direction, with the

[32] The Future of Natural Gas Markets and Geopolitics, Evolution of LNG Trade and Pricing
[33] The Future of Natural Gas Markets and Geopolitics, On the future of Natural Gas Markets and Geopolitics

boom in shale gas production the prospect of US LNG imports evaporated and incremental LNG supply had to seek new markets. Europe was especially attractive because of the process of gas market liberalization and creation of a single European gas market, allowing new entrants to offer gas on rapidly developing wholesale markets and gas-to-gas competition within as well as across national boundaries. Qatari LNG, which is marketed primarily by Exxon-Mobil, in association with Qatar Petroleum, previously intended for the United States, was instead sent to Europe, and contributed to the creation of competitive conditions that had been quite elusive in previous years, notwithstanding successive EU legislative packages intended to stimulate competition. The trends in the global LNG market described in the previous section may, lead to a seriously depressed European gas market for at least the next five years. According to this analysis, Europe will continue to be the market of last resort because it is open, and capable of receiving large volumes of LNG on a spot basis with no need for long-term contracts. East Asian markets are not expected to grow, as the Japanese nuclear power fleet is progressively brought back into operation and the Chinese economy is widely expected to slow down, furthermore, China may increase its reliance on pipeline gas, if the two major export projects out of Eastern and Western Siberia respectively come to fruition. European gas price environment may remain competitive until the end of this decade. While the future of gas demand in Europe remains uncertain, because of projects that are justified primarily by strategic rather than commercial considerations, such as the doubling of the Nord Stream, will face considerable financing challenges, the Russian government is deeply involved in gas affairs, and notwithstanding all difficulties the State has the possibility of supporting Gazprom in the implementation of projects that make little or no commercial sense, but there is a cost to this policy.[34]

3.2.2 *EASTERN MEDITERRANEAN*

The last years the Eastern Mediterranean has been a centre of attention as a potentially important natural gas province in the making. This is essentially due to a succession of sizable gas finds by Israel and the Republic of Cyprus in their offshore areas that fall in what is known as the Mediterranean's Levant Basin. In 2009-10 Israel discovered two large gas fields, Tamar and Leviathan, about a year later the first ever exploratory drilling offshore Cyprus led to the discovery of a substantial amount of natural gas in the Aphrodite field. Tamar, Leviathan and Aphrodite are geographically fairly close to each other, their estimated total capacity of about 990 Bcm is a fairly modest amount in global terms but clearly quite significant as regards the potential to transform the regional energy landscape by providing energy supply security and reducing dependence on energy imports, in addition to its impact on relations between the countries of the region.
Another of these countries, Egypt, has actually been an important gas producer and exporter since the early 2000s. As of 2014 it is proved natural gas reserves, over three quarters of which lie in the Mediterranean Sea, amounted to more than 2,100 Bcm. Egypt's most recent and significant gas find, the Zohr field which is hailed as a "giant field" and is estimated to hold as much as 850 Bcm, is also in the Mediterranean. This massive gas discovery, incidentally, has potential implications for plans regarding monetization of the gas reserves in the nearby Leviathan and Aphrodite fields, both of which still await development. Egypt has actually been an important gas producer and exporter long before the large Israeli and Cypriot finds in the Levant Basin. As of January 2015 its proved natural gas reserves are appraised at 2,179 Bcm, over three quarters of these resources lie in the Mediterranean Sea. Moreover, a

[34] The Future of Natural Gas Markets and Geopolitics, The EU and the LNG as a Flexible Tool for Energy Security

May 2010 USGS assessment put the estimated mean of technically recoverable natural gas contained in Egypt's Nile Delta Basin at 6,310 Bcm, most of it in the sea,8 nearly three times the present proved reserves of the country. As extensively argued in the chapter by Houda Ben Jannet Allal, Egypt's most recent find of August 2015, the Zohr field, said to be the largest ever Mediterranean find, is estimated to hold up to 850 Bcm, located in Egypt's Shorouk, it is only 6 km away from the Egypt-Cyprus maritime border.
Israel has been at the forefront of exploration in the Eastern Mediterranean, searching for hydrocarbons since 1969. The country made its first noteworthy offshore discoveries in 1999-2000, Noa and Mari-B at shallow waters offshore Ashkelon, these small fields provided gas for domestic consumption and, as evidence of the region's offshore gas potential, helped sustain industry interest in further exploration. Israel's first major deep-water find, Tamar, located 90 km west of Haifa, was discovered in January 2009 by the US's Noble Energy and Israeli Isramco, Delek Drilling, Avner and Dor. In late 2010 a similar partnership containing Noble and Delek discovered the even bigger deep-water deposit of Leviathan, 50 km west of Tamar, the latter's recoverable reserves are nowadays appraised at 303 Bcm. Leviathan's reserves, initially estimated at 509-538 Bcm, have since been increased to 620 Bcm, other smaller offshore gas finds by Israel include Dalit (2009, 14.2 Bcm), Dolphin (2011, 2.3 Bcm), Shimson (2012, 8.5 Bcm), Tanin (2012, 34 Bcm) and Karish (2013, 51 Bcm). Between 2004 and 2011 Israel's gas consumption increased from 0.8 Bcm to a peak of 5 Bcm, from 2008 onwards the country was also importing Egyptian gas to meet up to half of its demand, starting in early 2011 Egyptian supplies became unreliable due to frequent sabotage attacks on the pipeline carrying the gas and on 23 April 2012, cancelling the relevant agreement, Egypt stopped sending gas to Israel altogether. During this period, with Mari-B almost depleted, Israel's gas consumption plummeted as the country struggled to replace lost supplies and deal with power shortages, this experience was a stark reminder to both the government and the public of Israel's vulnerability as regards energy supply security, and served to heighten the intensity of the debate concerning Israel's natural gas policy – that is, the extent to which Israel should priorities energy independence over becoming a gas exporter.[35]

3.2.3 *RUSSIA*

Russia holds the second largest proven gas reserves at 32.6 Bcm constituting 17.4% of global reserves, in addition Russia holds significant probable reserves in East Siberia reaching 7.5 Bcm. Russia has also substantial unconventional gas reserves which have not yet been properly explored.
Russia is the world's key gas producer, and Gazprom the world's biggest gas exporting Company, the country has the world's largest gas pipeline network, a long-term record of exports to the world's biggest gas importer (the EU) and the quickest growing gas market, Chin in its neighborhood. Gas has for years played a key role in Russian economy and policy, despite this global leadership in gas, established position, infrastructural connections and geographical proximity to key export markets. Russia and Gazprom have in recent years been encountering more and more challenges affecting volumes and profitability of gas sales. These challenges are related to significant changes in global, European and Commonwealth of Independent States (CIS) gas markets, decreased demand, oversupply and intensified competition, due also to growing availability of LNG, low prices environment, regulatory changes, drive to diversify away from Russian gas, Gazprom in particular, and/or to modify conditions of Russian gas imports. Additionally, there has also been increasing

[35] The Future of Natural Gas Markets and Geopolitics, Eastern Mediterranean Gas

competition on the internal gas market, which challenges the role and strategy of Gazprom and, in the longer term, may affect modes of development of the cost-intensive new gas fields and Russian gas export strategy. As a consequence, we are witnessing a major rethinking of Russian and Gazprom's gas strategy. The exact global role of Russian gas is not predetermined, and the developments of the next few years could be pivotal in defining and shaping both the internal gas market and Russia's gas relations with Europe and China.
The main region for Russian conventional gas production is Western Siberia, but due to aging and depletion of the traditional production base it observer's the growing role of new deposits and regions. Substantial investments, mostly by Gazprom, have made feasible a steadily increasing production in the last few years from new fields in the Russian Far East and Yamal peninsula, including the huge Bovanenkovo. The importance of these production centres will continue to grow in the future, together with an increased role for East Siberia and the Russian North West. In 2014 Russian gas production reached 642.1 Bcm, recording a decline of 3.9 % and remaining below the 2008, pre-economic crisis levels. The most important producer in Russia is Gazprom, which in 2014 produced 444 Bcm, this was the worst result in Gazprom's history and well below its potential production estimated in 2014 at 600 Bcm, while, Non-Gazprom production was significantly lower, amounting to roughly 197 Bcm.[36]

3.2.4 *SOUTHESTERN ASIA*

For much of the past decades, Asia has led the world in economic growth. Japan, South Korea, Taiwan and then China have successively gone through rapid industrialization and urbanization process. The economic boom and the export-driven development model known as the "East Asian Miracle" have sustained the global demand for energy and resources, in this process, Asian economies have become the world's largest LNG importers. Japan and South Korea are the largest and the second largest LNG importers respectively, mainly due to the fact that both countries are island or peninsular, and have very limited gas reserves and production. Asia has been the major driver for the growing world market for natural gas and liquefied natural gas (LNG) in recent years, China's economic growth, Japan's shutdown of its nuclear facilities following the Fukushima disaster in 2011, and steady increase in demand from South Korea, India and other Asian economies led to the Asian market being responsible for about 75 percent of global LNG imports, and pushed Asian LNG import prices to record levels in early 2014.[37]

Japan, produced 4.6 billion cubic meters (Bcm) in 2013, down from an average of 5.2 Bcm over the decade (2003-12), Japan alone took 37% of total LNG imports worldwide during 2012-14, up from 31% in 2011.3 Alongside Japan's declining domestic supply and the continued demand for natural gas due to its scale of the economy, the 2011 Fukushima nuclear plant disaster after the Tsunami led to the government decision to shut down most of Japan's nuclear facilities, which were responsible for producing 30% of Japan's total electricity, thus creating a short-term spike demand for more gas consumption.
South Korea, is also another key player in the global gas and LNG importing business, as an indication of the government's continued emphasis on the use of gas and LNG, South Korea will invest 6.1 billion dollars to expand domestic gas infrastructure, such as pipelines and storage tanks, through 2029. The residential use of gas and LNG is expected to continue to rise in the coming years, but the country is also planning to use more nuclear energy to

[36] The Future of Natural Gas Markets and Geopolitics, Russia
[37] The Future of Natural Gas Markets and Geopolitics, Asia's Natural Gas and LNG Market Trends

generate power due to emission-related considerations, this means less import of LNG for power generation, a shift that already had an impact on the LNG import volume.
China, although producing a good part of its own fossil fuel consumption, has been steadily increasing the share of its imported oil, gas and LNG since the mid-1990s. Since China became a WTO member in the early 2000s, its economy has gone through another round of robust growth, with GDP growth averaging around 10 percent. China's demand for energy and other raw materials in this period was dubbed the "commodity super cycle," meaning the demand from China was so strong that prices of oil, gas, coal, major metals and other key resources would sustain their high prices for a prolonged period of time. Even after the 2008 world financial crisis, the Chinese government's stimulus package was so strong that the country underwent a shaped recovery primarily due to infrastructure spending.
Such unprecedented growth put enormous pressure on China's energy supply, the country depends on coal for close to 70% of its total energy consumption, which translates into China alone using over 50% of global coal supply. It surpassed the United States last year as the largest importer of crude oil, with 60% of its oil coming from foreign countries and despite its efforts to increase production of domestic natural gas, it could not keep up with the double-digit growth it had been experiencing in natural gas consumption, an average of 17.3% increase per year between 2002 and 2013.[38]

