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Offshore Center Danmark

Niels Bohrs Vej 6
DK-6700 Esbjerg, Denmark

Screening Report

Screening of the LNG Transport Market

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info@offshorecenter.dk

Tel: +45 36973670
www.offshorecenter.dk

TITLE	:	Screening of the LNG Transport Market
AUTHOR	:	Talat Darwish (OCD)
SYNOPSIS	:	This report gives a brief review of the possibility of small scale LNG activities in Denmark. The report is not extensive in all areas, but does give a general market review of the LNG market as well as a more specific insight into possibilities for Danish suppliers. In the report it has also been attempted to analyze the strength and weaknesses of factors regarding the possibilities of Danish companies to provide small scale LNG services. The report could be used as an eye-opener towards an increased focus amongst Danish companies within this important and growing market.
CHECKED BY	:	Morten Holmager
APPROVED BY	:	Peter Blach

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DK-6700 Esbjerg, Denmark

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1 Executive Summary

The Danish natural gas transmission and distribution system is extensive and covers most of the country. The natural gas is transported ashore from the North Sea fields through two more than 200 km long high-pressure submarine transmission pipelines. At the gas treatment plant in Nybro, any liquid and sulphur content are removed and the gas is prepared for onward transportation in the transmission system. The transmission system has a capacity of 8 billion m^3 per year.

All natural gas for the Danish market comes from fields in the Danish sector of the North Sea. The biggest producer of natural gas in Denmark is Dansk Undergrunds Consortium (DUC), which produces gas from a number of fields, and who also export to Holland via an offshore export pipeline. In addition, the South Arne Group (HESS Denmark) produces natural gas from the South Arne field.

Dong Energy purchases and transports all natural gas for the Danish market and also distributes gas to customers in Southern Jutland and parts of Zealand. Dong Energy is a state-owned limited company.

Natural gas is used in all sectors of the society in Denmark. Currently consumption totals 5 billion m^3, with the following breakdown into applications:

	Million m^3	**Percentage**
Small-scale CHP*	1333	32
Industry and industrial CHP	1215	29
Residential and business customers	942	23
Primary CHP plants	646	16

* Combined Heat & Power/District Heating

Table 1.1 Natural gas is used in all sectors of the society in Denmark cf. /4/

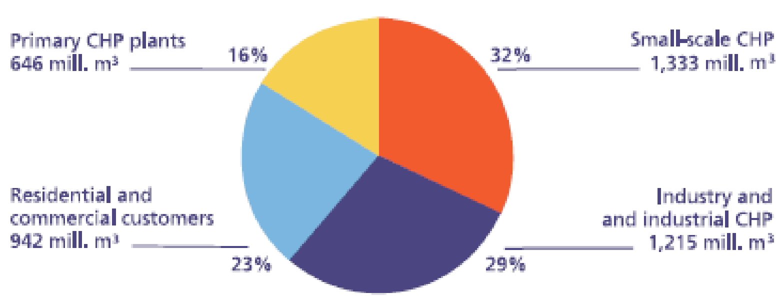

Figure 1.1 Natural gas is used in all sectors of the society in Denmark cf. /4/

Based on recent statistics, the production of gas in Denmark covers twice the country gas demand and about 25% of the Danish total consumption of energy. Studies indicate that the demand for gas as a source of energy will increase in the coming years.

Liquefied Natural Gas (LNG) is expected to become one of the most important energy sources to cover the future worldwide energy demand, with a significant increase of

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energy consumption expected over the next 25 years. Denmark can take an important place in this market, because of the decades long Danish companies' expertise within the Danish natural gas transmission and distribution systems and further experience gained on international markets. Denmark currently, however, has no LNG re-gasification facilities.

However the manufacturing and development of tools and equipment related to the LNG industry can be a good investment opportunity for the Danish companies, as they are closely familiar with the gas industry, since the early eighties. Their experiences make their entry barrier towards the LNG product and services market smaller than for many of the companies in the neighboring countries, who do not have this first-hand experience.

Denmark hence has a good opportunity to position itself within the LNG market. Also in the more distant future, re-gasified LNG, could prove a means of satisfying Denmark's energy demand.

Globally, it is expected that natural gas will in the near future, be one of the main sources of energy worldwide, and substitute oil to a certain extent. Some countries are already depending on natural gas as a strategic source of energy, such as Japan, Korea, France, etc. Many countries will follow this way with the ever-increasing world-wide demand on energy and with depleting oil reserves. Already in Europe many countries are working seriously in this way and taking steps to build all related facilities of LNG to secure the current and future energy needs.

Although Denmark is expected to be an energy exporting country for many years to come, small scale LNG plants could still prove essential to provide energy in remote regions within the Kingdom of Denmark, such as Greenland and the Faroe Islands. In these regions, no gas grid connection is possible to a European continental gas grid. Even for remote Danish islands, small scale LNG plants could be a possibility.

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2 Introduction

Liquefied Natural Gas (LNG) provides many challenges and opportunities which should not be overlooked planning the possible directions for the future business expansion. It is a very good opportunity for Danish companies as well as European and international companies to offer technical and logistic experience for possible LNG activities in Denmark.

The report covers basic information and definitions about LNG activities around the world and also the possibility of LNG activities in Denmark.

2.1 Background

The report was carried out by Offshore Center Danmark under the development project “Small Scale LNG Transportation”. The project group consists of:

- Aalborg University Esbjerg
- COWI
- Dansk Gasteknisk Center A/S
- DHI – Water & Environment
- York Refrigeration, Marine & Controls ApS
- Endress + Hauser
- Offshore Center Danmark

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3 LNG

Liquefied natural gas, or LNG, is natural gas in its liquid form. When natural gas is cooled to minus 161 degrees Celsius and pressures of between 101 and 6000 kPa, it becomes a clear, colorless, odorless liquid. LNG is neither corrosive nor toxic. The density of LNG is roughly 0.41 to 0.5 kg/L, depending on temperature, pressure and composition. In comparison water has a density of 1.0 kg/L.

Natural gas is primarily methane, with low concentrations of other hydrocarbons, water, carbon dioxide, nitrogen, oxygen and some sulfur compounds. During the process known as liquefaction, natural gas is cooled below its boiling point, removing most of these compounds. The remaining natural gas is primarily methane with only small amounts of other hydrocarbons. This substance weighs less than half the weight of water so it will float if spilled on water. The natural gas fed into the LNG plant will be treated to remove water, hydrogen sulfide, carbon dioxide and other components that will freeze (e.g., benzene) under the low temperatures needed for storage or be destructive to the liquefaction facility. The end-product, purified LNG, typically contains more than 90% methane, table 3.1 give examples of LNG composition from different sources. It also contains small amounts of ethane, propane, butane and some heavier alkanes. The purification process can be designed to give almost 100% methane.

Constituents	**Algeria**	**Libya**	**Brunei**	**North Sea**	**Iran**	**Alaska**
Methane	86.3	66.8	88.0	85.9	96.3	99.5
Ethane	7.8	19.4	5.1	8.1	1.2	0.1
Propane	3.2	9.1	4.8	2.7	0.4	-
Butane	0.6	3.5	1.8	0.9	0.2	-
Pentane & Other	0.1	1.2	0.2	0.3	0.2	-
Nitrogen	-	-	0.1	0.5	1.3	0.4
Carbon Dioxide	-	-	-	1.0	-	-

Table 3.1 Composition of LNG. cf. /8/

3.1 Transportation of LNG

LNG is transported in double-hulled ships specifically designed to handle the low temperature of LNG. These carriers are insulated to limit the amount of LNG that boils off or evaporates. This boil off gas is sometimes used to supplement fuel for the carriers. LNG carriers are up to 300 meter long, and require a minimum water depth of 12 meter when fully loaded. There are currently 220 ships which transport more than 120 million metric tons of LNG every year, see figure B10 page 41.

There are 40 LNG receiving terminals located worldwide. Japan, South Korea, the United State and a number of European Counties import LNG.

3.2 LNG Storage

When LNG is received at most terminals, it is transferred to insulated storage tanks that are built to specifically hold LNG. These tanks can be found above or below ground and keep the liquid at a low temperature to minimize the amount of evaporation. If LNG vapors are not released, the pressure and temperature within the tank will continue to rise. LNG is characterized as a cryogen, a liquefied gas kept in its liquid state at very low temperatures. The temperature within the tank will remain constant if the pressure is kept constant by allowing the boil off gas to escape from the tank. This is known as auto-refrigeration. The boil-off gas is collected and used as a fuel source in the facility or on the tanker transporting it. When natural gas is needed, the LNG is warmed to a point where it converts back to its gaseous state. This is accomplished using a re gasification process involving heat exchangers.

3.3 Use of LNG

Natural gas is the cleanest burning fossil fuel. It produces less emissions and pollutants than either coal or oil. The demand for natural gas increases. Natural gas is available outside of many countries that use gas as a strategic source of energy, but this gas is not accessible by pipelines, so natural gas can be imported to these countries from distant sources in the form of LNG. Since LNG occupies only a fraction 1/600 (see figure 3.1) of the volume of natural gas, and takes up less space, it is more economical to transport across large distances and can be stored in larger quantities. LNG is a price-competitive source of energy that could help meet future economic needs in the world.

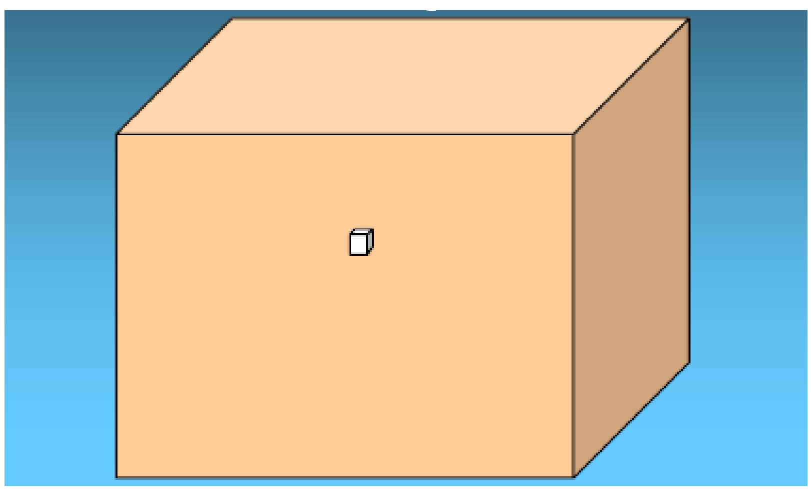

Figure 3.1 LNG Transformation when Liquefied to 1/600 in Volume. cf. /8/

3.4 Is LNG Flammable/Explosive?

When cold LNG comes in contact with warmer air, it becomes a visible vapor cloud. As it continues to get warmer, the vapor cloud becomes lighter than air and rises. When LNG vapor mixes with air it is only flammable if it's within 5%-15% natural gas in air. If it's less than five percent natural gas in air, there is not enough natural gas in the air to burn. If it's more than 15% natural gas in air, there is too much gas in the air and not enough oxygen for it to burn.

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As a liquid, LNG is not explosive. LNG vapor will only explode if in an enclosed space. LNG vapor is only explosive if within the flammable range of 5%-15% when mixed with air.

3.5 LNG Investment

In 1964 the UK and France were the LNG buyers under the world's first LNG trade from Algeria, witnessing a new era of energy. As most LNG plants are located in "stranded" areas not served by pipelines, the costs of LNG treatment and transportation were so huge that development has been slow during the past half century. The construction of an LNG plant costs 0.75-2.2 billion Euro, a receiving terminal costs 0.4-0.74 billion Euro, and a LNG vessel cost 0.15-0.22 billion Euro. Compared with the crude oil, the natural gas market is small but mature. The commercial development of LNG is in a style labelled value chain, which means LNG suppliers first confirm the downstream buyers and then sign 20-25 year contracts with strict terms and structures for gas pricing. The LNG business has been regarded as a game of the rich, where only players with strong financial and political resources could get involved. Major international oil companies (IOCs) such as BP, ExxonMobil, Royal Dutch Shell; and national oil companies (NOCs) such as Pertamina and Petronas, are active players. Japan, South Korea and Taiwan import large sums of LNG due to their shortage of energy. In 2002 Japan imported 54 million tons of LNG, representing 48% of the LNG trade around the world that year. Also in 2002, South Korea imported 17.7 million tons and Taiwan 5.33 million tons. These three major buyers purchase approximately 70% of the world's LNG demand.

