

Chapter 1

Introduction

1.1 Introduction

For more than two decades, natural gas has been the fastest growing energy resource drive due to very good efficient fuel for power generation and very low greenhouse emissions. Pipelines were found to be economically suitable, safe and reliable for transportation where the conventional gas fields were accessible. Natural Gas is condensed to -162 C or -259 F at an atmospheric pressure. The condensed liquid is called Liquefied Natural Gas (LNG). The reduction in volume is $1/600^{\text{th}}$ the natural-gas volume at the burner tip. This condensed form is easy to transport by ships and trucks. Over the last three decades, Liquefied Natural Gas Industry has brought remote gas fields accessible to gas markets where pipelines were not reachable.

Currently, LNG supply chains have brought in competition into the pipeline supplied markets and have increased energy supply security of many imports dependent countries, which were having geopolitical constraints for pipeline supply. Liquefied natural gas is economical for routes crossing long stretches of seas, oceans, as undersea pipeline construction is very expensive.

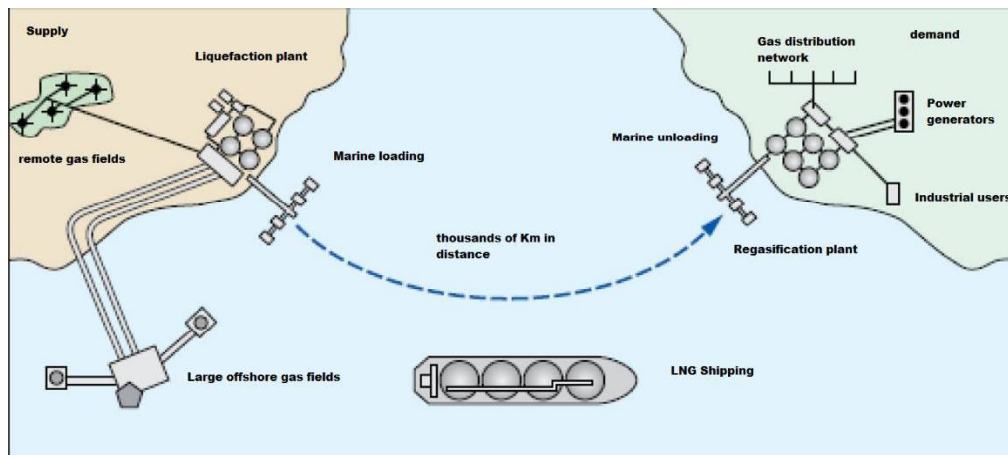


Figure 1.1 Key elements of Natural-Gas Supply Chain

Source: (Michael J Economides, Saeid Mokhatab, Wood, 2016)

The figure 1.1 demonstrates an ideal LNG supply chain process. Natural Gas is supplied from remote gas fields to the Liquefaction plant commissioned near to

the sea port. Here the Natural Gas is converted to Liquefied form and is loaded on to the LNG ships at marine loading point. The LNG is transported to the port of unloading and unloaded at unloading marine point. The LNG is stored as Regasification plant and is converted into natural Gas and is transported via natural-gas distribution network to power plants and industrial users.

1.2 World LNG Business

There has been a steady growth in World LNG as per data obtained from (International Group of Liquefied Natural Gas Importers, 2014) till (International Group of Liquefied Natural Gas importers , 2006) is shown below in figure 1.2