3.2.5 *USA*

The natural gas revolution that has gradually unfolded in the last three and a half decades in the United States is nothing short of remarkable, the unique combination of technological advancements, early government support, a regulatory and incentive system, and an entrepreneurial, risk-taking culture has resulted in a dramatic uptake of gas production from unconventional resources primarily in the Barnett, Haynesville and Fayetteville, and later the Bakken, Marcellus and Eagle Ford shale basins. Since the 1990s and especially from the mid-2000s unconventional natural gas production has been on a steady rise, reaching 47% of total dry gas production in the US in 2013.Total gas production in the US increased by 35 percent between 2005 and 2013 to approximately 680 Bcm. Despite depressed oil prices affecting associated gas production in the US, total US gas production will continue to grow, industrial usage of natural gas is also projected to grow rapidly, especially in industries such as bulk chemicals using natural gas as a feedstock. Most of the new industrial projects are located on the US Gulf Coast, but some are also planned in other gas-rich areas, such as North Dakot, the United States will remain a very attractive destination for energy-intensive industries. Residential use of natural gas consumption is predicted to decline slightly from 2018 all the way to 2040, while it slightly increases in the commercial sector over the same period, gas usage for road transportation will also grow, albeit at a slower rate due to the loss of economic advantage over gasoline and diesel powered engines. The growing production of gas and the slower increase in demand opens up the possibility of substantial quantities of gas for export. Indeed, in 2016 Cheniere's Sabine Pass export terminal commenced its commercial operations, the first of a series of LNG export projects coming online in the next five years, exports was earnest from 2017 when most liquefaction plants will enter into operation, turning the US into a net exporter.[39]

When discussing US LNG export potential, the most often cited issue is the political and regulatory bottlenecks LNG exporters face when trying to apply for the necessary

[38] The Future of Natural Gas Markets and Geopolitics, Asia's Natural Gas and LNG Market Trends
[39] The Future of Natural Gas Markets and Geopolitics, The USA as a New Gas Exporter

licenses from FERC and DoE. The United States has a somewhat arcane legislation in place in the form of the 1938 Natural Gas Act that restricts gas export in principle and puts in place a process to determine whether gas export projects are authorized to proceed. The permitting process differentiates between export destination, countries that have a free trade agreement among them South Korea being the only major LNG importer, with the US enjoy preferential treatment in the form of a quasi-automatic approval process, while export license applicants willing to ship gas to non-FTA countries have to undergo a cumbersome process to determine whether the export of natural gas in that particular case is in the "public interest." The United States is expected to produce a significant surplus of natural gas in the coming decades, and US natural gas exports will have a major impact on the international gas markets, though in the current depressed price environment US LNG export projects face considerable challenges from a commercial perspective, multiple factors including elevated import demand and energy security considerations in Europe, improved demand prospects beyond 2020 in Asia, as well as climate considerations in both developed and developing markets point towards robust and sustained US LNG exports beyond 2020.[40]

It is hard to predict how much LNG will eventually come out of the US and to which markets. In any case US LNG exports will contribute to the emergence of a more liquid, more diversified and more global gas market, indirectly US gas has already improved European energy security inasmuch as the lack of major import needs for the US has increased global gas supply liquidity and improved access conditions for European off takers to LNG shipments. US LNG exports will help "depoliticize" gas relations in both Europe and Asia and improve the prospects of increased gas usage and coal-to-gas switching in major consumer countries especially in Asia, facilitating climate action, price and security of supply are the primordial concerns of major coal users hesitant about a larger-scale switch to gas. US LNG exports could alleviate both.[41]

3.2.6 *Middle East*

The Arab region is a rapidly growing market for energy and relies on oil and natural gas for its energy mix more than anywhere else in the world, regional primary energy consumption tripled, from around 150,000 ktoe in 1990 to around 435,000 ktoe by 2016. The GCC economies, all of them fossil fuel producers with a concentration of energy intensive industrialization strategies since the 1980s, have seen particularly fast wealthiest states on a per capita basis, and most others being middle-income countries, demand for energy is further set to grow over the coming decades, resulting in a further rise in regional energy consumption throughout the period up to 2030.[42]

Fossil fuels have historically been vitally important in the Arab region's energy mix, more than 95% of regional energy supply is derived from oil and natural gas, making the Arab region the most fossil fuel-dependent region in the world. Oil has historically played a key role as a key natural resource asset in a number of Arab countries in the Gulf and the Maghreb, making it both the most important export product and a key fuel on domestic

[40] The Future of Natural Gas Markets and Geopolitics, The USA as a New Gas Exporter
[41] The Future of Natural Gas Markets and Geopolitics, The USA as a New Gas Exporter
[42] The Palgrave Handbook of International energy Crisis, Energy and the Economy in the Middle East and North Africa

energy markets throughout the region. Natural gas is a second, increasingly important energy resource besides oil, whose production, consumption, particularly in Arab countries' power sectors and import have risen sharply in recent decades. Arab countries hold some of the world's most important conventional energy resources, accounting combined for over 40% of globally traded oil alone, fossil fuel resources are unevenly distributed between Arab countries. The GCC economies, Algeria, Egypt, Iraq and Yemen are net exporters of energy, although all of them also import energy such as transport fuel and, in some cases, natural gas. Other countries such as Jordan, Lebanon, Morocco, Sudan, the Syrian Arab Republic and Tunisia are net importers whose domestic energy mix has historically been more diversified, though it remains heavily dependent on imported fossil fuels.[43]

Relatively high and rising oil prices during the 2000s up to the early 2010s have since triggered a series of reform efforts throughout Arab countries, including in oil and gas exporting countries, both groups share a historically high degree of dependence on fossil fuels, though some progress has been observed in both energy importing and exporting countries that have made diversifying their domestic energy mix a policy priority. Indeed, policy changes have included efforts to adjust domestic energy pricing frameworks and to integrate some elements of energy-efficiency regulation into an increasing number of Arab countries' domestic energy sector policy frameworks. More recently, increased focus has arisen around the promotion of a more diversified range of energy sources, boosting the profile of renewable energy in particular, Arab oil and gas exporters have been part of this transition, as their economies have significant opportunities to gain from a more sustainable use of energy within their domestic markets. Producers such as Iraq, Kuwait, Libya and Qatar rely for over 80% of their government revenues on fossil fuel export earnings, a proportion that has barely changed over the past decades. Fossil fuels diverted from international to domestic markets in producing states result in a fiscal opportunity cost that could be minimized through more efficient use of energy, which historically received little priority and greater reliance on renewable energy, which has grown increasingly cost-effective.[44]

Energy price reform that has been progressing in the Arab region is likely to play an important enabling role for more sustainable energy consumption and production patterns, lack of cost-reflective energy prices is a major disincentive to energy efficiency and distributed renewable. At the time of writing, energy subsidies remain a feature in many Arab energy markets for different user groups, although their size has been falling along with reform progress in some countries, coupled to fluctuating shadow prices on international markets. At the same time, changing energy prices also entail many socio-economic challenges, including the protection of energy access by low- and middle-income households as well as businesses and industries, integrating energy planning into wider socio-economic development planning will help governments design policies in an inclusive way, for instance by coupling energy price reform to improved other social safety nets, and the redirection of subsidies to investment in sustainable energy technologies. [45]

[43] The Palgrave Handbook of International energy Crisis, Energy and the Economy in the Middle East and North Africa

[44] The Palgrave Handbook of International energy Crisis, Energy and the Economy in the Middle East and North Africa

[45] The Palgrave Handbook of International energy Crisis, Energy and the Economy in the Middle East and North Africa

The Arab region consists of a diverse set of countries with different national contexts, including in the case of energy, however, most countries remain exceptionally reliant on fossil fuels with a highly limited role played by clean energy alternatives, in particular renewable energy, while the region also lags behind other region's progress in energy efficiency. In the Arab LDCs, energy access remains incomplete, severely obstructing socio-economic progress. Making sustainable energy part of Arab countries' policy agenda requires far more systematic efforts than has been the case in the past.[46]

[46] The Palgrave Handbook of International energy Crisis, Energy and the Economy in the Middle East and North Africa

3.3 LNG Shipping Market

3.3.1 *NEWBUILD DELIVERIES*

The LNG shipping market has developed rapidly since the early 2000s, following a general upward trend during the previous decade. The global financial crisis in 2008 resulted in a slowdown in orders. This resulted in a short decline in deliveries until 2013, but the market has since picked up again, with recent years exceeding previous yearly deliveries. As seen in the chart above, LNG new build deliveries are still growing and this is expected to continue into the next few years, following a trend established over the past several years, 86% of the new builds delivered in 2019 were between 170,000 cm and 180,000 cm in size, averaging about 170,000 cm. Vessels of this size remain within the limits of the new Panama Canal expansion transit while maximising economies of scale. Although larger vessels have become more common over time, this is a departure from the trend seen in the 2007-2010 period, when 45 Qatari Q-Class new builds exceeded 200,000 cm in capacity.
The fleet was relatively young and vessels under 20 years of age make up 91.1% of the overall fleet, which was aligned with developments and growth in recent years in liquefaction projects, newer vessels are larger and more efficient, with far superior project economics for their operational lifetime. The global fleet was young, as only 11 active vessels are aged 30 years or older, including three that have already been converted to FSUs. At the end of 2019, there were approximately 20 vessels laid-up around the world.
The global LNG vessel orderbook counted 126 carriers as of year 2019, an impressive tally representing 23.3% of the current fleet size of 541 units. This illustrates shipowners' expectations that LNG trade will continue to grow, in line with the increase in liquefaction capacities in the coming years. Another 43 vessel deliveries was expected in 2020, accounting for a 7.9% increase in the global fleet count. The last of 15 initial Icebreaker-class vessels – highly innovative and more capes intensive ships that are able to traverse the Arctic – were delivered in 2019 to off take from Novatek's Yamal LNG project in northern Russia.
Spot charter rates are affected by balances between shipping demand and supply, in turn driven by liquefaction capacity and LNG vessel deliveries. Charter costs in 2019 began strong at approximately US$70,000 per day for steam turbine vessels and US$100,000 per day for TFDE/DFDE. Rates proceeded to level off to approximately US$30,000 for steam turbine vessels and about US$40,000 for TFDE/DFDE vessels, varying as expected with summer months impacting LNG shipment volumes. Sanctions on China Ocean Shipping Company Limited (COSCO) followed by a European storage build-up and sustained increases in US production caused an acute increase in charter prices, rates (West of the Suez) peaked in late October at US$105,000 for steam turbine vessels, US$145,000 for TFDE/DFDE vessels and US$160,000 for XDF/MEGI vessels.[47]

3.3.2 *LNG CARRIERS*

LNG containment systems are designed to store LNG at a cryogenic temperature of -162 C (-260F). This has been a key element in designing containment systems for LNG carriers, which can be split into two categories — membrane systems and self-supporting systems. Membrane systems are mostly designed by Gaztransport & Technigaz (GTT), while self-supporting systems comprise mainly of spherical "Moss" type vessels. Due to the advantages

[47] 2020 WORLD LNG REPORT

highlighted in this section, modern newbuilds have for the most part adopted the membrane type.
In both systems, a small amount of LNG is converted into gas during a voyage. This is referred to as boil-off gas, a direct result of heat transferred from the atmospheric environment, liquid motion (sloshing of LNG), the tank-cooling process and the tank-depressurization process. Boil-off rates (in older LNGCs averaging around 0.15% of total volume per day), with recently built LNGCs are below 0.10% of total volume per day. Membrane and self-supporting systems can be further split into specific types, which are examined.
The two dominant membrane type LNG containment systems are the Mark III and NO96, designed by Technigaz and Gaztransport (GTT), respectively, which subsequently merged to form Gaztransport & Technigaz (GTT). Membrane type systems have primary and secondary thin membranes made of metallic or composite materials that shrink minimally upon cooling. The Mark III has two foam insulation layers while the NO96 uses insulated plywood boxes purged with nitrogen gas. The KC1, a new membrane system designed by KOGAS, has also entered the market in recent years, breaking GTT's membrane monopoly.[48]