In recent years, as more players take part in investment, both in downstream and upstream, and new technologies are adopted, the prices for construction of LNG plants, receiving terminals and vessels have fallen, making LNG a more competitive means of energy distribution. The standard price for a 125,000 m^3 LNG vessel built in European and Japanese shipyards used to be 185 million Euro. When Korean and Chinese shipyards entered the race, increased competition reduced profit margins and improved efficiency, reducing costs 60%. The per-ton construction cost of a LNG liquefaction plant fell steadily from the 1970s through the 1990s, with the cost reduced approximately 35%.

3.6 Advantages and disadvantages of LNG

LNG takes up to 600 times less space than regular natural gas at ambient temperature and pressure, which makes it easier to transport and store than natural gas. LNG can be stored above or below ground in specially designed double walled storage tanks. LNG can be transported over long distances via double-hulled LNG ships, which are specially designed tankers that keep the LNG chilled during transport. LNG is also used to replace diesel in heavy-duty trucks and buses and new gas fueled locomotives as a lower emissions alternative.

LNG operations are capital intensive. Upfront costs are large for construction of liquefaction facilities, purchasing specially designed LNG ships, and building re gasification facilities. Methane, a primary component of LNG, is considered a greenhouse gas because it increases carbon levels in the atmosphere when released.

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4 Worldwide LNG Importers

Natural gas, one of the largest sources of energy, can be found all over the world. LNG comes from countries with large natural gas reservoirs including Algeria, Australia, Brunei, Indonesia, Libya, Malaysia, Nigeria, Oman, Qatar, and Trinidad and Tobago. The largest gas reserves can be found in the Middle East. Much of the natural gas reserves found around the world are separate from oil and as new reserves are discovered and processed, growth in the LNG industry will continue.

Worldwide there are currently 13 countries that export LNG. There are approximately 40 LNG import terminals with many more planned. LNG import terminals exist in Japan, South Korea and Europe, as well as in the United States, which currently has five import terminals (including Puerto Rico).

4.1 Japan

According to the Energy Information Administration (EIA), Japan has about 39.6 billion m^3 in proven natural gas reserves and because domestic natural gas production is minimal, Japan imports about 97% of its natural gas, all in the form of LNG. This accounts for a majority of global trade in LNG, making Japan the world's largest importer of LNG. Since Japan has very little of its own natural gas reserves and no pipelines to supply gas from other countries, it relies heavily on imported natural gas to meet its needs. Japans LNG supply is imported from the Southeast Asian countries of Malaysia and Indonesia. A small amount of their LNG supply comes from Alaska.

EIA also states that city gas consumption in Japan has increased by more than 70% in the last decade due to a 25% increase in natural gas customers and also to a large rise in consumption by industry. The Japanese government has plans to deregulate the retail natural gas sector over the next several years to promote increased competition and lower prices. Almost all of the LNG currently imported into Japan is used in the electric power and gas utility industries.

Even though Japan is one of the most seismically active areas in the world, 24 of the existing 40 LNG import terminals are found near highly populated major cities in Japan.

Negishi was Japan's first LNG terminal, and was completed in 1969. The Negishi facility received its first shipment of LNG from Kenai, Alaska in 1969 to supply two of Japan's largest utilities, Tokyo Gas and Tokyo Electric Power Company.

Six import terminals were built and began operation in Japan during the 1970s. During this decade, Japan also began receiving shipments of LNG from Brunei. In the 1980s another six receiving terminals were added along with additional LNG shipments from Malaysia and Australia. Ten more terminals started up during the 1990s bringing the total to 23 LNG import terminals in Japan. The 24th terminal in Japan began operation in 2001.

Japan is the biggest importer for the LNG in the world and it is leading at using for LNG for transportation.

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4.2 South Korea

South Korea is the second largest importer of LNG in the world, according to the EIA. South Korea depends on imports for 95% of its natural gas needs and has been importing LNG since 1986. Currently most of its LNG comes from Indonesia, Malaysia, and Qatar, with a small amount from Brunei and Oman. Though South Korea currently relies on imported liquefied natural gas (LNG) to meet its demand for natural gas, they are currently working on a project to develop a natural gas deposit offshore to supplement their own natural gas supplies. Natural gas in South Korea is mainly used for electricity and residential heating.

Four LNG receiving terminals currently exist in South Korea, one each in Pyongtaek, Inchon, Tongyeong, and Kwangyang. The Kwangyang facility began operation in June 2005.

4.3 Taiwan

According to the Energy Information Administration, the Chinese Petroleum Corporation (CPC), Taiwan's national oil company, operates Taiwan's only LNG receiving terminal which is located in Yung-An, Kaohsiung. Chinese Petroleum Corporation has announced the construction of its second LNG import terminal in Tatan, which will be completed in 2009. Taiwan receives its LNG from Indonesia and Malaysia. A consortium, Tung Ting Gas, consisting of several private Taiwanese and Japanese firms, is planning a LNG re gasification project in Tao-Yuan County. Construction on this project began in mid-2001 and is scheduled for completion in 2006. Most of the natural gas from this terminal is will be used for domestic electric power generation.

4.4 USA

There are 113 active LNG facilities in the U.S. Natural gas is liquefied and stored at about 58 facilities in 25 states and 96 LNG storage facilities are connected to the natural gas pipeline grid. Massachusetts alone accounts for 14 major satellite facilities, or roughly 40% of all satellite facilities in the United States. There are five satellite LNG facilities in New Jersey, the second highest in the U.S.

4.5 LNG Safety

Once an LNG carrier reaches a receiving terminal, the LNG is unloaded and stored in large tanks until it is re-vaporized and piped into the natural gas distribution network. LNG is a hazardous liquid, because it is cryogenic and, as natural gas, it is combustible.

LNG hazards result from three of its properties: cryogenic temperatures, dispersion characteristics, and flammability characteristics. The extremely cold LNG can directly cause injury or damage. A vapor cloud, formed by an LNG spill, could drift downwind into populated areas. It can ignite if the concentration of natural gas is between 5% and 15% in air and it encounters an ignition source. An LNG fire gives off a tremendous amount of heat.

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A large array of laws, regulations, standards, and guidelines are currently in place to prevent and lessen the consequences of LNG releases. These requirements affect LNG facilities' design, construction, operation, and maintenance.

To address terrorist risk, the Ship and Port Facility Security Code was adopted in 2003 by the member countries of the International Maritime Organization (IMO), an agency of the United Nations responsible for maritime matters concerning ship safety. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans.

4.5.1 Explosion and Fire Accidents

October 1944, Cleveland, Ohio - At the Cleveland peak-shaving plant a tank failed and spilled its contents into the street and storm sewer system. The resulting explosion and fire killed 128 people. The tank was built with a steel alloy that had low-nickel content, which made the alloy brittle when exposed to the extreme cold of LNG.

1964 and 1965 Methane Progress.- While loading LNG in Arzew, Algeria, lightning struck the forward vent riser of the Methane Progress and ignited vapor which was being routinely vented through the ship venting system. A similar event happened early in 1965 while the vessel was at sea shortly after leaving Arzew. In both cases, the flame was quickly extinguished by purging with nitrogen through a connection to the riser.

1969, Portland, Oregon - An explosion occurred in a LNG tank under construction. No LNG had ever been introduced into the tank. The cause of the accident was attributed to the accidental removal of blinds from natural gas pipelines which were connected to the tank. This led to the flow of natural gas into the tank while it was being constructed.

January 1972, Montreal East, Quebec, Canada - A back flow of natural gas from the compressor to the nitrogen line occurred during defrosting operations at a LNG liquefaction and peak shaving plant. The valves on the nitrogen were not closed after completing the operation. This caused over-pressurization of the compressor and the natural gas entered the control room (where operators were allowed to smoke) through the nitrogen header. An explosion occurred when an operator tried to light a cigarette.

February 1973, Staten Island, New York- While repairing the interior of an empty storage tank, a fire started. The resulting increase in pressure inside the tank was so fast that the concrete dome on the tank lifted and then collapsed down inside the tank killing the 37 construction workers inside.

October 1979, Cove Point, Maryland - A natural gas leak caused an explosion killing one plant employee and seriously injuring another and causing about 2.3 million Euro in damages.

April 1983, Bontang, Indonesia - A rupture in a LNG plant occurred as a result of over pressurization of the heat exchanger caused by a closed valve on a blow down line. The exchanger was designed to operate at 1.76 bar. When the gas pressure reached 34.5 bar, the exchanger failed and the explosion occurred.

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August 1987, Nevada Test Site, Mercury, Nevada - An accidental ignition of a LNG vapor cloud occurred at the U.S. Department of Energy Test Site during large-scale tests involving spills of LNG. The cloud was accidentally ignited and damaged and propelled polyurethane pipe insulation outside the fence.

January 2004, Skikda, Algeria - A steam boiler that was part of a LNG production plant exploded, triggering a second, more massive vapor-cloud explosion and fire. The explosions and fire destroyed a portion of the LNG plant and caused death, injury, and material damage outside the plant's boundaries. Please see fact sheet.

June 2004, Trinidad, Tobago - Workers were evacuated after a gas turbine at Atlantic LNG's Train 3 facility exploded.

July 2004, Ghislenghien, Belgium - A pipeline carrying natural gas from the Belgian port of Zeebrugge to northern France exploded, resulting in 23 known fatalities. The cause of the incident is still under investigation but it appears that a contractor accidentally damaged the pipe.

March 2005, District Heights, Maryland - A Washington Gas company-sponsored study released in July 2005 pointed to subtle molecular differences in the imported liquefied natural gas the utility began using in August 2003 as the cause of a house explosion.

4.5.2 Spill and Leak Accidents

Early 1965, Methane Princess Spill - LNG discharging arms were disconnected prematurely before the lines had been completely drained, causing LNG liquid to pass through a partially opened valve and onto a stainless steel drip pan placed underneath the arms. This caused a star-shaped fracture to appear in the deck plating in spite of the application of seawater.

May 1965, Jules Verne Spill - LNG liquid spill at Arzew, Algeria, caused by overflowing of a cargo tank that resulted in the fracture of the cover plating of the tank and adjacent deck plating.

1971, La Spezia, Italy - This accident was caused by “rollover” where two layers of LNG with different densities and heat content form. The sudden mixing of these two layers results in the release of large volumes of vapor. In this case, about 2,000 tons of LNG vapor discharged from the tank safety vales and vents over a period of a few hours, damaging the roof of the tank.

July 1974, Massachusetts Barge Spill - After a power failure and the automatic closure of the main liquid line valves, 0.151 m^3 of LNG leaked as it was being loaded on a barge. The LNG leaked from a one-inch nitrogen-purge globe valve on the vessel’s liquid header. This leak caused several fractures to the deck plates.

September 1977, Aquarius Spill - During the filling of a cargo tank at Bontang, LNG overflowed through the vent mast serving that tank. The incident may have been caused

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by difficulties in the liquid level gauge system. The high-level alarm had been placed in the override mode to eliminate nuisance alarms.

March 1978, Das Island, United Arab Emirates - An accident occurred due to the failure of a bottom pipe connection of an LNG tank. The tank had a double wall (a nine-percent nickel steel inner wall and a carbon steel outer wall). Vapor from the outer shell of the tank formed a large heavier-than-air cloud which did not ignite.

April 1979, Mostafa Ben Bouliad Spill - While discharging cargo at Cove Point, Maryland, a check valve in the piping system of the vessel failed releasing a small quantity of LNG. This resulted in minor fractures of the deck plating.