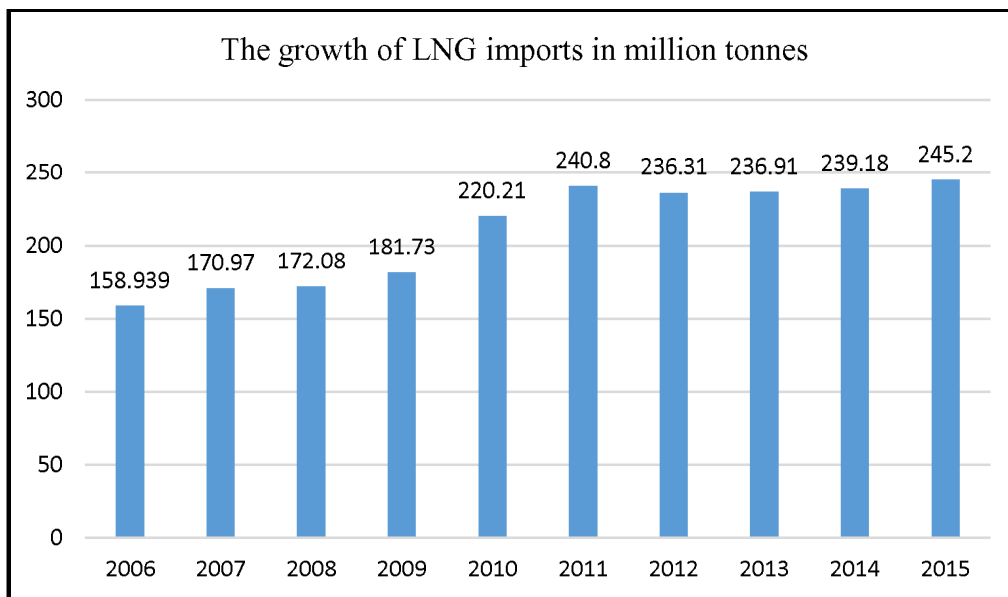


Figure 1.2 World LNG imports in million tons

Source: The LNG Industry: GIIGNL reports

There has been a steady growth of about 9% in LNG trade since the year 2006. However, it can be noticed that the year 2011 has seen a steep rise in LNG business due to Fukushima nuclear disaster in Japan. It has been also seen from the report (International Group of Liquefied Natural Gas Importers, 2014) it is moreover seen that 75% of the worldwide LNG demand has come from Asia. There have been 30 importing countries led by Japan, 19 exporting countries and 40% of global LNG volumes have been supplied from middle-east with Qatar leading into the region. From the figure 1.3 below, we could understand the leading importers of LNG.

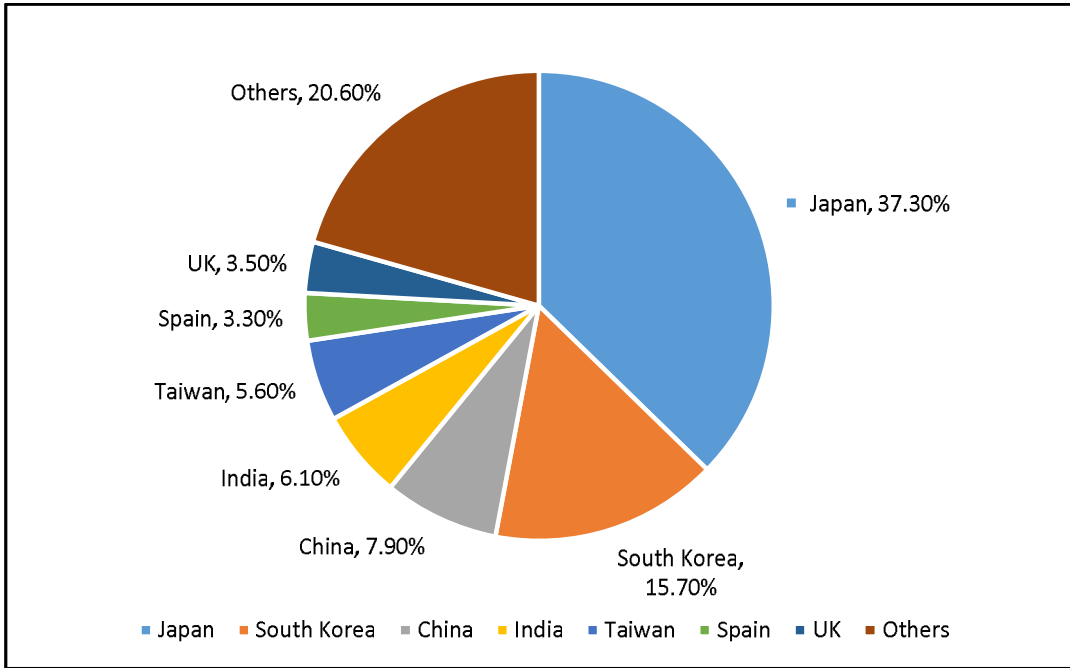


Figure 1.3 World-leading importers of LNG

Source: (International Group of Liquefied Natural Gas Importers, 2014)

From the above figure 1.3, Asian region is the largest importer of LNG with Japan leading, followed by South Korea, China and India is the fourth largest importer of the world LNG.