3.3.2.1 PROPULSION SYSTEMS

Propulsion systems impact capital expenditure, operational expenses, emissions, vessel size range, vessel reliability and compliance with regulations, outlining the importance of this decision. Prior to the early 2000s, steam turbine systems running on boil-off gas and heavy fuel oil were the only propulsion solution for LNG carriers. Increasing fuel oil costs and stricter emissions regulations created a need for more efficient engines, giving rise to alternatives such as the Dual-Fuel Diesel Electric (DFDE), Triple-Fuel Diesel Electric and the Slow-Speed Diesel with Re-liquefaction plant (SSDR). In recent years, modern containment systems generating lower boil off gas alongside the prevalence of short-term and spot trading of LNG have spawned demand for more flexible and efficient propulsion systems in order to adapt to varied sailing speeds and conditions.
These factors have resulted in a new wave of dual-fuel propulsion systems, also burning boil-off gas with a small amount of pilot fuel or diesel. This includes the high-pressured MAN B&W M-Type, Electronically Controlled, Gas Injection (MEGI) and low-pressured Winterthur Gas & Diesel XDF.
As propulsion systems are manufactured by third parties such as Wärtsilä, MAN B&W and Winterthur Gas & Diesel, different shipbuilders generally offer a variety of propulsion systems. As such, shipowners are not restricted to specific shipbuilders or geographies when choosing newbuild specifications best matching their purpose.[49]

3.3.2.2 STEAM TURBINES

The use of steam turbines for ship propulsion is mostly now considered to be superseded technology and hiring crew with steam experience is difficult nowadays. In a steam turbine propulsion system, two boilers supply highly pressurized steam at over 500°C (932°F) to a high, and then low, pressure turbine to power the main propulsion and auxiliary systems. The steam turbines main fuel source is boil-off gas, with heavy fuel oil as an alternative should the former prove insufficient. The fuels can be burned at any ratio and

[48] 2020 WORLD LNG REPORT
[49] 2020 WORLD LNG REPORT

excess boil-off gas can be converted to steam, making the engine reliable and eliminating the need for a gas combustion unit (GCU), maintenance costs are also relatively low.
The key disadvantage of steam turbines is the low efficiency, running at 35% efficiency when fully loaded (most efficient). The newer generations of propulsion systems, DFDE/TFDE and XDF/MEGI engines, are over 25% and 50% more efficient when compared to the steam turbine. There are currently 224 active steam turbine propulsion vessels, making up 41.4% of the total current fleet. There are no steam turbine vessels being built currently, showing the high adoption rates of newer technologies. In 2015, an improvement on the steam turbine was introduced, involving reheating of the steam in-cycle in order to improve efficiency by over 30%. Aptly named the Steam Reheat system (or Ultra Steam Turbine), there are 12 active vessels with the propulsion in place but zero newbuilds due.[50]

3.3.2.3 VESSEL AGE

The current global LNG fleet is relatively young, considering the oldest LNG vessel operating was constructed in 1977. Vessels under 20 years of age comprise 91.1% of the fleet, consistent with liquefaction capacity growing rapidly from the turn of the century. In addition, newer vessels are larger and more efficient, with far superior project economics over their operational lifetime. This is a result of improvements in technology and an increase in global LNG trade. As capacity and global LNG demand continue to grow with each passing year, this trend is slated to continue. With financial and safety concerns in mind, shipowners plan to operate a vessel for 35-40 years before it is laid-up, a term describing vessels left idle. A decision can then be made on whether to scrap the carrier, convert it to an FSU/FSRU, or return it to operation should market forces pick up. When commissioning a newbuild, a shipowner determines vessel capacity based on individual needs, ongoing market trends and technologies available at the time. Liquefaction and regasification plants also have berthing capacity limits, an important consideration. As individual shipowner needs are also affected largely by market demand, newbuild vessel capacities have stayed primarily within a small range around period averages.

Due to the dominance of steam turbine propulsion, vessels delivered before the mid-2000s were exclusively smaller than 150,000 cm, as this was the range best suited to steam turbine engines. The LNG vessel landscape changed dramatically when Nakilat, the Qatari shipping line, introduced the Q-Flex (210,000 to 217,000 cm in size) and Q-Max (263,000 to 266,000 cm in size) vessels, specifically targeting large shipments of LNG to Asia and Europe. These vessels achieved greater economies of scale with their SSDR propulsion systems, representing the 45 largest LNG carriers ever built.
After the wave of Q-Class vessels, most newbuilds settled at a size between 150,000 and 180,000 cm, making up 53.6% of the current fleet. The technology developments leading to the adoption of this size are the new propulsion systems, such as the MEGI, XDF and STaGE types, that maximise fuel efficiency between 170,000 and 180,000 cm. Another crucial factor is the new Panama Canal size quota – only vessels smaller than this size were initially authorized to pass through the new locks, imperative for any ship engaged in trade involving US LNG supply. In May 2019 the Q-Flex LNGC ‘Al Safliya’, which is larger than 200,000 cm, became the first Q-Flex type LNG vessel and largest LNG vessel by cargo capacity to transit the Panama Canal. Every vessel delivered in 2019 and 95.5% of the LNG orderbook with determinable capacities fall within the 150,000 to 180,000 cm capacity range.[51]

[50] 2020 WORLD LNG REPORT
[51] 2020 WORLD LNG REPORT

3.3.3 *FLOATING STORAGE REGASIFICATION UNIT*

Able to store and convert LNG to gaseous form, FSRU vessels have become popular over the past two decades, now contributing to 6.3% of the global fleet. Compared to traditional regasification plants, FSRUs offer better flexibility, lower capital outlay and a faster means of implementing LNG sourced natural gas. While operating expenses are higher for an FSRU, total capital expenditure can be as little as half that of an onshore terminal. FSRUs can either be built from scratch or converted from an old LNG carrier. The duration of construction is also significantly shorter than that of an onshore terminal, as low as 50% for a newbuild or even lower if the FSRU is an LNG carrier conversion. However, FSRUs have not been free of issues. Delivery delays, power cuts and rising costs have affected certain projects, slightly dampening demand for the vessels. In addition, spikes in charter rates can motivate shipowners to utilize the ships as carriers, reducing the number of FSRUs operating as degasification or storage units.[52]

3.3.4 *ORDERBOOK VESSEL COST AND DELIVERY SCHEDULE*

Of the 126 vessels in the global LNG vessel orderbook as of 2019 year-end (carriers and FSRUs), it is worth noting that almost one-third of all current newbuilds are to be delivered to shipowners affiliated with typical LNG buyers. The remainder consists of shipowners affiliated with typical LNG sellers, traders and independent shipping companies, betting on continued LNG cross-border demand. A high proportion of 95.5% of newbuild vessel capacities fall within the 150,000 to 180,000 cm capacity range. This is a result of maximizing MEGI and XDF efficiencies while keeping to new Panama Canal lock size limits.

The top three LNG builders – South Korean yards Hyundai Ulsan and Samho, Samsung Heavy Industries and Daewoo Shipbuilding – have approximately 47, 31 and 30 vessels on their orderbooks respectively. Hyundai and Samsung are working on a large proportion of newbuilds with XDF systems, while Daewoo's orders include a large number of MEGI engines, possibly developing a specialty. Elsewhere, Chinese builder Hudong-Zhonghua has a notable seven carriers on order. Qatar is rapidly increasing its liquefaction capacity, expressing ambitions to move from 77 MTPA at present to 126 MTPA by 2027. To support this increase, Qatar Gas has expressed its intention to commission a large order of LNG carriers. In 2019, the Qatari shipping company Nakilat acquired a 60% stake in four newbuilds with Maran Gas, and purchased full ownership of four carriers that had previously been jointly owned with International Seaways.

The cost of constructing an LNG carrier is highly dependent on characteristics such as propulsion systems and other specifications involving the ship design. Historically, DFDE/TDFE vessels started out being pricier than steam turbine vessels, with the higher newbuild costs offset by efficiency gains from operating more modern ships. DFDE/TFDE newbuild costs have varied heavily over the years due to different specification standards – a prominent example is the 2014 peak of over US$1,700/cm due to 15 ice-breaker class vessels ordered to service Yamal LNG. These vessels, delivered in 2017, were priced at about US$320 million which drove up average prices. Most of the new LNG vessels have been

[52] 2020 WORLD LNG REPORT

delivered between 30 to 50 months from order date. Despite changes in average vessel sizes over time, shipyards have been able to construct on a consistent delivery schedule, with variance within this band occurring during introduction of new propulsion systems. This can be attributed to shipyards having to adjust to novel designs with new engines, an example being delivery duration peaks in 2009, reaching over 50 months in the years following introduction of DFDE/TFDE systems. As Korean shipbuilders are becoming more experienced in delivering XDF and MEGI vessels, the average delivery duration for newbuild orders is expected to remain around 30 months moving forward.[53]

3.3.5 *CHARTER, FLEET VOYAGES AND VESSEL UTILISATION*

With gas prices depressed globally, delivery costs take up a higher proportion of netback calculation when trading LNG. Charter costs thus greatly affect LNG players' market strategy, whether for spot or term charter. Charter costs in 2019 started at about US$70,000 per day for steam turbine vessels and US$100,000 per day for TFDE/DFDE vessels in 2019. Rates reduced to approximately US$30,000 for steam turbine vessels and about US$40,000 for TFDE/DFDE vessels in the second quarter of the year, before varying as summer months impacted LNG trade flows. A spike in late October drove peak charter prices to US$105,000 for steam turbine vessels, US$145,000 for TFDE/DFDE vessels and US$160,000 for XDF/MEGI vessels. LNG charter rates are affected by demand for shipping LNG (driven by liquefaction capacity) and supply of shipping capacity (a function of global fleet size). Historically, LNG was commonly sold and purchased under long-term contracts, encouraging shipowners to enter term charters with bigger players. A relatively small amount of vessel capacity was available on a spot basis for arbitrage opportunities, lack of liquidity could lead charter rates to be largely affected by the mismatch between supply and demand.
In the early 2010s, fleet growth was well balanced with additional liquefaction coming online, resulting in a stable charter market. However, vessel deliveries far outweighed liquefaction capacity growth from 2013 onwards, resulting in a glut of LNG shipping capacity and a steady decline of charter rates. This continued until 2015, after which they remained between US$15,000 and US$50,000, for steam turbine engines, both East and West of Suez until the fourth quarter of 2017, when a rapid increase in Asian LNG demand sparked an initial increase in spot charter rates. Throughout 2018, spot charter rates were volatile, swinging between previous highs and corrections.[54]

A total of 5,701 of LNG trade voyages were completed in 2019, an 11% increase compared to the 2018 level of 5,130 voyages, thanks to new supplies from the US and Australia, demand growth in Asia and the ability to absorb these extra volumes in European markets. The start-ups of Cameron LNG T1, Elba Island and Freeport LNG T1 in the US and Prelude FLNG in Australia added another 2 MT to the market in 2019. The abundant new supplies, coupled with mild seasonality in Asia, have brought down gas prices to record lows on a global basis, reduced arbitrage spreads across continents and diverted more-than-expected LNG cargoes to Europe. Above 3,848 LNG trade voyages were completed for Asia in 2019, a slight 2% increase YoY, however, a record of 1,364 LNG voyages were for Europe in 2019, a 70% rise compared to 2018.
A project completed in 2016 widened and deepened the Panama Canal, which allows for more transits. The voyage distance and time from US's Sabine Pass terminal to Japan's Kawasaki LNG site can be reduced to 9,400 nautical miles (nm) and 29 days transiting

[53] 2020 WORLD LNG REPORT
[54] 2020 WORLD LNG REPORT

Panama Canal, compared to 14,500 nm and 45 days through Suez Canal and close to 16,000 nm and 49 days via the Cape of Good Hope. The most common voyage globally in 2019 was from Australia to Japan, with 447 voyages within the year, while the most common voyage to Europe in 2019 was from Russia, with 286 shipments during the year, followed by 265 voyages from Qatar and 181 voyages from the US, respectively. The 5,701 LNG trade voyages were done by 541 vessels in 2019, the average number of voyages completed per vessel was 10.5 in 2019, a slight rise from the 2018 level of 10.3, the voyage time averaged at 12.8 days in 2019, remaining constant from 2018. It normally takes longer voyage time and fewer completed trips from the Atlantic basin to Asia, but since a significant number of LNG trades were diverted from Asia to Europe, the average voyage times for 2018 and 2019 were quite close. [55]

[55] 2020 WORLD LNG REPORT

4. MARKET ANALYSIS

The market will analyse in two phases, to be easier in the end the comparison between them. First phase is the pre-Covid19 and pre Ukraine war period (2010-2020) approximately, while the second phase is post-Covid19 and Ukraine war period (2021-2023).