April 1979, Pollenger Spill - While the vessel was discharging LNG at a terminal in Everett, Massachusetts, LNG leaking from a valve gland apparently fractured one of the tank's cover plating.

4.6 World LNG Market Structure

The structure of the international LNG market influences current and future LNG trade. Key issues include differences in history and pricing mechanisms between the Atlantic and Pacific Basins, recent market changes that increase flexibility in LNG trade, the declining trend of LNG costs throughout the value chain, and the addition of new participants to the market.

- LNG trade evolved differently in the Atlantic and Pacific basins, and this continues to affect import volume, pricing systems, and contract terms. Importing countries in the Pacific Basin are almost totally dependent on LNG while countries in the Atlantic Basin use domestic supplies and pipeline imports as well as LNG to meet natural gas demand.

- Recent changes in the LNG market have trended towards increased flexibility. Contracts have loosened terms on both price and volume, and can be negotiated for shorter periods of time. Additionally, flexibility in LNG shipping has led to an increase in short-term contacts.

- Costs of liquefaction, shipping, and re gasification have declined over time, lowering costs to producers. Since the LNG market is primarily driven by long-term contracts with pricing mechanisms pegged to petroleum products, however, lower operating costs do not necessarily translate into lower LNG prices, at least in the short term.

- Buyers and sellers have been taking on new roles. Buyers have been investing in the upstream, including liquefaction plants (e.g., Tokyo Gas and the Tokyo Electric Power Company have both invested in the Darwin liquefaction plant in Australia). Traditional sellers, such as BP and Shell, have leased capacity at terminals and are extending their role into trading. New buyers have been emerging, including independent power producers in Puerto Rico and the Dominican Republic.

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5 LNG in Europe

Several countries in Europe that currently have operating LNG import terminals including Belgium, France, Greece, Italy, Spain and Portugal. Europe imports most of its LNG supply from Algeria, but also receives LNG shipments from Africa, the Middle East and Trinidad and Tobago.

EIA indicates that France, which imports the most LNG in Europe due to having limited natural gas resources, receives its LNG from Nigeria. A substantial portion of this LNG is piped into Italy from France. A number of additional projects are proposed in these European countries. The United Kingdom (UK) has a large natural gas reserve in the Southern Gas Basin, although production has been declining. The UK currently has no LNG import terminals, but several have been proposed.

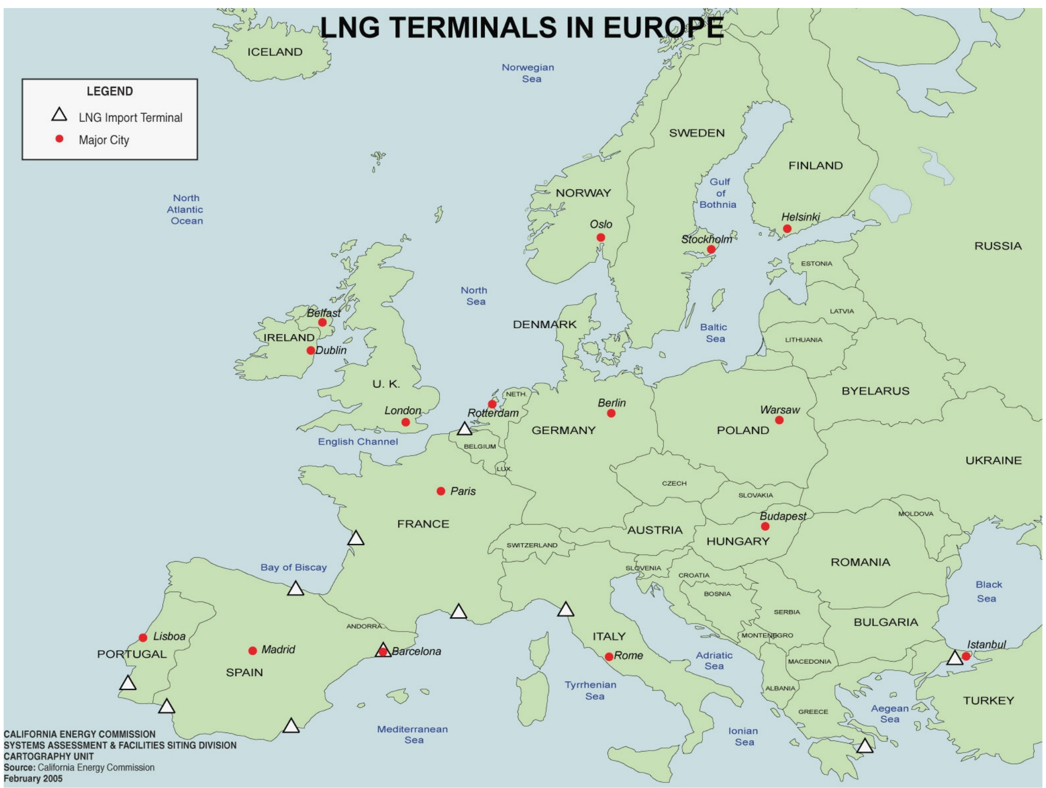

Figure 5.1 LNG Terminals in Europe

5.1 The Demand for LNG in Europe

Declining North Sea gas reserves, increased production costs and the deregulation of European gas and electricity markets have all combined to create new opportunities for LNG in Europe.

Further, many European countries rely on a limited number of energy supply sources. Such reliance may create serious issues of security of supply in the future, as evidenced

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by the recent confrontation between the Ukrainian Government and Gazprom. LNG is more flexible than pipeline gas and is therefore seen as an essential aspect of diversification of energy supply sources.

Yet the ability to move LNG to European markets has been constrained by a lack of access to re gasification capacity due in part to the limited number of terminals currently in operation as well as to the existence of long-term capacity rights held by a small number of industry participants. Many new LNG import terminals have been proposed in recent years in response to the increase in LNG demand. There are currently 11 LNG import terminals operational in Europe.

Other terminals in Belgium, France, Italy, Spain and the United Kingdom are under construction or being expanded and are due to become operational in the next three years. Many other terminals have been proposed in potentially new LNG importing countries such as Cyprus, Ireland, Germany, the Netherlands and Poland. Some of these proposed terminals are sponsored by companies developing upstream liquefaction in order to secure downstream market access for their LNG and/or by power utilities seeking new gas supplies.

5.2 Regulation of European Import Terminals

The European Commission has become more active in the European gas sector, introducing a number of directives designed to facilitate competition and create a single Europe-wide gas market.

In Directive 2003/55/EC of the European Parliament and of the Council (the “Second Gas Directive”), the European Commission introduced measures requiring member states to provide open access to gas infrastructure (including LNG terminals) on fair, transparent and non-discriminatory terms. The conditions and tariffs of third-party access to LNG terminals must be published by terminal operators, as well as approved by the national regulator.

The Second Gas Directive anticipates a system of regulated third-party access to LNG receiving terminals. Developers of new import facilities and existing import facilities for which new capacity is being developed may obtain an exemption to such third-party access requirements from the national regulator if the project satisfies certain criteria. So far, exemptions to the third-party access regime have been granted to five new LNG terminals: three in the United Kingdom (Grain LNG, Dragon LNG and South Hook LNG) and two in Italy (Isola di Porto Levante and Brindisi). Each EU member state had the obligation to implement legislation adopting the terms of the Second Gas Directive by 1 July 2004. However, the extent to which this has happened varies considerably across the EU.

Different approaches have been taken by each of the current and prospective LNG importing European countries in implementing the Second Gas Directive. As a result, rules governing access to LNG terminal capacity may differ and impact the speed at which a single European gas market can be accessed. The European Commission may

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examine whether the legislation adopted by a country is consistent with the regulated access framework set out in the directive itself.

In the United Kingdom, the Gas (Third- Party Access) Regulations became effective in August 2004, amending the Gas Act 1986 to reflect the regulated access provisions of the Second Gas Directive.

France has implemented the terms of the Second Gas Directive by amending legislation passed in 2002 and 2003. In relation to the new terminal to be located at Fos Cavaou, the French gas market regulator recommended that only 10% of capacity at the terminal needed to be “open access” in the first instance, thereby permitting Gaz de France and Total to take 90% of the terminal’s capacity on a long-term basis.

Spain enacted legislation to implement the first EU gas directive in 1998. This legislation governs third-party access to Spanish terminals and opens all LNG import capacity to regulated third-party access. At present, up to 75% of a Spanish terminal’s total capacity can be allocated on a long-term basis (more than two years) and 25% on a short-term basis (not more than two years). In Italy, the energy market regulator has indicated that developers may take up to 80% of terminal capacity on a long-term basis.

In the case of other LNG importing countries, the European Commission has confirmed that Greece and Portugal qualify as emerging markets and, as such, are exempt from the third-party access requirements of the Second Gas Directive. Cyprus, which may soon become an LNG importing country, may also be eligible for an exemption from the third-party access regime of the Second Gas Directive. The exemptions granted to each of such countries are temporary and will expire automatically on the tenth anniversary of the first delivery made pursuant to the first long-term natural gas supply contract.

5.3 Regulating Import Terminal Usage

As European gas markets attract an even greater volume of LNG, import terminals will become increasingly congested. For those terminals with more than one user, the contracts regulating terminal usage arrangements may be placed under considerable strain, especially in times of high LNG demand. In particular, port interface issues and the allocation of liability for a range of potential losses require clear, detailed and enforceable agreements.

In North America, several of the multi-user import terminals have based their terminal usage agreements on a similar form, thereby bringing a helpful degree of standardization to the market place.

A similar approach has yet to emerge in Europe, leaving importers who bring LNG cargoes to multiple European terminals to grapple with contractual structures that may differ considerably from one import terminal to the next.

5.4 LNG Import Terminals in Europe

5.4.1 Existing Terminals

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- Zeebrugge, Belgium
- Montoir, France
- Fos-sur-Mer, France
- Revithoussa, Greece
- Panigaglia, Italy
- Sines, Portugal
- Bilbao, Spain
- Barcelona, Spain
- Cartagena, Spain
- Huelva, Spain
- Sagunto, Spain

5.4.2 Terminals under Construction

- Fos Cavaou, France
- Isola Di Porto Levante, Italy
- Brindisi, Italy
- El Ferrol (Mugardos), Spain
- Dragon, UK
- South Hook, UK

5.4.3 Proposed Terminals

- Fieri District, Albania
- Vassiliko, Cyprus
- Omisalj, Croatia
- Le Verdon, France
- Wilhelmshaven, Germany
- Tarbert, Ireland
- Livorno, Italy
- Livorno Offshore (OLT project), Italy
- San Ferdinando, Italy
- Gioia Tauro, Italy
- Taranto, Italy
- Taranto, Italy
- Vado Ligure, Italy
- Muggia, Italy
- Zaule, Italy
- Priolo/Augusta/Melilli, Italy
- Porto Empedocle, Italy
- Offshore Trieste, Italy
- Eemshaven, The Netherlands
- Maasvlakte or Groningen, Netherlands
- Lion Gas LNG, The Netherlands
- Gdansk or Swinoujscie, Poland
- The Canary Islands, Spain
- Anglesey, UK
- Teesside, UK

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- Teesside Offshore, UK

For details with regard to each individual European country, please refer to appendix A.

6 Small Scale LNG Transport in Europe

A growing market for the future energy supply is Liquid Natural Gas transport. Currently natural gas provides 25% of all energy consumption in the world and the International Energy Agency has forecast that gas demand will grow at a faster rate than oil in the coming years.

Currently world LNG transport is exported from South East Asia, the United States, the Middle East and some African countries like Algeria and Nigeria. Import terminals are primarily situated in Japan and the United States.

Douglas and Westwood, an international energy analyst, has stated that the growth of LNG in the period 2005-2009 will increase by 50 billion Euro. Expenditure on LNG facilities will increase from 5.3 billion Euro in 2004 to 13 billion Euro in 2009.