From the same report (International Group of Liquefied Natural Gas Importers, 2014) the detail of leading exporters is described in figure 1.4 below.

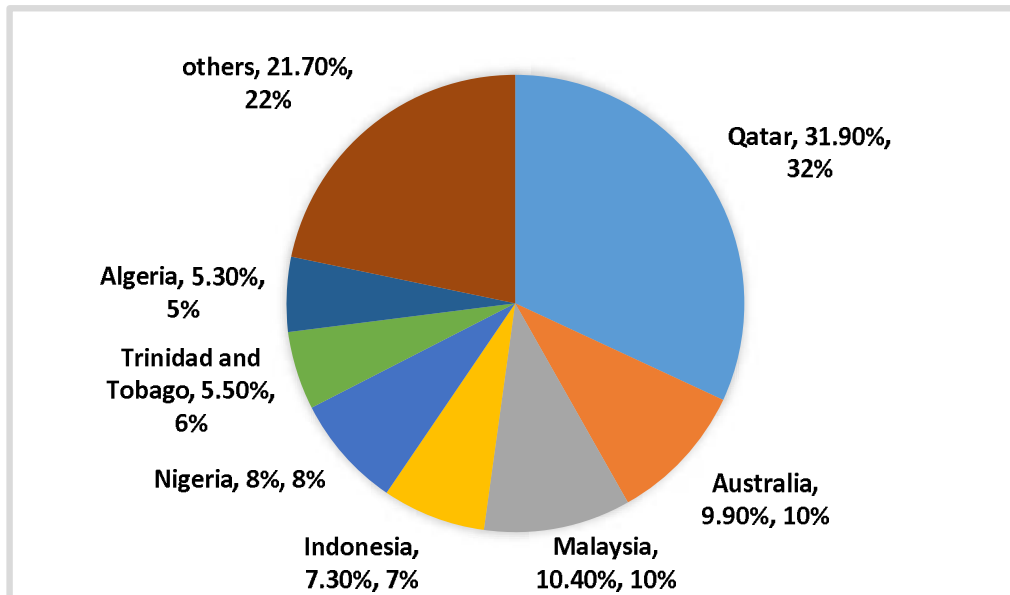


Figure 1.4 World-leading exporters of LNG

Source: (International Group of Liquefied Natural Gas Importers, 2014)

From the above figure 1.4 Qatar is the leading exporter of LNG followed by Malaysia and Australia. Even though Qatar has been dominating in exports, the biggest game changer would be United states of America, which would be majorly exporting LNG from the year 2017 sourced from Shale reserves and widening of Panama Canal allowing LNG ships of capacity 1, 80, 000cm. Australia would be exporting in large volumes with new LNG projects being completed by the year 2017.

1.3 LNG imports to India

From the year 2005, India has been importing liquefied Natural Gas (LNG) to meet its deficiency in domestic production and as best option for cleaner fuel. From (International Group of Liquefied Natural Gas Importers, 2014) to (International Group of Liquefied Natural Gas Importers, 2006) there has been a steady growth in LNG imports to India as shown below.

There has been 16.9% average increase in growth rate of natural-gas imports over the last eight years. With decrease in domestic production of natural gas and limitation in pipeline imports due to hostile neighbours as discussed in (Singh, 2008) and (Rahul Tongia, 1999), India is dependent on LNG to cater to domestic demand.

From the (Industry Group, 2013) the natural-gas availability and demand are detailed below.