4.1 Pre Covid19

Liquefied natural gas entered international trade in a very modest way in the 1960s. The first experimental voyages with LNG carriers were carried out in the 1950s, but the first commercial trip was in 1964, between Algeria and the UK. A year later, LNG cargoes began flowing from Algeria to France, while in 1969 trade between Alaska and Japan was initiated. An interesting characteristic of the LNG market is the fact that the transport element was traditionally only the last in a long chain of planning decisions that have to be made for any individual project. LNG ships are probably among the most sophisticated and technology-intensive in the world, with prices in the region of $200 million for a ship with a typical capacity of 160,000 cbm, built in the Far East.
LNG projects are extremely capital-intensive, usually requiring billions of dollars of funds, of which a substantial part has to be provided by equity holders, projects are usually set up as joint ventures between developed and developing countries, and involve long lead times, usually between 7 and 10 years. Some of the factors that need to be in place for a project to be successful include, a big enough reserve of gas, which is unlikely to be consumed domestically for the next 20 years at least. One or more buyers willing to enter long-term purchase contracts, a host government willing to be flexible on fiscal issues, expertise in technical and safety areas and willingness of all parties to view the projects on a long-term, cooperative basis, these factors will undoubtedly continue being important in the future. However, through the 2000s, we have witnessed a gradual, but persistent, increase in the amount of LNG cargoes that move on a short-term basis.
According to GIIGNL (2012), there were 89 liquefaction trains in 185 exporting countries in 2012, with a total capacity of 282 mtpa (million tonnes per annum). Qatar currently holds the largest LNG production capacity, with 14 liquefaction trains operating at Ras Laffan, by the two production companies, Qatargas and Rasgas. Qatar invested heavily in these facilities, in order to monetize its large gas reserves and, as we have seen earlier, it is now the world's largest LNG exporter, as well as the second largest overall gas exporter.[56]

The other large capacity holder is South Korea, whereas in Europe it is Spain and the UK holding the top two places. The US, albeit the world's second largest capacity holder, is a bit of an anomaly. In 2012, only about two per cent of this capacity was utilized. Quite a few of these degasification terminals were built or expanded in the early part of the 2000s, in anticipation of a surge in US gas imports, but then, the shale gas revolution hit the US market and many of these plants have remained seriously underutilized. However, with the possibility of a sizeable expansion of US exports of shale gas, several plans are afoot for converting some of these plants into liquefaction terminals.
LNG trade accounts for only about ten per cent of world natural gas production and is rather small compared to trade flows of other energy commodities, but because of the complexity of its transport logistics, LNG flows have been meticulously documented on a voyage-by-

[56] LNG, Natural Gas, Commodity Trade and Finance

voyage basis, since the very beginning in the 1960s. The carriage of the liquid itself is only one of several steps of a carefully planned procedure, which includes carriage of gas from the point of production to the port liquefaction facility, loading, degasification at the port of Destination, and transport to the point of consumption. LNG contracts have been extensively documented and are being regularly quoted in special publications by organizations such as Cedigaz and the International Group of Liquefied Natural Gas Importers. Details of contracts are given in GIIGNL (2012), and a small excerpt for Qatar contracts is given in, as one can clearly see, the vast majority of contracts are for durations in excess of 20 years, and in some cases they extend over 30 years, an indication of how important long-term commitment from both buyers and sellers is essential.[57]

4.1.1 *LNG TRADE*

In Europe, Spain and France established significant expansions of trade and the UK LNG demand evolved to become the highest in Europe in just a few recent years, in Asia, South Korea's LNG imports have grown more than threefold, whereas Japan has posted a respectable 68%growth during that period, it is through the emergence of China and India during the period that is signaling where much of the future growth is expected to come from. US LNG imports rose steadily to 21.82 bcm in 2007, but contracted to 10.01 bcm in 2011 due to shale gas competition and price collapse, nonetheless in 2010 the United States still imported 10 times more LNG than it did in 1996, the LNG industry is not dead in North America, but is likely to play a more complex import–export role in the future.
In addition to the large market shares dominated by the countries mentioned earlier, the emergence of a diverse Latin American import market is revealed, something that was not envisaged until just a few years ago. Indeed, Argentina, Chile, and Brazil are all developing LNG infrastructure to facilitate access to secure energy supplies and promote economic growth. The LNG industry has managed to circumvent access to the politically and geographically stranded gas resources of Bolivia. The emergence of LNG markets in some of the European countries with low gas demand such as Portugal and Greece and Italy, together with expansions in the Turkish market are likely to be followed over the next decade by new market entrants from Eastern Europe such as Poland, Baltic States, and some Balkan nations. In addition the Netherlands, the only net gas exporter in the European Union, commissioned in 2011 its first regasification terminal in Rotterdam, it is likely that Rotterdam will become an important northwest Europe gas trading hub with pipeline gas and LNG competing for access to the large German and UK markets under a range of term and spot contracts. Indexation of such trade to benchmark gas prices should provide further competition to pipeline gas from Norway and Russia indexed to oil and petroleum product prices, new LNG facilities are planned for France (e.g., EdF plans a new plant at Dunkirk sanctioned in 2011). Stagnant macro-economic growth may slow LNG development in Europe, however, with North Sea gas in decline and EU environmental policies curtailing nuclear and coal power plant developments, even if energy demand remains flat in the region, the quantity of gas imports seems destined to increase significantly. The European drive to substitute fossil fuels and nuclear by intermittent renewable energies (mainly solar and wind) also requires back-up supplies, and natural gas provides the most efficient option to provide such back-up supplies. The emergence of small LNG import markets in Kuwait and Dubai is testament to the versatility and flexibility of the industry, with short-term cargoes coming not from neighboring Qatar but from around the world. More short-term spot markets such as these are

[57] LNG, Natural Gas, Commodity Trade and Finance

destined to develop over the coming decade and will play an important role in market liquidity, diversity, and competition for spot LNG cargoes.[58]

The four largest LNG producers Qatar, Malaysia, Indonesia, and Australia, in that order by volume accounted for 58% of all LNG exports in 2010. In 2003 the top four exporting countries, Indonesia, Algeria, Malaysia, and Qatar, accounted for 63% of all LNG exports. This highlights the diversification of the LNG export markets and that some countries are increasing their share of it through massive capital investments such as Qatar and Australia, while others are losing ground through much slower investment and expansion strategies, aging infrastructure, and depleting reserves supplying the older plants such as Algeria, Indonesia, and UAE.
Hovering just below the top four exporting nations in 2011 were Nigeria and Trinidad; both expanded their capacity rapidly between 2000 and 2005 but subsequently their growth has been curtailed. In the case of Nigeria there are plenty of reserves but the problems include political unrest in the Niger Delta areas where the gas is located, unstable fiscal terms (i.e., the Nigerian government is seeking to increase its fiscal take and pay little for gas consumed domestically within Nigeria), and procurement constraints that inhibit import of specialist technology. This situation has resulted in several potential investors delaying commitments for several years on new plants. In the case of Trinidad the problem is both limited proven gas reserves inhibiting rapid expansion by building new liquefaction trains and the rapid and significant fall in demand for LNG in the United States, its main and geographically closest customer.[59]

4.1.2 *LNG VIA REPORTS*

The tidal wave of LNG projects that were sanctioned between 2009 and 2014 led many to predict the emergence of surplus LNG as it took time for demand to catch up with the rapid growth in supplies, but many observers have so far been surprised by the apparent absence of such a glut. There is certainly little evidence of LNG facilities standing idle due to a lack of Demand, this absence partly reflects that, due to a variety of technical issues, actual LNG supplies have come on stream less quickly than originally planned, moving supply more into line with the original demand profiles. However, the apparent absence of a glut also reflects the fact that the surplus LNG supplies which did emerge resulted in bouts of unsustainably low prices rather than a build-up of idle capacity.
2017 was a bumper year for natural gas, with consumption (3.0%, 96 bcm) and production (4.0%, 131 bcm) both increasing at their fastest rates since the immediate aftermath of the financial crises. The growth in consumption was led by Asia, with particularly strong growth in China (15.1%, 31 bcm), supported by increases in the Middle East (Iran 6.8%, 13 bcm) and Europe, the growth in consumption was more than matched by increasing production, particularly in Russia (8.2%, 46 bcm), supported by Iran (10.5%, 21 bcm), Australia (18%, 17 bcm) and China (8.5%, 11 bcm). The other central factor supporting the strength of global gas markets was the continued expansion of liquefied natural gas (LNG), which increased by over 10% in 2017, its strongest growth since 2010, aided by the start-up of new LNG trains in Australia and the US. Finally China's increased need for LNG accounted for almost half of the global expansion, with China overtaking Korea to be the world's second largest importer of LNG after Japan.

[58] LNG Trade, Handbook of Liquefied Natural Gas
[59] LNG Trade, Handbook of Liquefied Natural Gas

This is illustrated by Asian spot LNG prices that shown by the Japan Korea Marker (JKM), over the past years fluctuating in a range between US LNG exporters' full-cycle costs and their short-run operating costs. Exporters of US LNG have been willing to supply LNG as long as they covered their operating costs, even if that was less than their full-cycle costs. So there has in fact been an LNG glut of sorts in recent years, but this has manifested itself in periods of unsustainably low prices rather than idle LNG capacity.[60]

2018 was a bonanza year for natural gas, with both global consumption and production increasing by over 5%, one of the strongest growth rates in either gas demand or output for over 30 years. The main actor here was the US, accounting for almost 40% of global demand growth and over 45% of the increase in production.
US gas production increased by 86 bcm, an increase of almost 12%, driven by shale gas plays in Marcellus, Haynesville and Permian. The US achieved a unique double first in 2018 recording the single largest-ever annual increases by any country in both oil and gas production , in case there was any doubt, the US shale revolution is alive and kicking.
The gains in global gas production were supported by Russia (34 bcm), Iran (19 bcm) and Australia (17 bcm).
Although some of the increase in US gas supplies was used to feed the three new US LNG trains which came on stream in 2018, the majority was used to quench the thirst of domestic demand. US gas consumption increased by 78 bcm in 2018 – roughly the same growth as the country achieved over the previous six years, this exceptional strength appears to be largely driven by the same weather-related effects, with rising demand for space heating and cooling fuelling increased gas consumption, both directly and more importantly, indirectly via growing power demand. The expansion of gas consumption within the US power sector was further boosted by almost 15 gigawatts of coal-fired generation capacity being retired.
Outside of the US, the growth in global gas demand was relatively concentrated across three other countries, China (43 bcm), Russia (23 bcm) and Iran (16 bcm), which together with the US, accounted for 80% of global growth. China gas consumption grew by an astonishing 18% between 2018 and 2019, this strength stemmed largely from a continuation of environmental policies encouraging coal-to-gas switching in industry and buildings in order to improve local air quality, together with robust growth in industrial activity during the first half of 2019.[61]