In Europe there are currently 11 LNG terminals with several new terminals on the way. Export of LNG is not currently in place but set to start from Norway by 2006 from the Snøvit field in the Barents Sea. The primary importer in Europe is France due to significant lack of domestic supply, but also Spain and Italy are major importers. Germany and the U.K are potential major importers in a future LNG import market.

A development and research project for small scale LNG transport in Europe based on natural gas production from the North Sea would be able to assess the market and the technology available to develop this energy source. The primary concern in Europe is safety at liquefaction terminals and import terminals, which has an effect on the location of terminal sites.

While large terminals and LNG transport ships exist in the European market area, the development of small scale transport system, which is economically feasible would be beneficial to the European countries in a future where natural gas is predominant over oil as an energy source. Currently economies of scale are making possible the development of huge liquefaction trains at terminals but small terminal sites along European shoreline (in harbors, bays, beachheads) in the future should also be considered as an alternative to meet the demand for energy consumption.

6.1 Gas in Denmark

The Danish Energy Authority makes a yearly assessment of the Danish natural gas reserves. As per 1 January 2005, the reserves are assessed at 132 billion m^3 of natural gas. This assessment shows a 3% decline in the Danish natural gas reserves, compared to the 2004 assessment. The decline in the reserves is caused mainly by the production in 2004.

The exportation of natural gas from Denmark, however, is rising in volume. This is primarily due to a new pipeline connection from one of the Danish production platforms (Tyra Vest) to the NOGAT pipeline in Holland.

The Danish pipeline transportation and distribution/transmission network as well as the storage facilities are well developed.

The two natural gas storage facilities in Denmark, Lille Thorup and Stenlille, have a total capacity of 1.7 billion m^3 (including the amount of working gas being 700 billion m^3). Part of the capacity is sold to Gastra A/S, the state-owned transmission company, for system integrity and emergency purposes.

The market for commodity sales and trading in Denmark is increasing and a further increase is to be expected in the future due to the market opening.

Natural gas consumption in Denmark is approximately 25% of total energy consumption in Denmark. Denmark is today 100% self-sufficient as to natural gas requirements. About 50% of the Danish natural gas production is today being exported.

The main part of the natural gas is transported from the production platforms in the North Sea to the gas processing facilities at Nybro on the west coast of Jutland. However, some of the gas is transported from the production platform Tyra Vest to the Netherlands through the gas export pipeline, which is connected to the NOGAT pipeline in the Dutch part of the North Sea. Dong Naturgas A/S, a state-owned company within the Dong Energy group, owns the upstream production pipelines and the natural gas processing facilities in Nybro.

The gas pipeline connecting Tyra Vest to the NOGAT pipeline on the Dutch continental shelf is owned by AP Møller Maersk; Shell Olie og Gasudvinding B.V., Danish Branch; Texaco Denmark Inc., Danish Branch; and Dong Naturgas A/S, with Maersk Olie & Gas A/S as operator.

Further, Dong Naturgas A/S is co-owner of the Deudan Link, through which all exports to Germany flow.

Dong Lager A/S, also a company within the Dong Energy group, owns the natural gas storage facilities located in Lille Torup and Stenlille.

Further, five offshore pipelines export Norwegian natural gas to continental Europe cross Danish territory. The pipelines are owned by Gassco (four) and Conoco Phillips (one).

The natural gas storage facilities are regulated by the Danish Natural Gas Supply Act and subject to the terms and conditions of the owner of the facilities.

A distribution network which is owned by a licensee, or shares of ownership in undertakings that own such networks, may be transferred only to the Danish state.

6.2 LNG and Danish Industry and Competencies

Danish companies are highly competent with a wide range of proficiency in gas industry in term of international level. Also a strong focus on safety will make it easier to enter the LNG market.

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The possibility for Denmark and Danish companies to enter the LNG market is more likely as service provider in the link between LNG exporters and natural gas consumers.

With high competencies in the natural gas industry, Danish companies may have an important position in the LNG market in Europe and worldwide.

Examples of Danish companies with an intimate knowledge within natural gas include amongst others:

- A.P. Møller Mærsk, - Aalborg Engineering, - BAXI, Buhl & Bønsøe, - COWI , - DONG Energy, - Enervision, - J. Lauritzen, - The Danish Gas distribution companies e.g HNG, Naturgas Midt-Nord & Naturgas Fyn, - Hollesen Energy, - Ib Andreasen Industri, - Max Weishaupt, - Moe & Brødsgaard, - Nissen Energi Teknik, - Nordjysk vvs & Byggeteknik, - Nordsjællands Varmeteknik, - Rambøll and the Danish research center Risoe

as well as the project participants i.e.:

- Aalborg University Esbjerg
- COWI
- Dansk Gasteknisk Center A/S
- DHI – Water & Environment
- York Refrigeration, Marine & Controls ApS
- Endress + Hauser
- Offshore Center Danmark

With a growing demand for gas in Europe and limitations in resources in the North Sea due to the declining gas production in the North Sea region, the entrance of Denmark to the LNG market would have a good chance to succeed. Denmark could become an important player contributing in the balance of energy demand and offer in Europe.

Danish companies have experienced staff and good qualifications in respect of production, processing, safety, etc. within the natural gas industry.

Also several Danish companies have experience within manufacturing and managing of LNG carriers and have skills in taking all responsibilities within LNG terminals as well as processing and exporting of the natural gas.

Furthermore the general high knowledge of Danish companies in international markets helps making contact with potential business partners worldwide more easily.

6.3 SWOT of the Possible LNG Facilities and Market in Denmark

6.3.1 Strengths

- Lack in energy resources and a growing energy demand in Europe and the world.
- Danish companies are highly skilled within the natural gas area, with many specializations which complement each other.
- Good position of many Danish companies in worldwide markets.

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- Large experience of Danish companies in international markets.
- An environment and safety related focus has been a tradition in Denmark.
- A networked related industry structure, making it easier to work with partners form complementary business segments.

6.3.2 Weaknesses

- Lack of any LNG industry facilities in Denmark.
- Lack of experience with LNG in Denmark by Danish companies and exporters.
- High cost of startup LNG industry facilities in Denmark.
- Large environmental and safety challenges.

6.3.3 Opportunities

- Good project opportunities within the key Danish companies in the natural gas industry with a good natural gas track record. Areas such as harbors, LNG carriers, LNG terminals, small re-gasification units, connections and export of the natural gas are possible project opportunities for the Danish companies.
- Good opportunity to use the existing Danish pipeline network which is linked to the gas market in Europe.
- Secure future energy supply.
- Possible opportunity for LNG facilities chain investment in remote areas within the Kingdom of Denmark e.g. the Faroe Island, Greenland or certain large islands. Investments could be made in harbor facilities, LNG small-scale carriers, LNG small-scale terminals, small re-gasification units and local pipeline grids.

6.3.4 Threats

- Companies abroad are to a certain extent already looking into the small-scale LNG segment e.g. Norway, who however has little natural gas track record.
- Challenges of security e.g. terrorism similar to elsewhere.
- Extreme safety needed in congested Danish harbors and other onshore LNG related facilities.
- Extreme environmental challenges in Denmark in case of possible an accident related to LNG.
- The small and medium size Danish companies might meet stiff competition from multinational conglomerates with a large financing backup.

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7 Conclusion

In Denmark, the natural gas share of the market is growing and now constitutes 25% of the gross energy consumption. Domestic natural gas consumption is about 5 billion m^3 per year. In addition, Denmark exports about 5 billion m^3 per year from the Danish sector of the North Sea to Germany, Sweden and the Netherlands. There are about 330,000 Danish natural gas customers.

The Danish natural gas supply is ensured both in the short and the long term through a well-functioning infrastructure with alternative supply routes and agreements on gas from several fields and suppliers, also external to the Danish sector of the North Sea.

Hence the conclusion of this report is that focus should not necessarily be to establish LNG terminals and facilities in mainland Denmark. However, the Danish natural gas specialists should find it easy to penetrate the European LNG market, given their long-term natural gas expertise and experience.

The LNG market is definitely growing, and many external factors are contributing to this increase in the European gas demand. The development of new LNG terminals in Europe and the expansion of existing facilities is a very important element of the response by the industry to such demand. Figure 7.1 shows the world energy demand 1971-2030. And Figure 7.2 shows the global gas consumption 2005-2015. It can be seen from figure 7.2 that LNG consumption will grow from 2005 to 2015 to about three times.

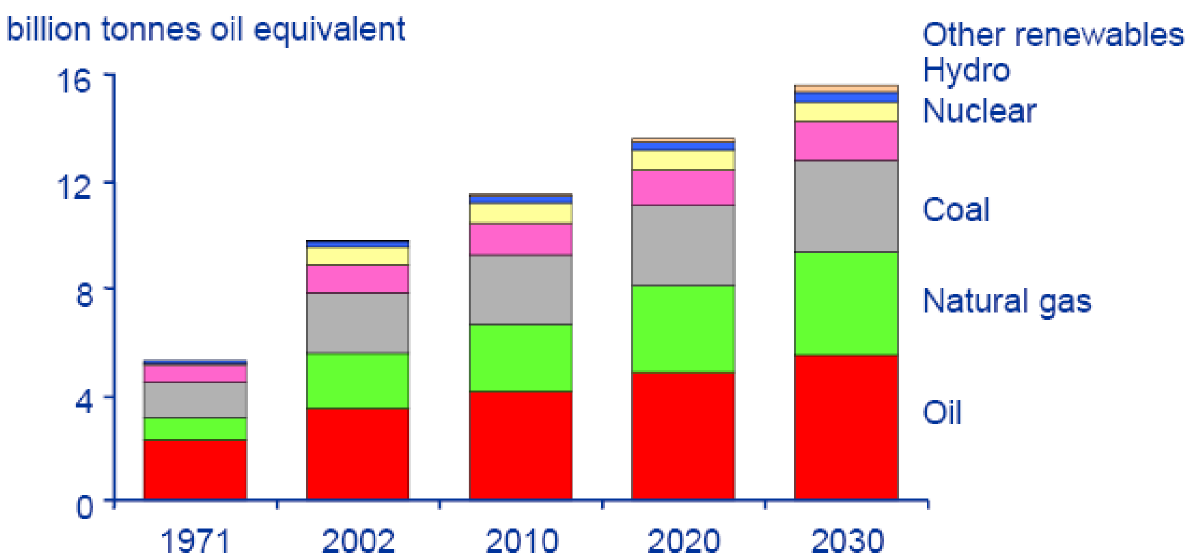

Figure 7.1 World energy demand 1971-2030 cf. /7/

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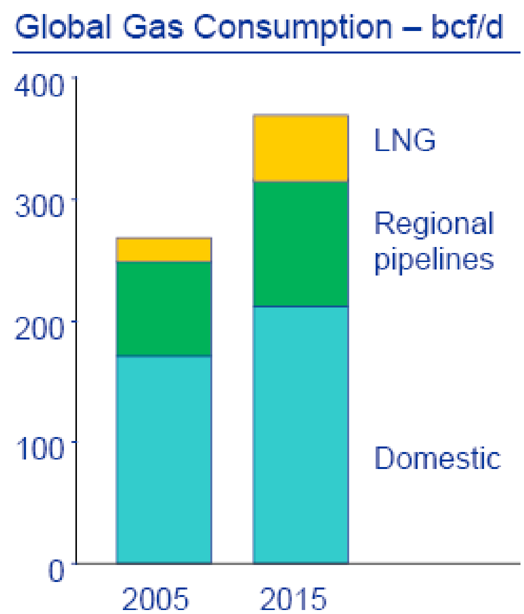

Figure 7.2 The Global Gas Consumption 2005-2015 cf. /7/

Denmark hence has a good opportunity to position itself within the LNG market. Also in the distant future, re-gasified LNG could prove a means of satisfying Denmark's energy demand.