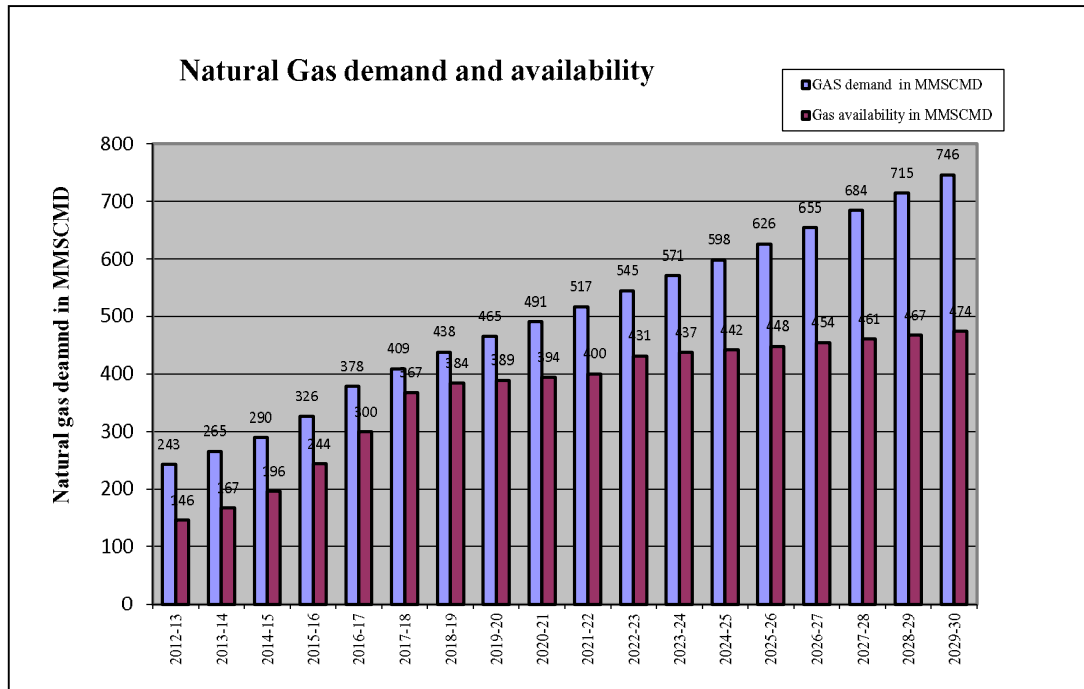


Figure 1.5 Natural-Gas Demand and Availability

Source: (Industry Group, 2013)

From the above figure 1.5, it is evident as per projections that there is a huge gap between supply and demand of natural gas in India till the year 2029-2030.

From the same report (Industry Group, 2013) the natural-gas availability is expected to grow at 7.2% CAGR by the year 2030. The LNG imports are expected to contribute approximately 30% of natural gas in 2012-2013 and are expected to contribute to 45% of total natural-gas availability by the year 2029-2030. Thereby the domestic resources are distinctly possible to reduce their contribution from 70% to 48% of natural-gas availability by the year 2029-2030.

However, from the same report, we could understand the sources of projected availability from the figure 1.6.

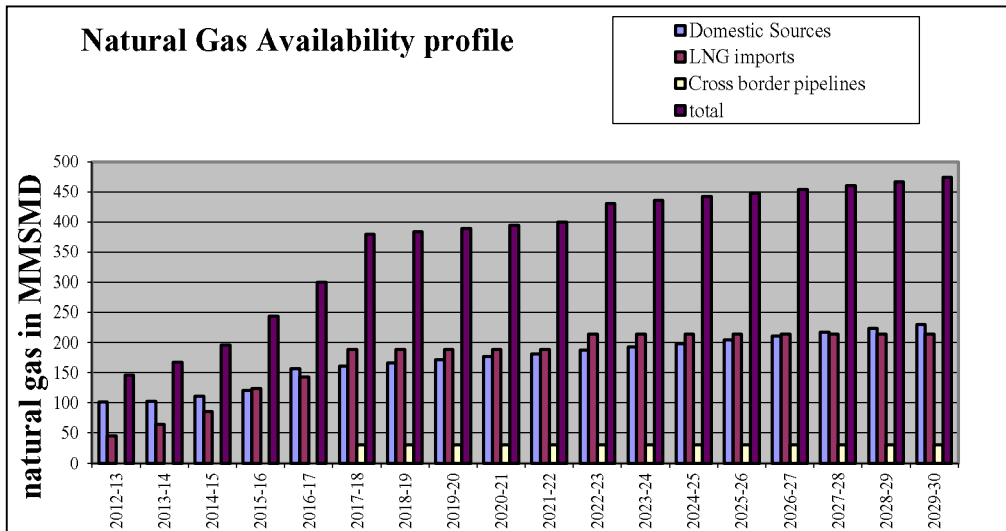


Figure 1.6 Natural-Gas Availability Profile

Source: (Industry Group, 2013)