Global LNG supplies continued their rapid expansion in 2018, increasing by almost 10% (37 bcm) as a number of new liquefaction plants in Australia, US and Russia were either started or ramped up. For much of the 2018, the strength of Asian gas demand, led by China, was sufficient to absorb these increasing supplies, but a waning in the strength of Asian demand towards the end of the year, combined with a mini-surge in LNG exports, caused prices to fall back and the differential between Asian and European spot prices to narrow significantly.
The prospect of further rapid increases in LNG supplies this year means there is a possibility of a first meaningful curtailment of some LNG supply capacity. The extent of any eventual shut-in will depend importantly on the European market, which acts as the de facto 'market of last resort' for LNG supplies.
Europe's gas demand contracted by a little over 2% (11 bcm) in 2018, but this fall in demand was more than matched (-13 bcm) by continuing declines in Europe's ageing gas fields. The small increase in European gas imports was largely met by LNG cargos diverted from Asia towards the end of the year as the Asian premium over European prices almost disappeared.
Russian pipeline exports to Europe were largely unchanged on the year, maintaining the

[60] BP Status Review 2018
[61] BP Status Review 2019

record levels built up in recent years, although with a slight decline in their share of Europe's gas imports. A key factor determining the role that Europe will play in balancing the global LNG market over coming years will be the extent to which Russia seeks to maintain its market share.[62]

Global natural gas consumption growth averaged 2% in 2019, below its 10-year average and down sharply from the exceptional growth seen in 2018 (5.3%), in volume terms, demand grew by 78 billion cubic meters (bcm), led by the US (27 bcm) and China (24 bcm). The growth in US and Chinese gas consumption was much slower than in 2018, as the boost from weather effects and policy driven coal-togas switching in China faded, a reduction in the number of unusually hot and cold days also contributed to a fall in Russia's gas consumption (10 bcm) – the largest decline of any country in 2019. Gas production grew by 132 bcm (3.4%) outpacing growth in consumption. The US accounted for almost two thirds of net global growth, with the volumetric increase of 85 bcm just shy of 2018's record increment (90 bcm), supply was also boosted by strong growth in Australia (23 bcm) and China (16 bcm).
Much of 2019's increase in gas production was used to feed additional exports of liquefied natural gas (LNG). LNG exports grew by 54 bcm (12.7%) in 2019, the largest annual increase ever, driven by record increases from the US (19 bcm) and Russia (14 bcm) as well as continued growth from Australia (13 bcm), on the LNG import side, nearly all incremental supplies headed to Europe, in contrast to 2018 when Asia drove import growth. European LNG imports rose by 49 bcm, representing an unprecedented 68% increase, growth was widespread, with the UK (11 bcm), France (10 bcm) and Spain (7 bcm) the largest individual contributors. The rapid growth in LNG led to a 4.9% increase in overall inter-regional gas trade, a rate more than double its 10-year average, this is despite a 1.7% decline in pipeline trade (-9 bcm) as pipeline imports into Europe from Russia and North Africa were partially crowded out by the abundance of LNG supplies. With production growth outpacing growth in consumption by a considerable margin, storage levels rose in most regions and prices fell sharply. US Henry Hub prices dropped almost 20% to average $2.53/mmBtu, while European and Asian prices, as measured by the UK NBP index and the Japan Korea Marker, fell by more than 40%, averaging $4.47/mmBtu and $5.49/mmBtu respectively, prices in Europe, the region most affected by LNG oversupply, fell to their lowest levels since 2004.[63]

4.2 POST COVID19 AND UKRAINE WAR

4.2.1 *COSUMPTION AND IMPORTS*

According to Wholesale Gas Price Survey for 2023, the total consumption in 2022 was around 4,082 bcm. GOG has the largest share at 51%, totaling 2,076 bcm, dominated by North America at 1,126 bcm, followed by Europe at some 409 bcm, the Former Soviet Union at 254 bcm, and Asia Pacific and Asia at 111 and 93 bcm respectively, in all GOG can now be found in 66 markets, in one form or another, and in all regions. The OPE share at 18%, totals 714 bcm and is predominantly Asia (331 bcm), Asia Pacific (229 bcm) and Europe (87 bcm), OPE is widespread also being found in 49 markets, including two-thirds of the countries in Europe (although most at very small percentages), and in all regions except North America. The BIM share at 3% totals some 133 bcm and is in 24 countries,

[62] BP Status Review 2019
[63] BP Status Review 2020

predominantly Middle East – Qatar, UAE, Israel and Iraq, and the Former Soviet Union – in countries importing from Russia, the total of "market" pricing rose from 62% in 2005 to 72% in 2022, mirrored by a decline in "regulated" pricing, from 38% in 2005 to 28% in 2021. Changes in percentages between surveys can arise because of actual changes in price formation mechanism or because of more rapid growth in consumption in countries with a specific type of price formation mechanism. The Trading category is by far the largest, dominated by North America and increasingly Europe, and has increased from 30% of total world consumption in 2005 to 38% in 2021 – a rise of 8 percentage points, the Bilateral category has risen from 1.1% to 8.4% - a rise of 7.3 percentage points, while the Spot LNG category has risen from 0.2% to 4.2% - a rise of 4 percentage points. The total rise in GOG between 2005 and 2022 has been 19.5 percentage points.[64]

Total imports in 2022 accounted for some 27% of total world consumption – 1,083 bcm, total imports are the sum of pipeline and LNG imports and comprise the three categories of GOG (Gas-on-Gas Competition - 56%), OPE (Oil Price Escalation - 38%) and BIM (Bilateral Monopoly - 6%). OPE declined from 63% in 2005 to 59% in 2007 as GOG rose from just over 21% to 28% and then in 2009, OPE gained share rising to 66% as BIM fell from 14% to 6%, with GOG rising to 29%. Since 2009 OPE has lost share by around 27 percentage points and GOG gained a similar share, in large part due to pipeline imports in Europe, but recently the rising share of GOG in LNG imports. Over the period 2005 to 2021, OPE pricing declined by 17% while GOG grew by 260%. It should be noted that total imports fell in volume terms in 2022, as a result of the lower Russian pipeline imports into Europe, but overall, the shares of OPE and GOG in total imports were not that much changed.[65]

LNG imports in 2022 accounted for some 12% of total world consumption, around 488 bcm**.** LNG imports are split 53% OPE and 47% GOG. OPE at some 259 bcm is mostly Asia Pacific – Japan, Korea and Chinese Taipei, followed by Asia – China, India and Pakistan – and Europe – mainly France, Spain, Turkey, Portugal, Italy and Poland.

The main changes in the fifteen surveys from 2005 to 2022 are a rise in GOG from 14% in 2005 to 32% in 2012, which was largely at the expense of the OPE category, before it fell back in 2014 to 25%, while in 2015 there was a recovery back to a 33% share, a fall in 2016 to 25%, before rising to 29% in 2017, 34% in 2018, 41% in 2019, 44% in 2020, 46% in 2021 and 47% in 2022. The GOG share is comprised of LNG going to the traded markets of North America and in Europe the UK, Belgium and Netherlands and any hub-indexed LNG contracts (such as Henry Hub), and spot LNG cargoes to the more "traditional" LNG markets in Asia Pacific, Asia and Europe (including unconstructed LNG into traded markets) and some of the newer markets. There was a significant increase in GOG between 2005 and 2007, which was principally due to a rise in spot LNG imports in Asia and Asia Pacific and a smaller rise in North American imports. Since 2007, there have been offsetting changes with North American LNG imports – which are all GOG – declining, European imports, principally to the UK increasing in 2009 and 2010 and relatively stability in Asia and Asia Pacific spot LNG imports, in 2012, as Europe's LNG imports declined, these were more than offset in the GOG category by rising spot LNG imports in Asia and Asia Pacific. The decline in 2013 reflected the fall in the share of spot LNG imports and a decline in LNG imports into the UK, the USA and Canada, the further small decline in 2014 was principally due to lower spot LNG cargoes in Asia and Asia Pacific, with correspondingly higher OPE under long term contracts.[66]

The rebound in 2015 was largely due to more spot LNG cargoes in all markets but especially Japan and the new markets, as the fall in spot LNG prices preceded the decline in oil-linked

[64] Wholesale Gas Price Survey 2023 Edition

[65] Wholesale Gas Price Survey 2023 Edition

[66] Wholesale Gas Price Survey 2023 Edition

contract prices, in 2016, the decline in GOG was a consequence of LNG trade becoming more contracted, with fewer spot LNG cargoes, which benefitted OPE, in 2017 this was reversed as spot LNG cargoes increased, in part due to the rise in Henry Hub priced US LNG exports. 2018 saw a significant change in LNG imports of all the surveys, driven by the continued rise in Henry Hub priced US LNG exports but also by a general rise in spot LNG cargoes. This change was just as large in 2019, rising to over 40% for the first time, with the volume of OPE LNG imports declining for the second year in a row. In 2020, the growth of GOG slowed but still rose to 44%, the rise in GOG was strongest in Asia and Asia Pacific, rising to 46% (up 5 percentage points) and 27% (up 6 percentage points) respectively. These rises offset a five percentage-point decline in Europe, largely due to a switch to more OPE volumes in Spain in 2020. In 2021, the two-point rise in GOG largely reflected a large increase in spot LNG cargoes to Latin America (Brazil mainly), Asia Pacific and China. There was also a switch away from OPE cargoes to GOG in Europe. 2022 saw some significant changes as LNG imports increased dramatically into Europe, replacing lost Russian pipeline imports, the GOG share in Europe rose to 76% in 2022 from 67% in 2021, with a large rise in spot LNG cargoes. Many of these spot LNG cargoes were diverted from China, where the GOG share fell to 27% in 2022 from 49% in 2021, and Pakistan, where the GOG share fell to 17% in 2022 from 41% in 2021.[67]

The volume of LNG going to the traded markets had been in decline since 2010, with the decline in US LNG imports, reaching a low point in 2018 as UK imports also declined. Spot LNG cargoes have increased, especially in 2017 and 2018 in Asia Pacific, Asia and parts of Europe plus the newer LNG importing markets. However, in 2019, the volume of LNG going to the traded markets of Northwest Europe increased markedly, as the abundant supply of LNG sought a home in the only market able to absorb the surplus, declining only slightly in 2020. In 2021, the traded share rose again on the back of contracted US LNG cargoes into Asian markets especially, finally in 2022, spot LNG cargoes increased again as Europe outbid other regions and mopped up increasing unconstructed LNG supply.[68]

4.2.2 *THE NEW ENERGY REPORTS*

The European gas market is on focus, both because it is the largest market in which there is active gas-on-gas competition,; and because of the key role it plays as the balancing market for liquefied natural gas (LNG) cargoes. European gas imports falling by over 8½ % in 2020. The gas-on-gas competition in Europe takes the form of pipeline imports, predominantly from Russia, competing against LNG imports, largely from the US as the marginal source of LNG. As LNG imports have increased in recent years it has raised the question of the extent to which Russia and other pipeline gas exporters will compete against LNG to maintain their market share or instead forgo some of that share to avoid driving prices too low.[69]

This issue could become more acute in a transition in which Europe moves away from natural gas and competition between different gas supplies intensifies, although there is lots of complicating detail, it appears that Russian exporters were prepared to forgo some market share in 2020. Pipeline imports from Russia as a share of European gas demand fell from 35% in 2019 to 31% in 2020, with much of the reduction happening in the first half of 2020. Some of that reduction initially reflected the record storage levels which had been built up towards the end of 2019, but Russian volumes remained low through the second quarter when the impact of the pandemic on European gas demand was at its height. In contrast, LNG