Globally, natural gas will in the not so distant future, be one of the main sources of energy worldwide, and substitute oil to a certain extent. Some countries are already depending on natural gas as a strategic source of energy, such as Japan, Korea, France, etc. Many countries will follow this way with the ever-increasing world-wide demand on energy and with depleting oil reserves. Already in Europe many countries are working seriously in this way and taking steps to build all related facilities of LNG to secure the current and future energy needs.

Although Denmark is expected to be an energy exporting country for many years to come, small scale LNG plants could still prove essential to provide energy in remote regions within the Kingdom of Denmark, such as Greenland and the Faroe Islands. In these regions, no gas grid connection is possible to a European continental gas grid. Even for remote Danish islands, small scale LNG plants could be a possibility.

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8 Appendix A

A.1 Belgium

Belgium does not produce any natural gas and the country relies entirely on imports to supply its gas needs. LNG is imported into Belgium through its sole LNG terminal in Zeebrugge. LNG imports are small (2.85 billion m^3 in 2004) compared to imports of natural gas by pipeline (16.40 billion m^3 in 2004); however, this will increase in the next few years as a result of the expansion of the Zeebrugge terminal.

A.1.1 The Zeebrugge Terminal

The Zeebrugge LNG terminal is located along the northern part of the Belgian coastline and is built on a man-made island. It is a reference point for the sale and purchase of LNG in Europe and internationally.

At the end of 2002, Distrigas (a Suez subsidiary) had imported more than 1000 LNG shipments under a sale and purchase agreement with Sonatrach, originally signed in 1975 for 20 years and recently extended until 2007. From 1982 to 2003, the equivalent of more than 75 billion m^3 of natural gas was delivered to Zeebrugge from Algeria.

The re gasification terminal is being extended with the addition of a fourth storage tank of 140,000 m^3. In July 2004, the operator of the terminal, Fluxys LNG, awarded an engineering, procurement and construction contract to a joint venture of SN Technigaz, Fontec and MBG under the supervision of Tractebel Engineering for the carrying-out of the extension works.

A.2 France

France is the largest importer of LNG in Europe, second only to Spain. In 2004, the total import of LNG was about 7.7 billion m^3, representing 17.1% of the total consumption of natural gas in France.

The domestic production is small, representing only 1% of total consumption. The consumption of natural gas in France is lower than in other countries of comparable size due to the extensive use of nuclear energy for power generation.

Gaz de France (in which the French state has a majority shareholding) owns the two LNG import terminals currently in operation in France: Fos-sur-Mer near Marseilles and Montoir de Bretagne near Nantes. Gaz de France has recently made important investments in the LNG sector: it has committed to the new LNG terminal of Fos Cavaou that will enter into operations in 2007; it has ordered three new LNG carriers that will be delivered over the next few years; and it has also taken equity interest upstream in LNG liquefaction plants in Egypt and in Norway. Some of the LNG produced in Egypt is set to be delivered to France.

A.2.1 The Terminals

Fos-sur-Mer started commercial operations in 1972. Most of the LNG unloaded at the terminal comes from Algeria. LNG deliveries at the Fos-sur-Mer terminal have been affected by the explosion at the Skikda facility in January 2004. Gaz de France has entered into several FOB sale and purchase agreements for deliveries through at least 2013.

Montoir de Bretagne is currently the largest LNG re gasification terminal in Europe with a re gasification capacity of 10.2 billion m^3 per year. It started commercial operations in 1980. In 2004, it received 95 cargoes, coming essentially from Algeria and Nigeria and, to a lesser extent, from Qatar, Abu Dhabi and Oman. In March 2005, the terminal received its first cargo from the Damietta facility in Egypt.

According to Gaz de France, a large proportion of the LNG produced at Idku in Egypt will be unloaded at Montoir until the new terminal at Fos Cavaou begins operations in 2007. Gaz de France plans to further expand the terminal to receive up to 120 cargoes a year over the next few years.

A.2.1.1 The Fos Cavaou Terminal

The third French re gasification facility, sponsored by Gaz de France and Total, is located next to Fos-sur-Mer. The Fos Cavaou terminal is currently under construction and is expected to start operations in 2007. The terminal will receive 6 Mtpa (8.28 billion m^3 per year) of LNG from Egypt. Gaz de France awarded a turnkey contract for the construction of the terminal to a joint venture between Sofregas, Saipem SA and SN Technigaz.

Gaz de France has entered into several sale and purchase agreements with several suppliers, most notably from Egypt (SPA for 4.7 billion m^3 per year from 2005 to 2025), Nigeria (Bonny Island facility – SPA for 0.5 billion m^3 per year until 2021) and Norway (SPA for 0.5 billion m^3 per year until 2023). Total has re gasification capacity rights for about 2.25 billion m^3 of gas a year. It is unclear where Total will source the LNG to be re gasified at Fos Cavaou.

A.2.2 Other Projects

Total has also planned to develop a LNG re gasification terminal at Le Verdon in the Southwest of France for a capacity of 2 – 3 billion m^3 per year.

The first LNG terminal operating in France was located in Le Havre and started receiving LNG cargoes in 1964 until 1989 when it was decommissioned. Gas Matters recently reported that, in the near future, the Port of Le Havre will send invitation for tender by interested parties to develop a new LNG terminal facility.

A.3 Greece

Greece only produces a small amount of gas. At present, it relies mainly on imported oil to satisfy its energy needs. However, the Greek natural gas market is growing. Currently, one third of the natural gas consumed in Greece is imported as LNG. The remaining part

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is imported from Russia by pipeline. The Greek natural gas industry is controlled by the Public Gas Corporation of Greece (DEPA), which is owned by the Greek Government (65%) and Hellenic Petroleum (35%).

A.3.1 The Revithoussa Terminal

In 2000, the Revithoussa LNG terminal started importing 0.69 billion m^3 per year of LNG from Skikda in Algeria pursuant to an LNG sale and purchase agreement with Sonatrach.

This agreement started in 1998 and has a term of 15 years. DEPA (The public gas corporation) has ordered a preliminary study for the possible expansion of the terminal. This expansion may include the addition of a third storage tank and the increase of the re gasification capacity to 6.5 billion m^3 per year. DEPA is said to have entered into an EPC (European paralympic committe) agreement with Sofregaz and Athena SA. A 400 MW power plant is also expected to be associated with the expanded LNG terminal.

The feasibility studies and expansion of the terminal are partly financed by the European Union.

A.3.2 Third-Party Access

Under the provisions of the Second Gas Directive, Greece qualifies as an emerging country and, as such, is exempt from third-party access obligations. This exemption is temporary and will expire on the tenth anniversary of the first gas delivery made pursuant to the first long-term natural gas contract.

A.3.3 Other Projects

It has been reported that the construction of a new LNG import terminal at the Kavala Port is under consideration. The Greek Regulatory Authority for Energy is reportedly considering a project for a new LNG terminal in Crete to fuel a power plant supplying electricity to the Island. A feasibility study was carried out in 2004.

A.4 Italy

A.4.1 The Italian Gas Market

Italy is a producer of gas with proven reserves estimated at more than 170 billion m^3. Italy is also a large consumer of natural gas with 66 billion m^3 in 2004, making it one of the largest gas markets in Europe behind the United Kingdom and Germany. According to industry analysts, the gas market is set to grow at a higher rate than in any other European country. Demand for natural gas is expected to increase by 22 billion m^3 by 2010.

Despite having gas reserves, Italy imports most of the gas it consumes from Algeria (pipeline gas and LNG) and Russia. The balance is supplied by pipeline from the Netherlands and Norway and by LNG shipments from Nigeria.

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A.4.2 Development of LNG Infrastructure

The Italian Government has been encouraging both the development of the gas trade and of LNG terminal facilities.

Currently, deliveries of LNG are all made through the sole Italian LNG terminal in Panigaglia (La Spezia). The amount of LNG delivered accounts for less than 10% of the total amount of gas imported into the country. LNG imports will increase with the start of operation of the Isola di Porto Levante LNG terminal and the Brindisi terminal, scheduled for 2008 and 2009 respectively.

Endesa's project to build a floating facility offshore Livorno also appears to be a strong prospect. There are several other LNG terminal projects planned but they are less advanced. Many of these other projects have encountered local opposition or have had their application delayed or rejected.

A.4.3 The Panigaglia Terminal

The LNG import terminal of Panigaglia started operations in 1971 and is one of the oldest in Europe. It re gasifies LNG coming essentially from Algeria. SNAM (an Eni subsidiary) and ENEL (ENEL is Italian largest power company) have entered into a long-term arrangement with Sonatrach for the delivery of, respectively, 1.84 billion m^3 for 20 years until 2016 and 1.59 billion m^3 for 11 years until 2010 on an FOB basis. The terminal is equipped with a small berth which allows the entry of small LNG carriers (less than 70,000 m^3) only.

The terminal operator, GNL Italia S.p.A., has to provide third-party access to other shippers in accordance with the provisions of the Second Gas Directive. However, in recent years, the operator denied terminal access to third parties arguing that no capacity was available. In January 2005, the Italian Authority for Electricity and Gas fined GNL Italia for denying Gas Natural the use of the terminal. Since this incident, Gas Natural has been able to receive shipments of LNG originally planned for Huelva in Spain at Panigaglia.

A.4.4 The Isola di Porto Levante LNG terminal (Rovigo – North Adriatic)

The Isola di Porto Levante LNG terminal, sponsored by Qatar Petroleum, ExxonMobil and Edison, is expected to be the first offshore LNG re gasification terminal in Europe. The terminal, currently under construction in Spain, will be located in the north of the Adriatic Sea and is expected to begin operations at the end of 2008.

A contract was awarded to Aker Kvaerner for the development of the gravity-based structure, LNG storage tanks and LNG offloading and re gasification facilities. Snamprogetti, an ENI affiliate, is the contractor for the pipeline associated with the project. Delivery frequency is anticipated to be an average of two ships per week. The gas for the project will be sourced from Qatar's North Field and processed through the Rasgas II facility.

The terminal has been granted a 25-year exemption to third-party access rules under the Second Gas Directive in relation to 80% of the terminal capacity. The remaining 20% will be available to third-party access. Edison will be the principal user of the terminal and will have access to about 80% of its total re gasification capacity.

A.4.5 The Brindisi Teminal

Since June 2005, the planned LNG re gasification terminal of Brindisi has been fully owned by BG. BG bought a 50% share interest in Brindisi LNG S.p.A., the owner and operator of the Brindisi terminal, from ENEL for a total amount of 44 million Euro.

BG has also acquired the re gasification capacity that was allocated to ENEL. In April 2005, the Italian regulator granted a 20-year exemption to third-party access for 80% of the total capacity of the terminal. The balance of the terminal's re gasification capacity will be available to third-party access.

The contract for the construction of the terminal has been awarded to a consortium led by Tecnimont S.p.A. in 2004. BG reported that the construction work has started and that the terminal is expected to start commercial operations in late 2009.

However, the administrative decisions authorizing the project have been challenged before local courts, which is likely to delay its completion.

A.5 Portugal

Portugal does not produce any natural gas. The natural gas used in Portugal is imported through a gas pipeline from Algeria through Spain and through the Sines LNG Terminal.

A.5.1 The Sines Terminal

The Sines LNG terminal started operations on 26 October 2003 and has had an immediate impact on local consumption of natural gas, which has increased from 3.1 billion m^3 in 2002 to 4 billion m^3 in 2004. Galp Atlantico, the special purpose vehicle operating the terminal, is a wholly owned subsidiary of Galp Energia (previously Transgas).

The LNG is supplied from the Bonny Island liquefaction facility in Nigeria pursuant to several sale and purchase agreements for a total quantity of gas approximately equivalent to 3.5 billion m^3. In 2004 and 2005, LNG cargoes from Oman, Qatar and Algeria were also delivered to the Sines terminal.

A.5.2 Third-Party Access

Pursuant to Article 28 of the Second Gas Directive, Portugal qualifies as an emerging country and, as such, is exempt from third-party access obligations. This exemption is temporary and will expire on the tenth anniversary of the first delivery made pursuant to the first long-term natural gas supply contract.