From the figure 1.6, the sum up availability is expected to grow at 7.2% CAGR by the year 2030. From the supply growth profile, LNG imports contribute to 30% of natural-gas availability in the year 2012-13, and it is expected to contribute to 45% of whole natural-gas availability by the year 2029-30. Therefore, domestic resource's contribution would reduce from 70% to 48.5% of natural-gas availability by the year 2029-30. India remains to be fourth largest importer of LNG as per report (International Gas Union, 2015). As per the study (Sakmar & Kendall, 2009) the LNG trade would accelerate over the next 25 years and the LNG traditionally being regional fuel would grow as global fuel. The review paper (Wood, 2012) discusses how LNG has emerged over two decades in Europe, Asia, and North America. The markets are dominated by long-term contracts as much of the capital is invested for building liquefaction and regasification infrastructure. The research paper (Kumar, Kwon, Choi, Hyun Cho, et al., 2011) has discussed that due to abundance of availability, clean burning properties, and efficiency as fuel, LNG is expected to play an important role in natural-gas industry and energy markets. India, China, Singapore, Vietnam, and Thailand would be the emerging consumers of LNG and the demand in Asia-Pacific region would be very strong.

1.4 International Natural Gas prices

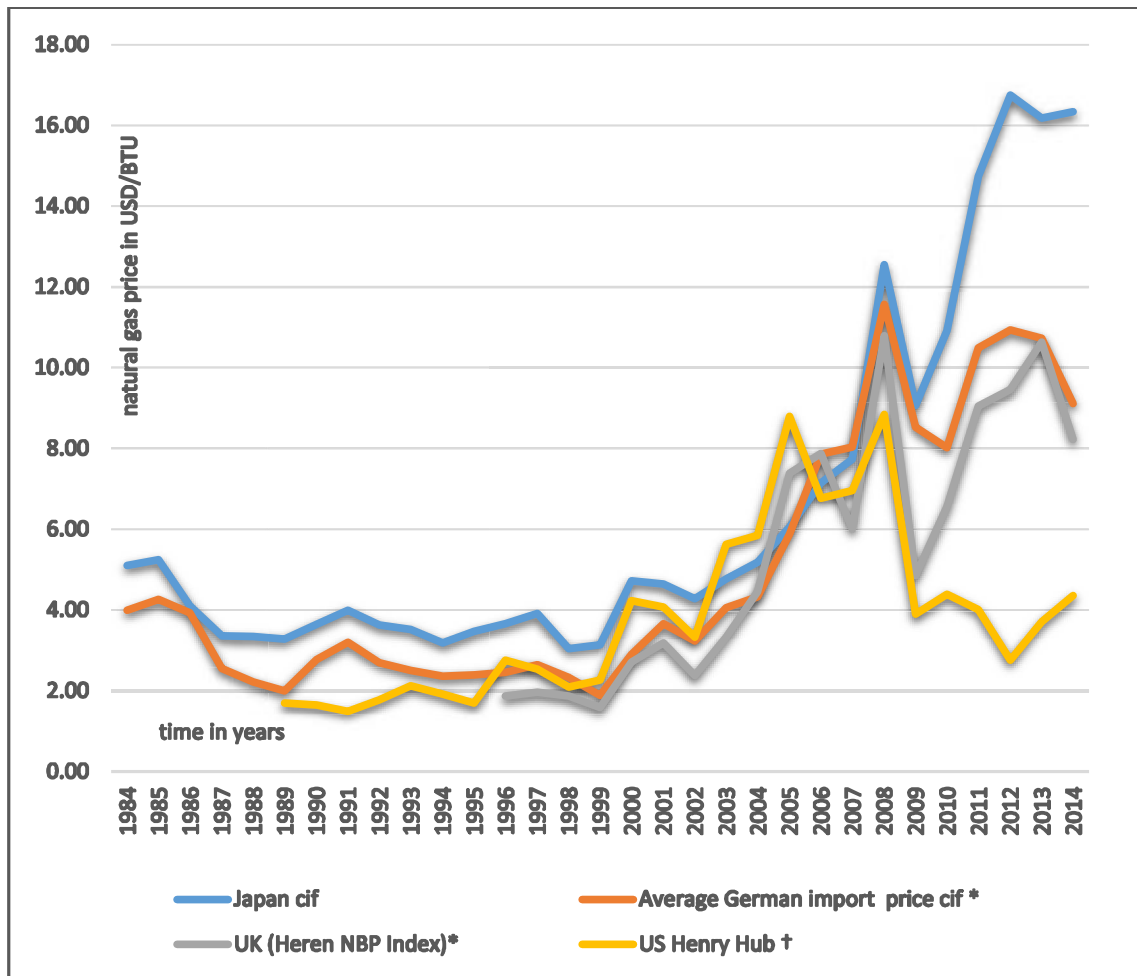


Figure 1.7 Trends in various Index prices of Natural-Gas

Source:(British Petroleum, 2015)

There has been no common index pricing for natural gas as various gas pricing mechanisms in different regions were followed. However, from the report (British Petroleum, 2015) we can understand various trends in index prices of natural-gas prices in Japan (Japan CIF), Germany (average import price), UK (national balancing point) and USA (Henry Hub prices). From the above figure 1.7, we can clearly understand that the prices have been at below USD 4/MMBTU until the year 2000, but the prices have surged higher over a period. In Japan, the prices have even touched as high as US\$ 16/MMBTU in the year 2014. Even though the prices have been varying in different regions but have

always remained volatile. The volatility of the natural-gas prices has affected the economies of much energy importing countries and energy security has been a major issue in their respective economies.

1.5 International LNG Ship Chartering prices

The chartering prices have historically been strong but as discussed in (International Gas Union, 2015), the year 2012 saw drop in charter rates until year 2013. Delay in supply of new ships in the year supported the spot charter rates, but the long-term charter rates saw rates dropping from 1,20,000 USD/day to 90,000 USD/day in the year 2013. The rates have further dropped in the year 2014 where the average charter rates have been from 70,000 USD/day to 80,000 USD/day. Some old vessels have also been chartered at 45,000 USD/day. Thus, the recent period saw fluctuations in charter rates in LNG shipping and with more vessels on the order book, the scenario is likely to face challenges.