[67] Wholesale Gas Price Survey 2023 Edition
[68] Wholesale Gas Price Survey 2023 Edition
[69] Statistical Review of World Energy 2021

imports were up year-on-year in the first half of 2020 and their share of European demand for the year as a whole was broadly unchanged at 21%, however, as to whether this provides a guide to the future behavior of Russian pipeline exports is less clear.[70]
The argument here is similar to the context of OPEC. In response to a fall in demand that is expected to be relatively short-lived, it may be entirely rational for pipeline exporters to use their flexibility to reduce supply temporarily to help stabilize the market and support prices. But the possible response to a sustained and growing contraction in gas imports as Europe transitions away from fossil fuels could be very different, with a stronger incentive for Russian pipeline exporters to compete to be the last producer standing. One of the factors affecting the response of pipeline exporters last year was their perception of how low European prices would need to fall to shut-in LNG exports, which takes us to the second aspect mentioned, Europe as the balancing market for LNG flows. Until 2020, this question of the shut-in price for LNG exports was largely hypothetical – shut-ins had never really occurred at scale. As European LNG forward prices fell below these operating costs, this triggered a significant shut-in of US LNG exports, average utilization rates of US LNG facilities began to fall in April in 2020, reaching a low of around 30-35% at the height of the summer. US LNG exports still increased by around 30% in 2020 helped by three new LNG trains coming on stream and several others ramping up, but had it not been for the cancelling of cargoes, the growth in US exports would have been closer to 80%.[71]

Global LNG trade increased by 2% to reach 362 million tons in 2020, most of the increase stemming from the beginning of the year. Asian LNG imports started to drop from the end of February 2020, as the major importers in the region, Japan, China and South Korea, were affected first by Covid-19, despite lower demand, supplies remained healthy. Export levels from Qatar and Australia, two of the largest exporters, remained stable, and US exports increased in March as Freeport and Cameron LNG ramped up production after commissioning, LNG imports into Europe remained strong as well, as buyers took advantage of the low market prices and substituted pipeline imports with LNG. Lockdowns were imposed in March 2020 in the largest LNG importing countries in Europe (Spain, Italy and France), causing Asian and European prices to drop below $3 per MMBtu. Also US exports had remained relatively resilient up to March, but export volumes then plummeted nearly 71% from April to July, as buyers started using the flexibility in their contracts to cancel cargoes from US liquefaction plants for the summer. Chenier reduced production levels from its Sabine Pass and Corpus Christi LNG facilities in response, thus helping to balance the market. Subsequent bad weather in the Gulf of Mexico caused outages at the Sabine Pass and Cameron LNG facilities, triggering a rally in global prices that lasted until October 2020, demand in Asia picked up again in the fourth quarter of 2020, as buyers in the region were active in the market, restocking ahead of winter.[72]

[70] Statistical Review of World Energy 2021
[71] Statistical Review of World Energy 2021
[72] Global Gas Report 2022

5. Crisis Effects

Crisis effects on the LNG market will be analyzed in two phase. First phase refers to the Covid19 effects, while the second phase refers to Ukraine war effect.

5.1 Covid19 Effects

A positive lesson from Covid19 demand shocks has been the gas value chain agility, the natural gas value chain demonstrated notable resiliency through the Covid-19 pandemic. Despite unprecedented shocks to the global energy system and challenging operational environments, gas has continued to reliably fuel society's critical functions, including power and water supply, hospital equipment, food production, and medical components manufacturing. The industry also nimbly adjusted to geographical and sectorial changes in demand patterns, for example, as the pandemic hit different regions at different times, gas volumes were rerouted to less affected areas where the demand was still strong. The value chain then adjusted back to the demand surge from the post-pandemic recovery, with 2021 natural gas supply surpassing 2019 levels.[73]

TTF gas prices fell to record low levels of $1.20 per MMbtu in May 2020, triggered by nationwide lockdowns and a pandemic-driven low demand environment. US LNG cargos were canceled between April and July, as the market demand remained depressed. Prices recovered quickly in 2021 and rallied upward, as the pace of global economic activity picked up, and gas demand increased, outpacing capacity additions, both the Asia Spot and TTF gas prices hit record highs, with the Asia Spot price peaking at $54 per MMbtu, as Europe and Asia competed for LNG cargoes. The Russia-Ukraine conflict also that started in February 2022 further exacerbated the already tight market, and the TTF Front Month contract was propelled to a new high of $68 per MMBtu in early March, a significant price premium was observed for European cargoes for the first time, as Asian gas was traded at a relatively discounted price. Upsteam oil and gas investments fell by 27% from 2019 to 2020, this was a consequence of Covid-19 demand destruction and the associated price collapse, as well as uncertainty around future demand and policy direction. Upstream capital investments have been in the range of $400-500 billion between 2016 and 2019, compared to a level of more than $700 billion in 2013 and 2014.[74]

Long-term LNG contracts are gaining in popularity to reduce exposure to spot-priced market volatility. The European market, which has been purchasing most of its LNG from the spot and futures markets, was particularly exposed to the price shocks in 2021 and 2022, with lower volumes flowing from Russia, Europe's reliance on cargoes from the US, Africa and the Middle East increased. China was to some extent shielded from high gas prices, due to its preference for long-term oil-indexed contracts over spot cargoes, a higher share of long-term LNG contracts can be used to minimize exposure to market volatility. The energy crisis prompted a renewed focus on supply security, for the first time in the history of gas markets, we are seeing a crisis close in scale only to the 1970's oil crisis, when the world faced shortages and price hikes, the crisis has been further exacerbated by supply shortages across all energy commodities, prompting an increased focus on energy security. Future energy systems must be designed with energy security in mind. When it comes to gas, the focus should be on developing a diverse gas supply chain through both upstream production

[73] Global Gas Report 2022
[74] Global Gas Report 2022

and infrastructure developments. Storage can also play an important role in ensuring energy security by offsetting disruptions to the supply chain, in addition to investing in more storage capacity, governments can impose mandates for minimum storage levels, this has been a common practice with oil, where governments and private practices hold inventories to safeguard the economy and maintain energy security. The European Commission addresses both the questions around a diverse gas supply and storage levels through recently announced policies.[75]

5.1.1 *Gas Demand 2020*

Global gas demand decreased by 2% in 2020. With the emergence of Covid-19 and the imposition of stringent lockdowns globally, imports decreased significantly from the second quarter of the year, despite these headwinds, gas demand was relatively shielded in 2020 by low gas prices, which enabled gas to remain competitive in the power sector, thereby preventing a large drop in demand. Additionally, demand in Asia remained constant, and even managed to grow in the key Chinese market, when other buyers in the region also took advantage of low prices to substitute coal in the power generation sector. Although China was dealt a heavy blow in the first quarter of the year as Covid-19 spread, its strict lockdown and social distancing regulations made it possible for industry and manufacturing to resume in late March 2020, despite a wide-reaching shut-down that lasted nearly two months, gas consumption in China reached 326 Bcm in 2020, a 7% increase from 2019. Gas demand in Japan, South Korea and Chinese Taipei, meanwhile, collectively decreased by about 2 Bcm (1.4%) from 2019 to 2020. Demand in Japan slipped marginally due to lower requirements in the power sector and increased competition from renewables, while South Korean gas demand remained constant at 56 Bcm, in India, gas demand grew by 1.4% in 2020, with domestic production meeting about half of the country's needs. Despite lockdowns and economic uncertainty, LNG import volumes increased by 15%, reaching 25 million tonnes, supported by gas demand for the power and city gas sectors, more over coal-to-gas switching at some power plants on the west coast also contributed to this trend, driven by record low LNG prices that challenged the economics of power plants fueled by imported coal. In 2020, longer lockdown periods and reduced economic growth in Europe resulted in a total demand decrease of 4% from 2019 levels, with year-end demand touching 526 Bcm, the biggest decreases were observed in Spain, Italy, France, Germany and the United Kingdom. Furthermore, Russia's domestic gas consumption fell by about 5% in 2020.

5.1.2 *Gas Demand 2021*

China's strong economic comeback in 2021, coupled with unusually cold weather in Europe and Russia, caused global gas demand to rise from 3,753 Bcm in 2020 to about 3,913 Bcm in 2021, representing a 4.3% increase. Higher supplies in the Middle East were absorbed within the region, the increase in demand resulted in China ramping up LNG imports to about 80 million tonnes, overtaking Japan as the world's largest importer. Despite record-high prices, Japanese and South Korean imports remained strong, totaling 77 million tonnes and 47 million tonnes, respectively. A drought in Brazil forced the country to import more LNG to meet power demand, while Argentina and Chile also boosted their LNG imports, after the slowdown due to Covid-19 in 2020, China's gas demand saw a 12% increase in 2021, led by strong demand in the power and industrial sectors. The underperformance of hydropower

[75] Global Gas Report 2022

in the country, coupled with tight coal supplies and high coal prices, incentivized more gas-fired power generation. Gas demand in Japan, South Korea and Chinese Taipei climbed by a collective 8%, largely due to strong winter demand during the first quarter and a build-up of inventory later in 2021, brazilian imports also increased significantly in 2021, driven by a decline in hydropower, while Russian gas demand reached new heights in 2021, growing by 9% versus the previous year, this was driven largely by the heat and power sectors amid intense weather fluctuations, between an unusually cold winter in 2020 and an extremely hot summer in 2021. Gas consumption increased by 3% in Europe in 2021, nearly returning to 2019 levels, demand growth was strongest in the residential sector, followed by the power and industrial sectors. Russian imports were lower than usual, and reduced storage fillings, especially from Russian companies, increased market tightness, keeping prices elevated throughout 2021.[76]

5.1.3 *Gas Supply 2020*

Due to Covid-19 impacts, global gas production dropped by 3.5% in 2020, as low oil and gas prices led to reduced investments into the sector. Gas production in the US decreased by 10 Bcm (1.07%) in 2020, with the top five shale plays in the US accounting for about 56% of total US gas production that year, global LNG production climbed by 3%, led by the US, where new trains allowed for higher exports despite record low prices. Production growth for 2020 was forecast to be strong, but many buyers canceled US LNG cargoes as Covid-19 hit Demand, Canada's domestic gas production was also hit by declines, with lower domestic demand and export volumes to the US. Europe saw an overall drop in gas production of about 7%, in part due to lower output from the Groningen fields in the Netherlands along with the maturing fields in the North Sea. Norwegian natural gas production levels remained relatively stable, in contrast, Russian output dropped by 10%, totaling 632 Bcm in 2020, owing largely to low demand during a relatively mild winter season and amid falling export volumes to Europe. In the Asia Pacific region, gas production dropped marginally, mostly due to low prices and declining output from mature fields in India, Indonesia, Thailand and Malaysia. China's domestic production increased in 2020 amid renewed prioritization of supply growth within the country, while India experienced a decline in production volumes. Gas production in the Middle East was 2% higher than 2019 levels, with a 2% increase in export volumes from the previous year, in Africa, on the other hand, lower export volumes impacted production, resulting in a 9% decrease year on year.[77]

5.1.4 *Gas Supply 2021*

A rebound in economic activity boosted consumption in the industrial, power and residential sectors, which led to a 4% increase in gas production globally, with levels at 4 028 Bcm, gas production in the US, Russia, and the Middle East was ramped up to meet rising demand levels in Europe and Asia. Production levels in the US climbed 2% from 2020 levels, despite significant outages during extreme winter weather in February and hurricanes in August. This was insufficient, however, for the US to meet its export market needs, thus necessitating import volumes from Canada, both countries saw a decline in underground storage inventory over the year. Gas output in Russia grew from 632 Bcm in 2020 to 712 Bcm in 2021, largely due to an increase in demand in the domestic market and an increase in pipeline exports. European gas production, meanwhile, declined by 4% despite a strong demand spike, this