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A.6 Spain

Spain has limited reserves of natural gas and imports most of the gas that it consumes. In 2004, it is estimated that 27.3 billion m^3 of natural gas were imported into Spain.

Natural gas consumption in Spain, one of the highest in Europe, has grown quickly and is expected to continue to grow significantly. This is particularly due to an increasing demand for electricity and the progressive replacement of older generation nuclear plants and coal-fired power plants by gas-fuelled power plants.

The Hydrocarbon Act of 1998 implemented the third-party access regime to gas infrastructure in accordance with Directive 2003/55/EC. The Hydrocarbon Act also requires that no more than 60% of natural gas imports shall come from any one country. The objective of this provision is to reduce the dominant position of Algerian gas imports. Competition is increasing in the gas market and there are now more than 30 companies licensed to market gas in Spain. Many of these companies are now entering into agreements to import LNG into Spain. Spain imported about 17.5 billion m^3 of LNG in 2004 (about 64% of total natural gas import).

The balance of natural gas is imported from Algeria and Norway by pipelines. About 87% of the LNG presently imported into Spain comes from Algeria, Nigeria and Qatar.

With five terminals currently in operation, Spain is the largest LNG market in Europe.

A.6.1 Barcelona, Cartagena and Huelva LNG Terminals

Enagas operates three LNG re gasification terminals in Barcelona, Cartagena and Huelva. Pursuant to Law 62/2003 of 30 December 2003, no shareholder is permitted to hold more than 5% of the shares of Enagas. All shareholders must comply with this provision before the end of 2006. All three terminals are undergoing expansion works.

A.6.2 The Bilbao Bahia de Bizkaia Terminal

The Bahia de Bizkaia LNG terminal is located near Bilbao. It started commercial operations in 2003. The operator of the terminal (BBG) is considering the expansion of the terminal capacity to respond to growing market demand. Subject to the Spanish Government's approval, BBG plans to double the output capacity by increasing the send-out capacity and by building another LNG tank costing about 120 million Euro. BBG is to supply approximately 40% of its gas to the Bahia de Bizkaia Electricidad BBE 800 MW CCGT power plant adjacent to the terminal. The terminal is expected to receive 59 cargoes of LNG in 2006 compared with 45 in 2005. In 2005 about 70% of the LNG delivered to this terminal was imported from Nigeria.

A.6.3 The Sagunto Terminal

The Sagunto re gasification facility is expected to receive LNG from Algeria, Egypt, Libya and the Middle East (including Qatar, Abu Dhabi and Oman). The first LNG carrier

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unloaded its cargo at the Sagunto terminal in February 2006. Following completion of the first stage of the project, there are plans for further developments which are dependent on market requirements.

Such developments would include, in the first phase, the construction of an additional 150,000 m^3 LNG storage tank and an increase in send-out capacity to 8 – 9 billion m^3 per year. The second phase would include the construction of two new 150,000 m^3 LNG storage tanks and an increase in send-out capacity to 10.2 billion m^3 per year.

A.6.4 The Mugardos Terminal

The LNG terminal, developed by Re gasificadora del Noroeste S.A. in Mugardos (Galicia), is currently under construction, and it is planned to come onstream at the end of 2006. The LNG to be processed at the terminal is expected to come from Algeria, Trinidad and Tobago, Nigeria, Norway and possibly Angola. The terminal will be available to third-party access. There are plans for extension of the storage capacity with two additional 150,000 m^3 LNG storage tanks and an increased re gasification capacity to 7 billion m^3 per year.

A.6.5 The Gascan Terminal

Endesa has proposed to build two new LNG terminals in the Canary Islands. The plants in Gran Canaria and Tenerife would each have one tank of 150,000 m^3 and a send-out capacity of 210,000 m^3/hour. Construction of both terminals is still speculative.

A.7 United Kingdom

The import of LNG into Europe occurred for the first time in the UK. From 1959 until the mid-1990s, LNG was imported from Algeria through the LNG terminal on Canvey Island. As gas production from the North Sea increased, LNG imports decreased and were gradually phased out. However, the decline of the North Sea gas reserves and the rapid increase in gas demand mean that the United Kingdom has become a net importer of gas. The British Government has been encouraging the development of import infrastructure including LNG facilities and pipelines.

Currently, there is one LNG import terminal in operation (Grain LNG) in the UK and two terminals are under construction (Dragon LNG and South Hook LNG). Other projects are also being discussed.

Grain LNG has been the quickest project to come onstream. National Grid, the owner of the terminal, converted one of its peak shaving LNG facilities into a LNG import terminal. The facility was commissioned in July 2005 and the first commercial cargo arrived in September 2005. The current terminal capacity was acquired by BP and Sonatrach in October 2003 to import 4.4 billion m^3 per year of LNG for 20 years. The terminal is being expanded to accommodate a further capacity of 9.3 billion m^3 per year and is expected to be completed by the end of 2008. The second trenche capacity has been allocated to Centrica, Gaz de France and Sonatrach. Grain LNG is planning a further expansion and has proposed an additional capacity of 6.9 billion m^3 per year on an open-season basis.

To comply with the requirements of the national regulator (OFGEM), the terminal is required to have a use-it-or- lose-it mechanism, which means that the primary holder of re gasification capacity must use their capacity or offer it to the secondary market. The financing of the terminal and its expansion has been partially financed by loans from the European Investment Bank.

A.7.1 The Dragon Terminal

The Dragon LNG terminal, located at Milford Haven in Wales, is sponsored by Petroplus, BG Group and Petronas. Dragon LNG will initially have the capacity to import 6 bcm of LNG.

It may subsequently expand its terminal capacity to 8.2 billion m^3 if planning permission is granted. Dragon LNG is expected to come onstream at the end of 2007. The users of Dragon LNG will be BG and Petronas. BG and Petronas have entered into 20-year terminal use agreements with Dragon LNG for 50% each of the terminal capacity. Petronas has entered into an agreement to sale its entire output to Centrica 3 billion m^3 per year.

The terminal is currently under construction. The EPC contract was awarded in 2004 to a joint venture between the UK's Whessoe Oil & Gas Ltd. and Volker Stevin Construction Europe B.V. from the Netherlands. Dragon LNG may supply a number of power plants. This may include a project by a subsidiary of Petroplus to build a 1,600 MW CCGT in Milford Haven.

A.7.2 The South Hook Terminal

South Hook LNG, sponsored by ExxonMobil and QatarGas, is also located at Milford Haven. Chicago Bridge & Iron is currently building the terminal, which is expected to be completed by late 2007. The contract for the expansion of the terminal has also been awarded to Chicago Bridge & Iron. LNG will be supplied from the Qatar Liquefied Gas Co. Ltd. (II) LNG plant built at Ras Laffan. ExxonMobil Gas Marketing Europe will buy the gas transiting through the terminal.

A.7.3 The Canvey Island Terminal

Canvey Island was Europe's first commercial LNG import terminal. Deliveries of LNG to the UK began in 1964 from the United States and Algeria. The site was converted in the 1990s into a Liquefied Petroleum Gas ("LPG") plant. Canvey Island will be the fourth UK LNG terminal if it secures the necessary planning permission (lodged in early January 2006). The Canvey Island sponsors (Centrica, LNG Japan, Calor Gas and Osaka Gas) plan to convert the existing LPG terminal (owned by Calor Gas) into a LNG terminal with a capacity of 5.4 billion m^3 of natural gas. The proposal includes the construction of two 120,000 m^3 LNG storage tanks, the reinforcement of the existing jetty and a new connection to the National Transmission System.

The terminal is expected to start receiving LNG in 2010. The project costs are estimated between 300 and 400 million Euro.

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A.7.4 The Anglesey Terminal

Canatxx Energy Ventures, a gas storage operator, has proposed to build a LNG terminal at Amlwch on the Isle of Anglesey off the coast of Wales. The site is situated near the company's proposed Fleetwood storage facility on the northwest coast of England. The storage tanks and re gasification infrastructure would be installed at the Great Lakes Chemical site, which is no longer in use. The project has encountered opposition from local groups and remains at the conceptual stage.

A.7.5 The Teesside Terminal

At the end of December 2005, ConocoPhillips announced it was pursuing a new LNG terminal project in Teesside, northeast of England. The terminal would receive LNG from the Qatargas 3 project, sponsored by ConocoPhillips and QatarGas.

ConocoPhillips plans to build an integrated receiving terminal and combined heat and power plant. ConocoPhillips plans to build the terminal on the existing North Sea Oil Terminal site and anticipates receiving final planning approval by mid-2007. The terminal could be operational by 2011.

A.8 Denmark

There are no LNG undertakings (including LNG production and facilities) in Denmark at present. However, the Danish Natural Gas Supply Act does include provisions on liquefied natural gas (LNG).

LNG activities may only be carried out under license. The license is granted by the Danish Ministry of Economic and Business Affairs. Licenses are granted for a minimum of 20 years.

Licenses to carry out LNG activities can only be granted to applicants who are considered to possess the necessary expertise and financial background. The provisions on access to the system in the Danish Natural Gas Supply Act also apply to LNG facilities.

The construction of LNG facilities requires permission from the Danish Ministry of Economic and Business Affairs. Such permission is granted only if the applicant produces evidence of the need for the LNG facility.

According to the Danish Natural Gas Supply Act, the relevant undertakings provide the fees and terms for access to the LNG facilities. The fees and the terms for services fixed by LNG undertakings shall be set not to discriminate between the system users. LNG undertakings shall notify the Danish Energy Regulatory Authority with respect to fees, tariffs, terms etc., including information on methods applied when calculating or determining fees, terms, and conditions for access to LNG facilities.

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9 Appendix B

Appendix B includes some useful figures and pictures which show obvious overview for LNG business in present and estimate in the future.

B.1 List of Figures

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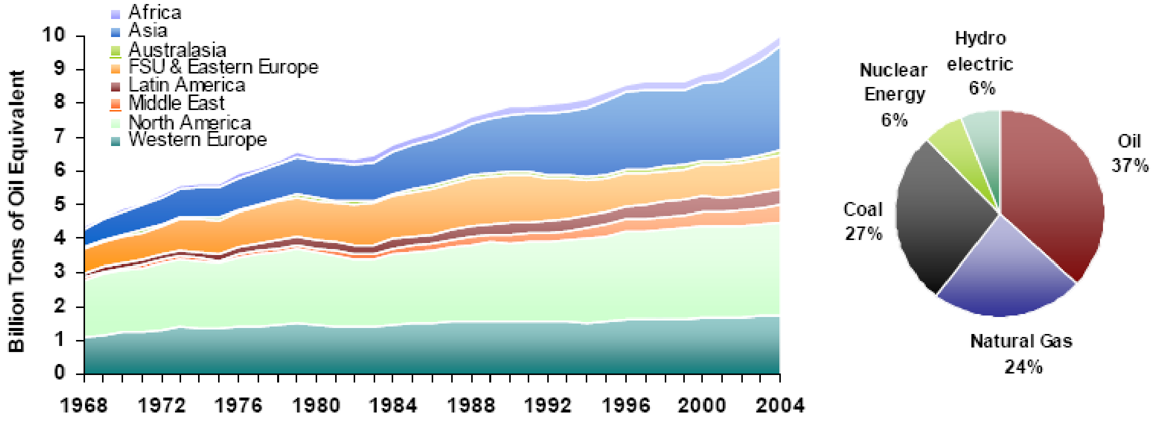

Figure B1 World Energy Demand 1968-2004. cf. /2/

- Natural gas currently satisfies 24% of global energy demand.