1.6 Need for Study

To cater to India's energy security, we have been importing long-term contracts with countries like Qatar with LNG prices linked to Japanese Crude Cocktail (JCC) prices. These JCC oil prices indexed contract has resulted in India paying heavy import price due to volatility and high price of Crude oil. India is also looking at imports from other alternative countries like USA through long-term contracts linked with price indexes like Henry Hub. India is as well planning to buy fresh LNG ships through Gas Authority of India for supporting its supply chain from USA thereby, there is a need to study the charter rates and new ship building prices of LNG.

Keeping in view the above plan, it is imperative to study the volatility of the various indexed prices of Natural Gas and LNG shipping to minimize the foreign exchange losses and to plan India's energy security.

1.7 Business Problem

From the above, we could understand two primary reasons of volatility.

- a. From the section 1.4, we can understand that there has been volatility in various index prices of natural gas.
- b. From the section 1.5, we could understand that there has been volatility in time charter rates of LNG ships.

Thus, from the above we could conclude the business problem as “Volatility of Liquefied Natural Gas prices, which are linked to various Indexes in the long-term contracts and due to Ship charter rates.”

1.8 Report Outline

The entire thesis report is divided into six chapters. The first chapter gives a brief outline of the present LNG imports and exports, India’s future dependence on LNG to meet its energy security, brief on volatility in index prices and charter rates and the business problem which gives a strong reason for taking up this study. The second discusses about review of Literature. The chapter discusses about various research papers regarding LNG markets and prices. The theory of volatility is detailed and various methods of measuring volatility are outlined. Various application GARCH models in the energy markets, shipping markets and new ship building prices are discussed and there by understanding the gaps. The third Chapter gives a brief about Research design. The chapter gives details about research objectives, data collection, models used for analysis. An overview of LNG value chain is detailed in fourth chapter giving insights about various elements of global LNG value chain. The fifth chapter gives detailed analysis of for all the three objectives, models used and interpretation of the results. The sixth chapter gives the conclusions and scope for further study.