[76] Global Gas Report 2022
[77] Global Gas Report 2022

was attributed to significant production drops in the Netherlands and the United Kingdom, whereas Norwegian gas output grew by about 2%. The Asia Pacific region managed to boost gas production by 1.5%, to 662 Bcm, driven mainly by India and China, gas output in India jumped by 25%, with two deepwater projects coming online in late-2020 and mid-2021. Meanwhile, China boosted its gas production level by 9%, to touch 205 Bcm.[78]

5.1.5 *Gas Pricing 2020*

2020 saw natural gas prices in the three major gas hubs drop to record lows due to Covid-19 lockdowns. After a very mild winter and healthy supplies in Europe, Title Transfer Facility (TTF) prices were the first to decline, with the Front Month contract dropping from a level of $5.20 per MMBtu at the end of November 2019 to only $1.20 per MMBtu in May 2020, the lowest level on record, the ANEA Front Month contract followed a similar trend, going from a peak of $6.50 per MMBtu in October 2019 to a low of $1.80 per MMBtu in May 2020. The drop in Henry Hub prices was less dramatic: a record low of $1.50 per MMBtu was recorded in June 2020 as domestic demand dropped due to lockdowns and seasonality, and as international buyers canceled more US LNG cargoes, although international demand fell as a result of lower economic activity, the low prices seen in all regions supported gas demand in the power sector, this shielded gas demand from suffering more serious consequences. Rystad Energy estimated at the time that demand levels in 2020 risked a drop of nearly 3%, whereas theultimate outcome was a 2% reduction, demand in the US and China (two of the biggest consumers) remained particularly strong, making up for larger drops in other regions, such as Europe.[79]

5.1.6 *Gas Pricing 2021*

The global gas market was subjected to a particularly turbulent year in 2021, with prices spiking at the start and the end of the year, as an already tight market responded to unforeseen weather events and rising volatility in commodity supply and demand. A longer term preference for gas over coal in power generation, coupled with Europe and Asia's rising dependence on imported LNG, resulted in the two regions competing directly for marginal gas supply, until coal became more competitive than gas from the third quarter of 2021. In Asia, spot gas prices hit record highs twice during the year, after a late winter spike in the first quarter of 2021, Asia Spot prices started to climb in the second quarter of the year and peaked again in October 2021, spiking to $54 per MMBtu as sustained demand from industry and coal shortages in China coincided with higher European LNG import draws. Both Asia Spot and TTF benchmark gas prices hit record highs, with Europe and Asia competing for LNG cargoes, in addition, the decreasing likelihood of Russian gas volumes arriving in Europe through the Nord Stream 2 pipeline compounded the tight market. To some extent, regional competition and market volatility were also due to a lag in upstream investments, resulting in less new supply to match forecasted demand. Capital expenditure in the upstream sector has been in constant decline since 2015, in addition to the impact of Covid-19 on

[78] Global Gas Report 2022
[79] Global Gas Report 2022

exploration activity in 2020, the rising pressure to reduce emissions and transition to zero- and low-carbon technologies had an exacerbated impact on gas market dynamics.[80]

5.1.7 *Gas Pricing 2022*

Gas prices continued to climb during the early part of 2022, driven by the Russia-Ukraine conflict that started in late February. The general uncertainty regarding Russian gas exports to Europe as a result of the ongoing conflict propelled European prices to new record highs, the T TF Front Month contract hit $68.30 per MMBtu on 8 March, which was about 12 times higher year-on-year, the monthly average price for March jumped 56% higher than that for February. Asian spot prices have also been impacted by the geopolitical risk, as a disruption of pipeline supplies to Europe would mean even more competition for spot LNG cargoes, as a result, Asia Spot prices rose to an average $39.30 per MMBtu in March, up 42% from February. In March 2022, the European Commission proposed a new plan called REP owerEU to uplift Europe's energy independence, in response to the Russia-Ukraine conflict. The main aim of this plan is to reduce EU dependence on Russian gas by two/thirds by the end of 2022, and to phase out Russian fossil fuels entirely by 2030, the REP owerEU plan was proposed by the European Commission in March 2022 and presented in May the same year.[81]

5.2 Ukraine War Effects

Global gas markets moved towards a rebalancing over the 2022/23 heating season, following the supply shock sparked by Russia's invasion of Ukraine in February 2022. Spot gas prices across the key northeast Asian, North American and European markets dropped by close to 70% between mid-December and the end of the first quarter of 2023, while storage sites ended the heating season well above their five-year averages. The reduced market strains and relatively well stocked storage sites ahead of the summer are reasons for cautious optimism for supply security, however, this confluence of factors should not distract from the further measures needed to mitigate potential risks that could quickly renew market tensions and price volatility. The European and global gas markets suffered a major supply shock in 2022 when Russia sharply reduced its pipeline gas deliveries to the European Union, by 80% over the course of the year and triggered a global energy crisis. Russia's steep gas supply cuts led to a reconfiguration of global LNG flows, drove up natural gas prices to all-time highs both in Asia and Europe and necessitated a readjustment in gas demand.[82]

The latest estimates indicate that global gas consumption fell by 1.5% in 2022, similar to the drop experienced in 2020 following the first wave of Covid-19 lockdowns. The bulk of demand reduction was concentrated in the key European and Asian import markets, the sharp increase in gas prices supported gas-tocoal switching dynamics in the power sector and depressed gas use in energy-intensive industries. Enhanced energy efficiency measures and the continued deployment of renewables reduced gas demand in a structural manner. The strong decline in gas demand continued into the early months of 2023 due to favourable

[80] Global Gas Report 2022
[81] Global Gas Report 2022
[82] Gas Market Report 2023

weather conditions and timely policy actions, natural gas consumption in advanced economies in Europe fell by an estimated 55 billion cubic metres (bcm) year-on-year during the 2022/23 heating season – its steepest drop in absolute terms for any winter season on record. The steep decline in natural gas demand reduced the need for storage withdrawals in Europe and the United States over the 2022/23 winter. In the European Union, storage injections equal to only half of the level seen in summer 2022 would be enough to reach the EU target of filling storages to 90% by the start of the 2023/24 heating season, lower injection demand over summer 2023 could potentially contribute to a further easing of market fundamentals.[83]

5.2.1 *LNG Industry*

LNG supply growth was relatively modest in 2022 at 5.5%, despite an unprecedented rise in LNG demand in Europe following the gradual decline in Russian pipeline gas deliveries throughout the year. The utilisation rate of global liquefaction capacity averaged 84% in 2022, unchanged from 2021 levels and slightly above the 2017- 2021 average of 83%, however, the rate in H2 2022 (at 82%) was markedly lower than during the first half of 2022 (at 87%). This midyear decline was due to a number of unplanned supply disruptions (led by the extended outage at Freeport) as well as technical issues and upstream underperformance at legacy plants, particularly in Algeria, Nigeria, Malaysia and Australia.
LNG demand trends were dominated by a sharp surge in gross LNG imports into Europe, up 66 bcm, which was balanced by a steep decline in the rest of the world, particularly in Asia. While the United States supplied approximately two-thirds (43 bcm) of the incremental LNG inflows into Europe, other "swing suppliers" were also able to redirect significant flexible volumes to the European market, with Qatar (5 bcm), Egypt (5 bcm), Norway (3 bcm), Angola (2 bcm), the Russian Federation (2 bcm) and Trinidad and Tobago (2 bcm) providing the bulk of the remaining one-third. The strong price premium at onshore European hubs over delivered LNG prices in both Europe and Asia, which at times exceeded USD 20/MBtu, incentivised an unprecedented build-up of LNG floating storage on Europe's shores during the final quarter of 2022. By the estimate of S&P Global Commodity Insights, total LNG volumes held up in floating storage around Europe averaged nearly 2 bcm in November 2022, an all-time high and nearly five times the average volume in 2020, the last year when LNG floating storage played a prominent role worldwide amid a global LNG.[84]

5.2.2 *Value of LNG Trade*

Despite rising by a mere 5.5% in volumetric terms, the value of global LNG trade doubled in 2022 to an all-time high of USD 450 billion, the global energy and gas crisis triggered by Russia's invasion of Ukraine drove up spot gas prices and LNG import bills to record levels across key Asian and European markets. Gas and LNG producers' record profits could support additional investment in reducing the emissions intensity of gas value chains, enhancing methane capture efforts and diversifying economic structures to adapt to the new global energy economy that is emerging. LNG played a critical role in mitigating the impact of Russia's deep cuts in piped gas supply to the European Union and was instrumental in

[83] Gas Market Report 2023
[84] Gas Market Report 2023

avoiding gas supply shortages in 2022, the stiff competition for flexible LNG cargoes between Asia and Europe provided strong upward pressure on hub and LNG spot prices throughout the year. In Europe month-ahead prices on the TTF averaged over USD 40/MBtu in 2022, almost eight times their fiveyear average between 2016 and 2020, in Asia LNG spot prices followed suit, averaging at USD 34/MBtu over the year, more than five times their five-year average between 2016 and 2020. Consequently, the estimated value of LNG traded under spot mechanisms – more than doubled to over USD 230 billion.

Heightened geopolitical uncertainty and tightening supply drove up oil prices to their highest level since 2013, this in turn placed upward pressure on oil-indexed LNG contract prices, which rose by 70% in 2022 to an estimated average of USD 15/MBtu. Hence, the value of LNG traded under long-term oil-indexed LNG contracts, approximately 60% of global LNG trade, rose by 90% to an estimated USD 220 billion. Markets with greater exposure to spot procurement experienced a sharper increase in their LNG import prices. The weighted average import price in Japan and Korea, which rely predominantly on longterm, oil-indexed contracts, rose by 80% to USD 19/MBtu in 2022, in contrast, the import price of the United Kingdom, heavily reliant on spot procurement, almost tripled compared with 2021 to an average of USD 28/MBtu. Europe's LNG procurement costs more than tripled compared with 2021 to an estimated USD 190 billion, and accounted for 60% of the total increase in the global LNG import bill. The region's LNG imports soared by over 60% (almost 70 bcm), while the estimated LNG import price more than doubled. The combined LNG import bill of Japan and Korea rose by 80% to close to USD 115 billion, while LNG imports declined by 2% compared with 2021, while the People's Republic of China's LNG procurement costs rose by almost 20% to over USD 50 billion, despite a decline of 20% in the country's total LNG imports.[85]

5.2.3 *Gas Price in 2022-2023 Winter*

Unseasonably mild weather, lower gas demand and improving supply fundamentals weighed on spot gas prices across all key gas markets during the 2022/23 winter. By the end of March 2023, Asian spot LNG and European hub prices had fallen below their summer 2021 levels. In Europe, Title Transfer Facility (TTF) spot prices averaged USD 23/MBtu during the 2022/23 heating season – almost 30% below the levels experienced in the previous winter. Gas prices on the TTF declined by almost 70% between mid-December 2022 and the end of March 2023. Unseasonably mild weather conditions, lower-than-expected gas use, strong LNG supply and gas inventory levels standing well above their historic averages provided strong downward pressure on European gas prices. The TTF retained a premium of USD 2.6/MBtu above the NBP hub in the United Kingdom, this incentivised continued gas exports from the United Kingdom to the European Union over the heating season, totaling at over 7bcm. By the end of March 2023, TTF month-ahead prices had fallen to USD 13/MBtu, their lowest level since July 2021.[86]