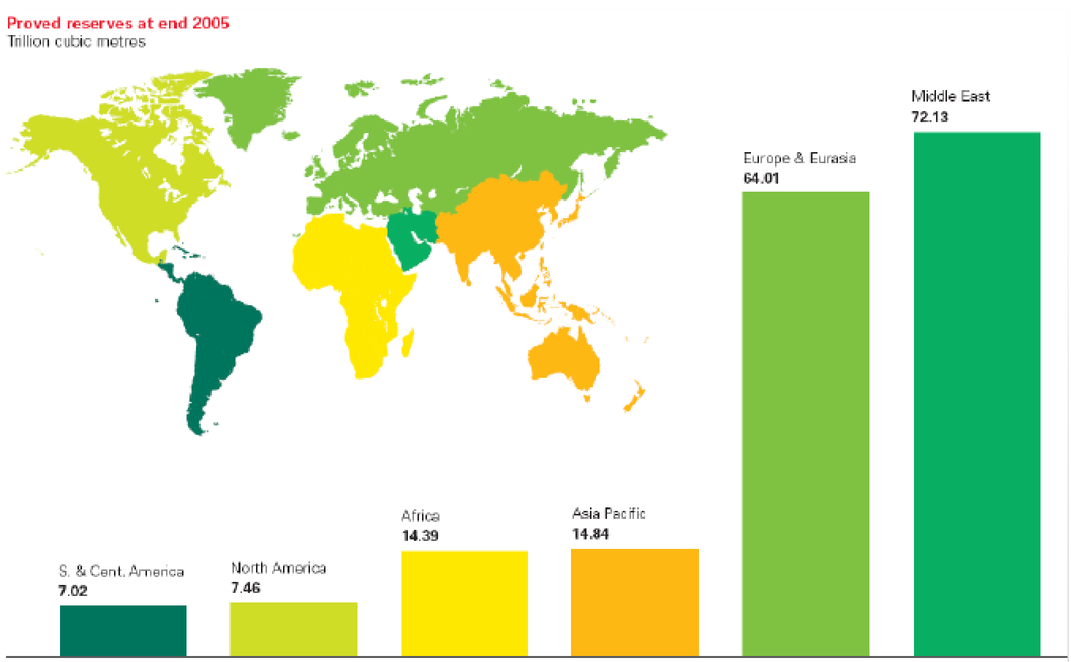

Figure B2 Proved Natural Gas Reserves at the End 2005. cf. /2/

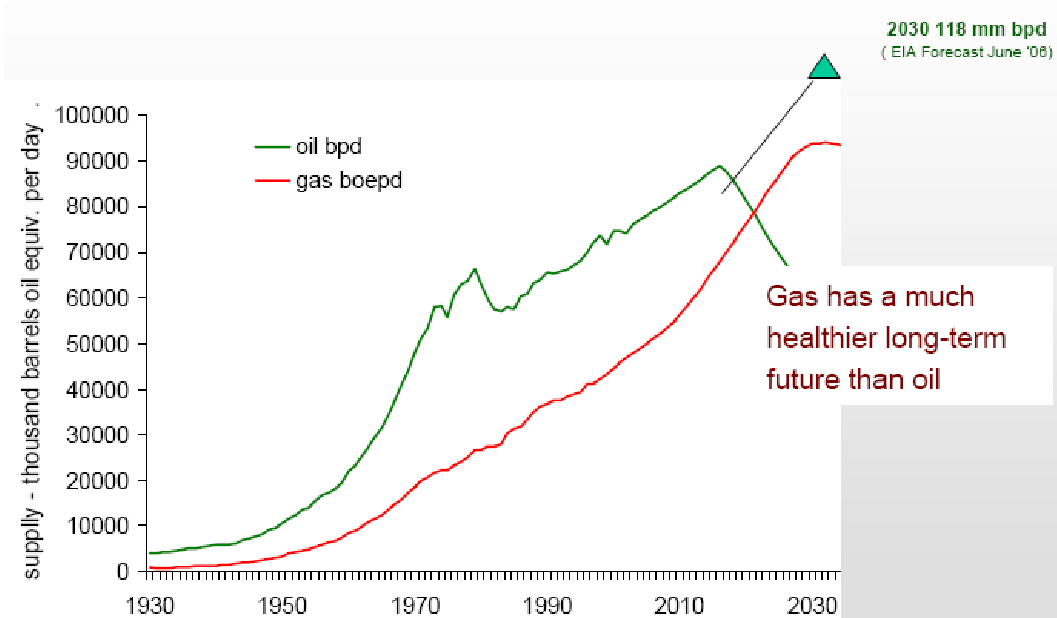

Figure B3 Oil and Gas Supply. cf. /2/

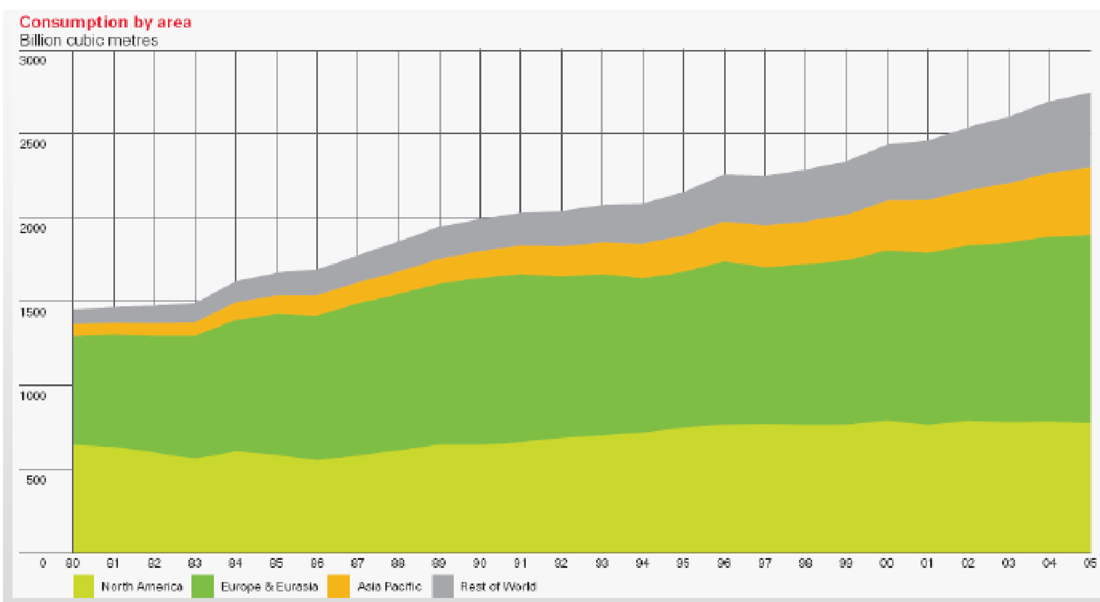

Figure B4 The Major Gas Consumers. cf. /2/

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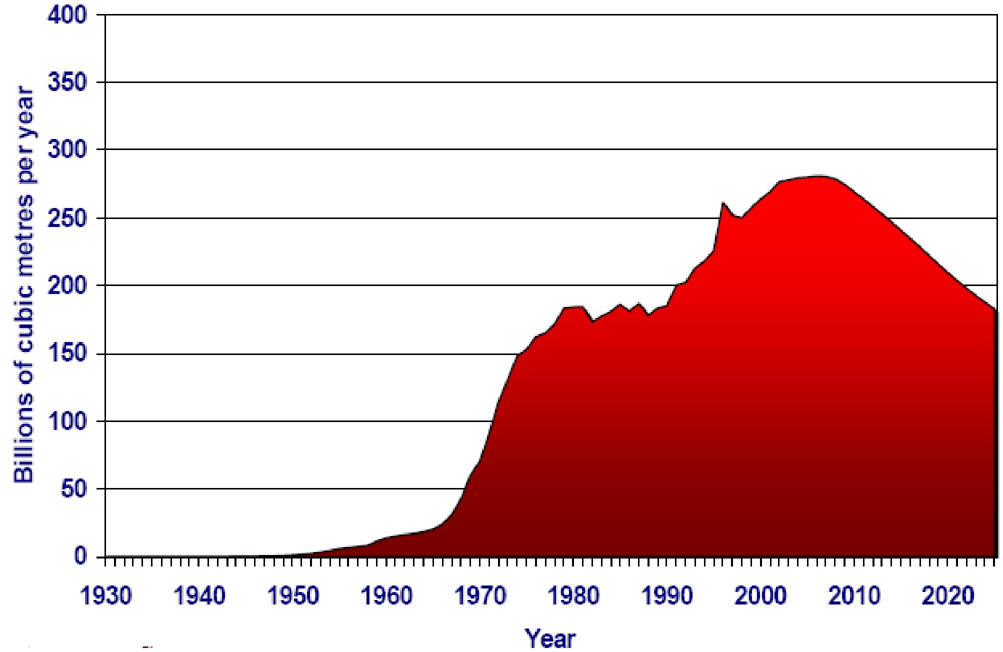

Figure B5 Gas Production in Western Europe. cf. /2/

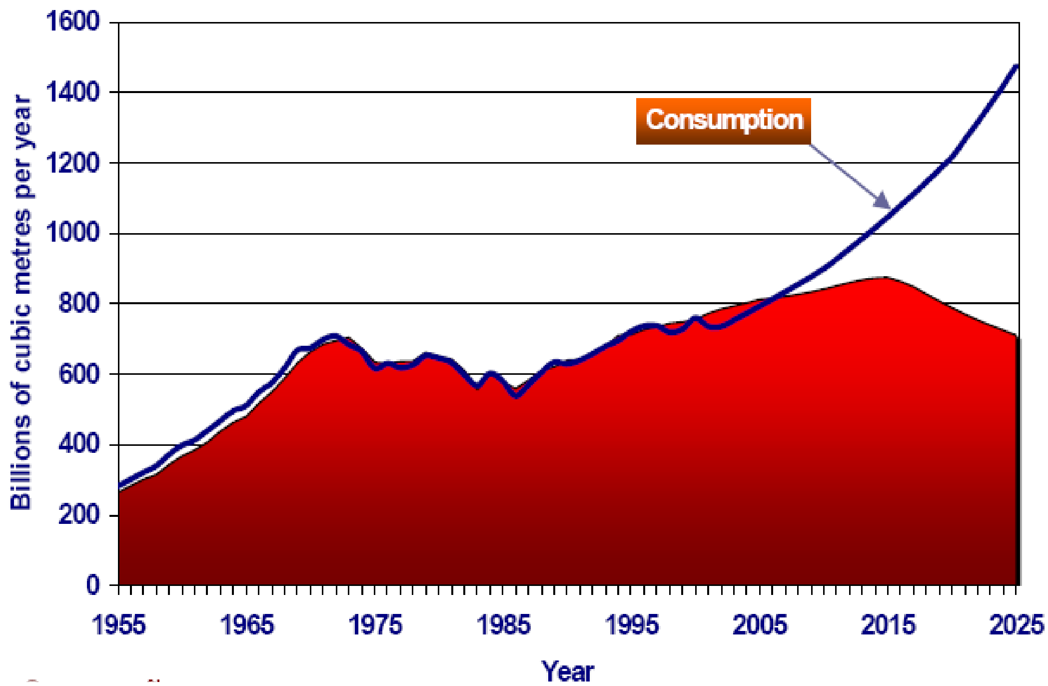

Figure B6 Gas Supply and Demand in North America. cf. /2/

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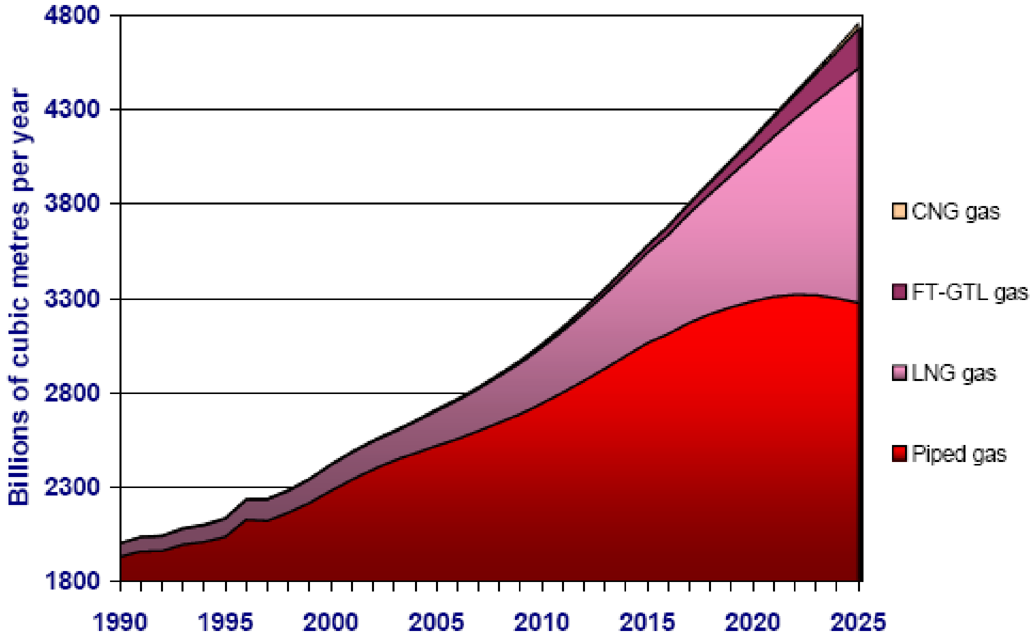

Figure B7 Major Growth in Gas Production. cf. /2/

- At 2003 93% of gas transported by pipe.
- At 2025 of 69% of gas will transport by pipes and 26% by LNG.
- So LNG to have increasing importance as a gas transportation method.