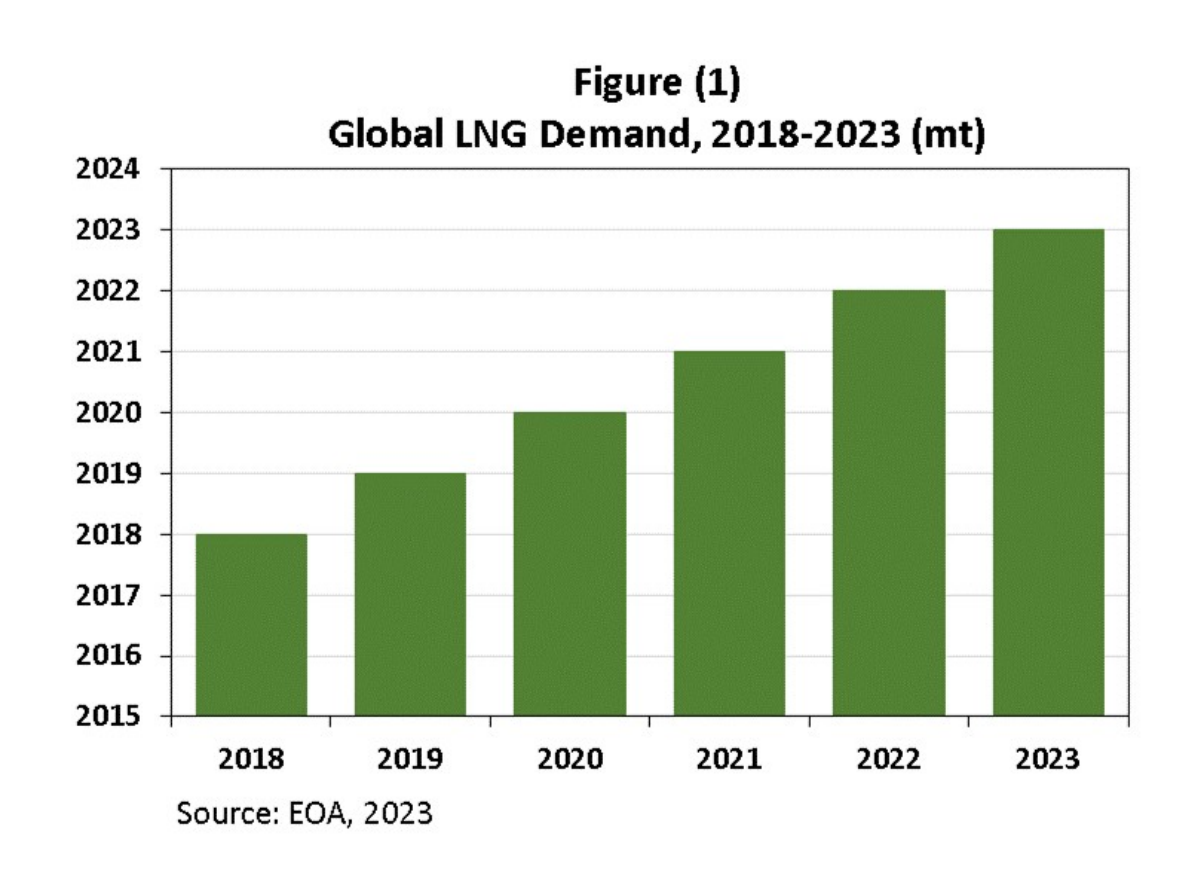
Asian spot LNG followed a similar trajectory to European hub prices, averaging USD 23/MBtu during the 2022/23 heating season, around 30% below the levels experienced in the previous winter. Less competition from Europe together with easing regional supply demand fundamentals provided downward pressure on prices, spot LNG prices declined by 65% from mid-December 2022, falling to almost USD 12/MBtu at the end of March 2023, a level close to the estimated price range of oil-indexed Asian LNG.[87]

[85] Gas Market Report 2023
[86] Gas Market Report 2023
[87] Gas Market Report 2023

In the United States, Henry Hub prices averaged USD 4/MBtu in the 2022/23 heating season, almost 15% below the levels experienced during the previous winter. Strong growth in domestic production combined with lower gas demand amid an unseasonably mild winter put downward pressure on gas prices. Forward curves as of the end of April 2023 indicate that TTF is set to average USD 15/MBtu in 2023, with Asian spot LNG averaging just below USD 15/MBtu and Henry Hub averaging USD 2.6/MBtu, the price spread between TTF and Asian spot LNG is expected to tighten significantly in 2023.[88]

[88] Gas Market Report 2023

6. Conclusion



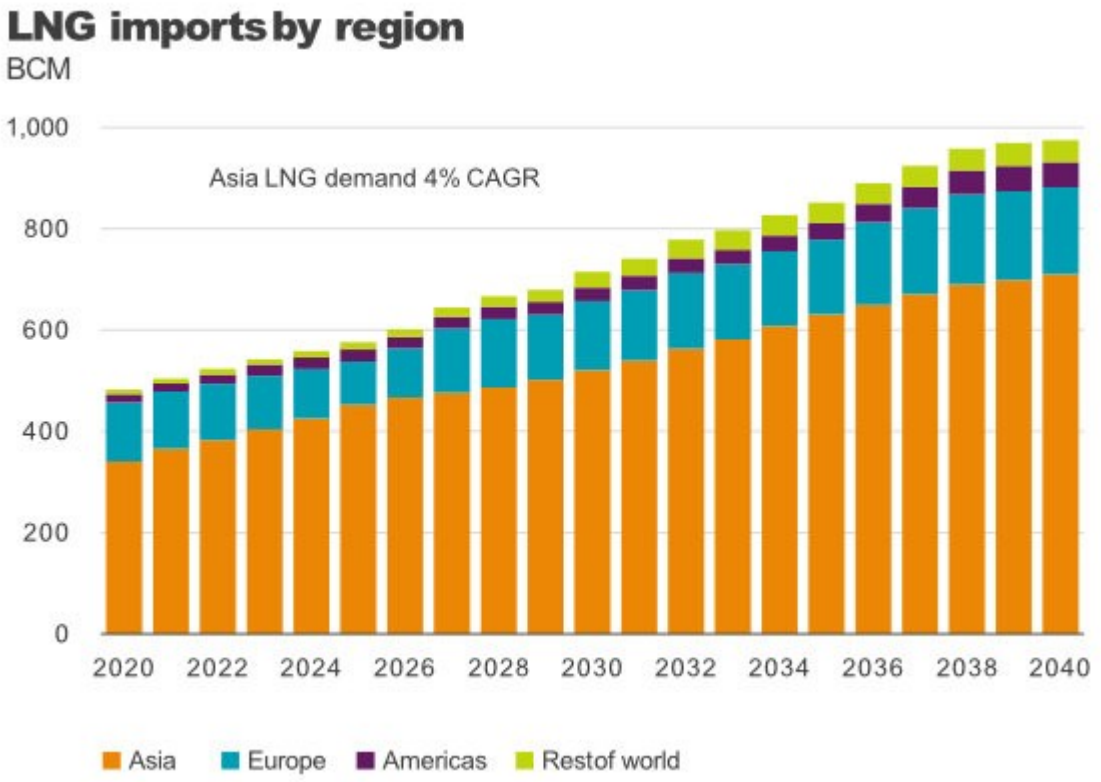
According to the graphic the global LNG demand increasing throw the years. Specifically at the postCovid19 period and Ukraine war, the LNG demand is nearby double in compare to the 2019. In 2023, the global LNG market experienced steady demand growth amid limited new capacity additions and lower spot prices compared to the historic levels recorded in 2022. Ship tracking data compiled by the EOA shows that global LNG demand hit an all-time high in 2023, reaching 401 million tons (mt), up from 390 mt in 2022, a 2.8% year-on-year growth.[89]

The previews pages sawing that, in 2018 a bonanza year for natural gas, with both global consumption and production increasing by over 5% and one of the strongest growth rates in either gas demand or output for over 30 years, US gas production increased by 86 bcm, an increase of almost 12%, apart from US the growth in global gas demand was relatively concentrated across three other countries, China (43 bcm), Russia (23 bcm) and Iran (16 bcm), which together with the US, accounted for 80% of global growth. In 2019 the increase in gas production was used to feed additional exports of liquefied natural gas (LNG), LNG exports grew by 54 bcm (12.7%), the largest annual increase ever, driven by record increases from the US (19 bcm) and Russia (14 bcm) as well as continued growth from Australia (13 bcm). European LNG imports rose by 49 bcm, representing an unprecedented 68% increase,

[89] GlobalLNGHub.com

growth was widespread, with the UK (11 bcm), France (10 bcm) and Spain (7 bcm) the largest individual contributors.

Global LNG trade was increased by 2% to reach 362 million tons in 2020, with most of the increase stemming from the beginning of the year. In 2019, the volume of LNG going to the traded markets of Northwest Europe increased markedly, as the abundant supply of LNG sought a home in the only market able to absorb the surplus, declining only slightly in 2020. In 2021, the traded share rose again on the back of contracted US LNG cargoes into Asian markets especially, finally in 2022, spot LNG cargoes increased again as Europe outbid other regions and mopped up increasing unconstructed LNG supply.



Source: GlobalLNGHub.com

LNG demand and LNG trade are about to be developed more the next decades. Asia demand for energy leads the way for more LNG trade between Europe, North America and Asia. If not the 2030, the 2040 the LNG demand will be doubled. As the energy demand increase, the LNG trade will develop by the energy demand drivers and the LNG market will growing up.

References

Books

Manfred Hafner - Giacomo Luciani (2022), The Palgrave Handbook of International Energy Crisis, PALGRANE MACMILLAN

Subhes C. Bhattacharyya (2011), Energy Economics Concept, Issues, Markets and Governance, SPRINGER

Michael Tamvakis (2015) second edition, Commodity Trade and Finance, INFORMA LAW FROM ROUTLEDGE

R. J. Clews (2016), Project Finance of the International Petroleum Industry, A.P. ELSEVIER

Ezekiel Adesina, Ben Asante, Natalia Camba, Fisoye Delano, Richard Donohoe, Nicholas J. Fulford, Paulino Gregorio, James Jewell, U.H. Paul Jones, Eng. Joyce Kisamo, Sally Kornfeld, Norman Lee, Melanie Lovatt, John Mauel, Susan Sakmar, Harry Sullivan, Thomas Viot (2017), Understanding Natural Gas and LNG Options, Department of Energy USA

Andrea Roncoroni - Gianluca Fusai - Mark Cummins (2015), Handbook of Multi-Commodity Markets and Products, WILEY

Silvia Colombo – Mohamed El Harrak – Nicolo Sartori (2016), The Future of Natural Gas Markets and Geopolitics, EUROPEAN ENERGY REVIEW

Saeid Mokhatab – John Y, Mak – Jaleel V. Valappil – David A. Wood (2014), Handbook of Liquefied Natural Gas, GPP

Reports

2020 WORLD LNG REPORT

BP Status Review 2018

BP Status Review 2019

BP Status Review 2020

Statistical Review of World Energy 2021

Global Gas Report 2022

Wholesale Gas Price Survey 2023 Edition

Gas Market Report 2023

Websites

https://www.iea.org/topics/global-energy-crisis

https://www.bp.com/en/global/corporate/news-and-insights/press-releases/recession-drove-2009-energy-consumption-lower.html

https://www.federalreservehistory.org/essays/oil-shock-of-1973-74

https://www.britannica.com/money/alternative-investment-types

https://www.oecd.org/coronavirus/policy-responses/the-impact-of-coronavirus-covid-19-and-the-global-oil-price-shock-on-the-fiscal-position-of-oil-exporting-developing-countries-8bafbd95/#section-d1e325

https://yenaengineering.nl/gas-pipeline/

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3962073/

https://globallnghub.com/report-presentation/global-lng-outlook-2021