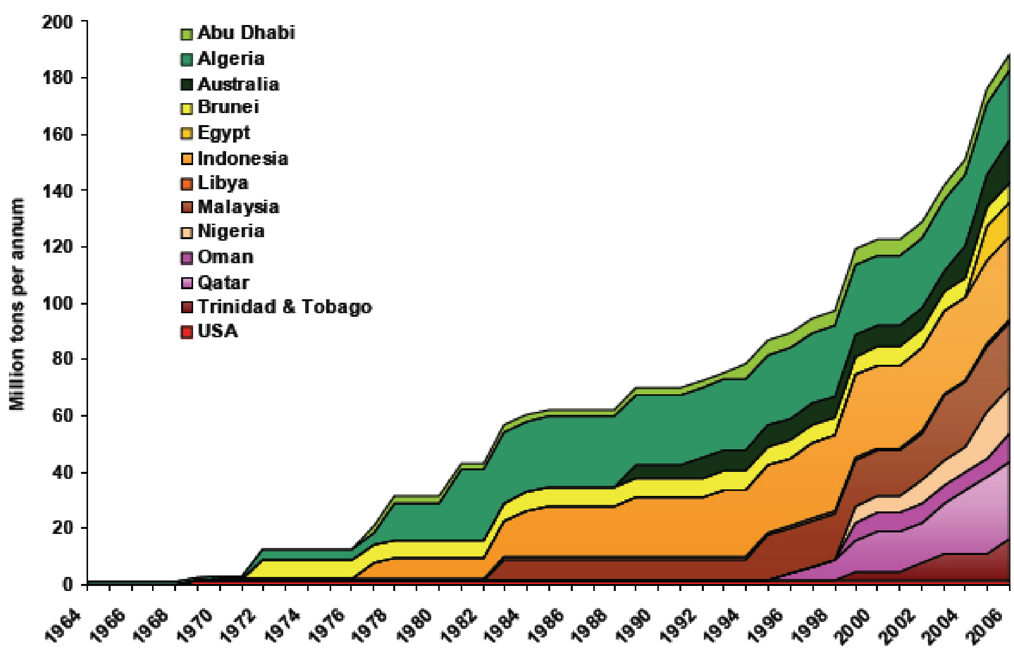

Figure B8 Historic Growth in LNG Production. cf. /2/

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- LNG business now well established 20 export terminals running a total of 78 liquefaction trains, combined capacity of 185 million metric tons per year.

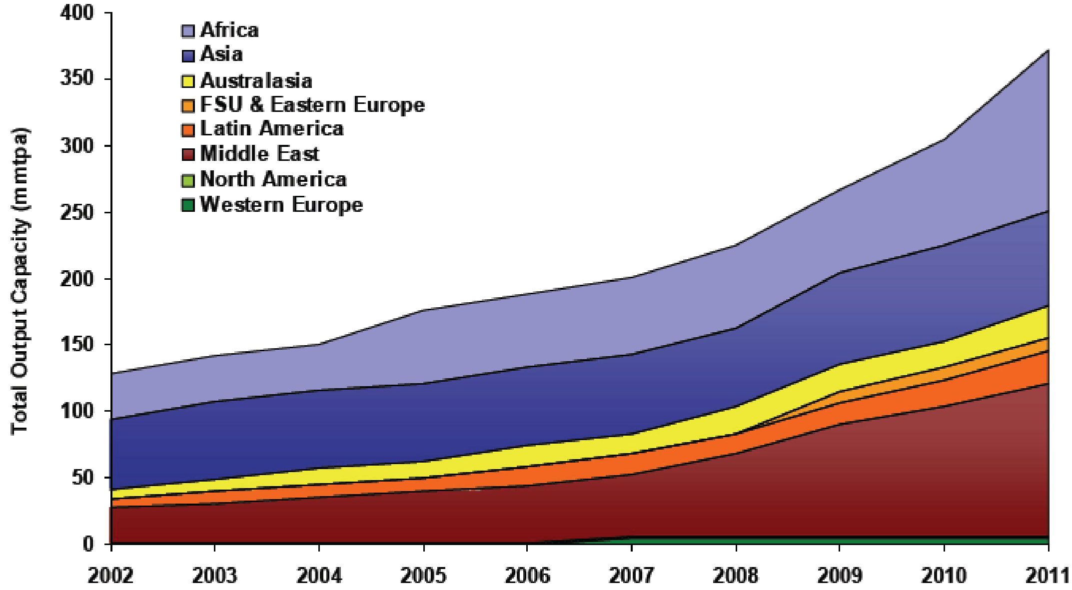

Figure B9 The Growth in LNG Production Forecast. cf. /2/

- Rapid growth in LNG output capacity expected over the next five years to reach in excess of 370 million tons per year by 2011.

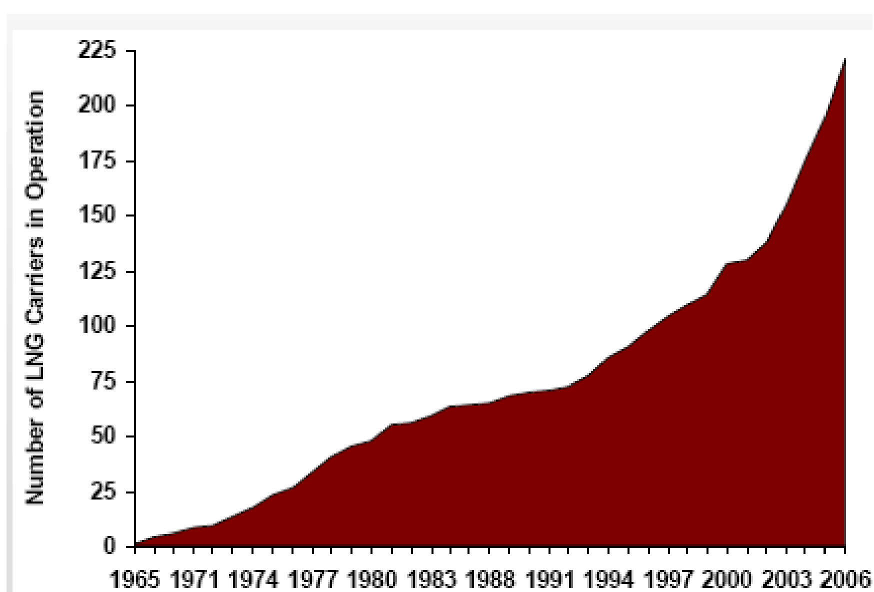

Figure B10 LNG Carriers. cf. /2/

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- Now over 220 carriers in operation.
- Most expensive type of cargo vessel – typical 150,000 m^3 unit 150 million Euro.

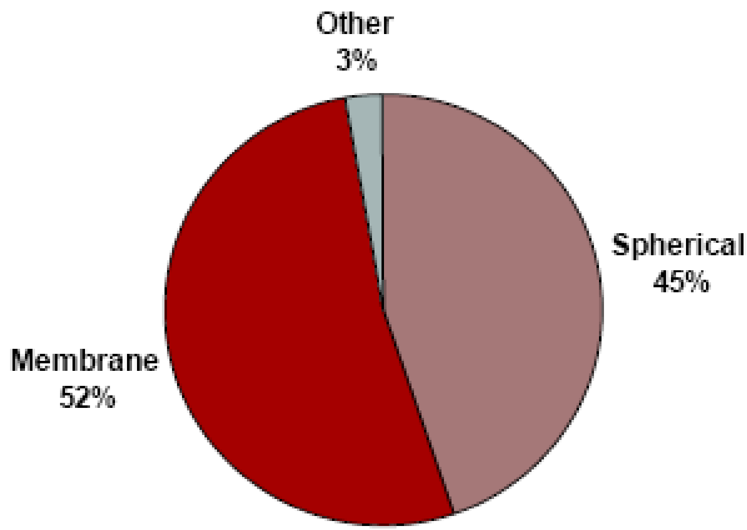

Figure B11 LNG Fleet Composition. cf. /2/
See Figure B11a & B11b

- Current fleet – 52% use membrane containment system, 45% use spherical.
- Other systems do exist, not widely adopted (eg. IHI SPB) or only used in small applications (eg. cylindrical).

Figure B11a LNG Membrane Carrier. cf. /2/

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Figure B11b LNG Spherical Carrier. cf. /2/

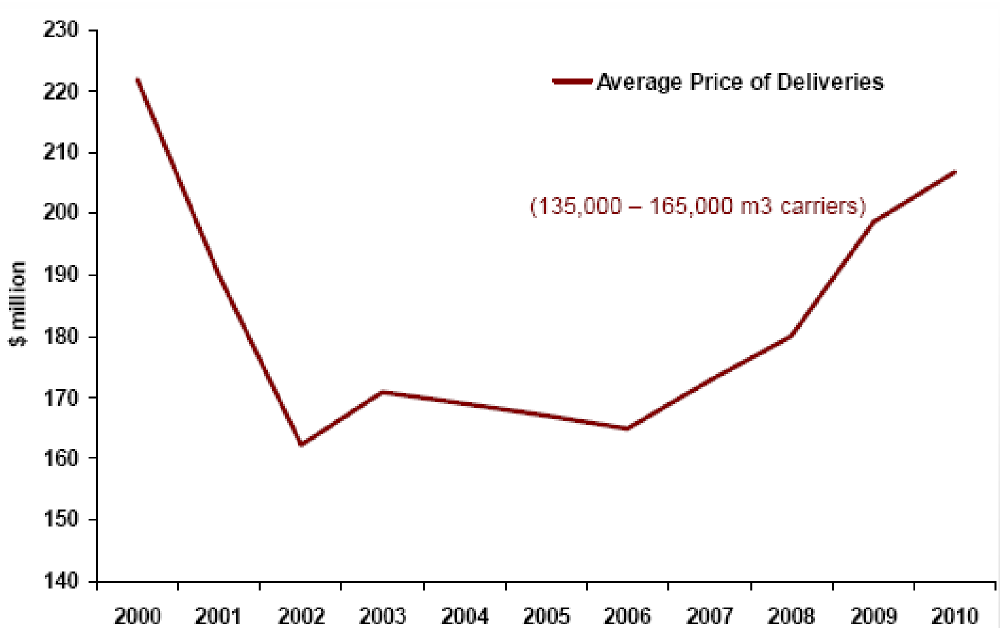

Figure B12 LNG Carriers Price. cf. /2/

- Prices fell from 186 million Euros in 1998 to 119 million Euros in 2004.
- After 2004, Shipbuilding boom - Lack of yard capacity and increased steel costs increased the prices up till 149 million Euros.

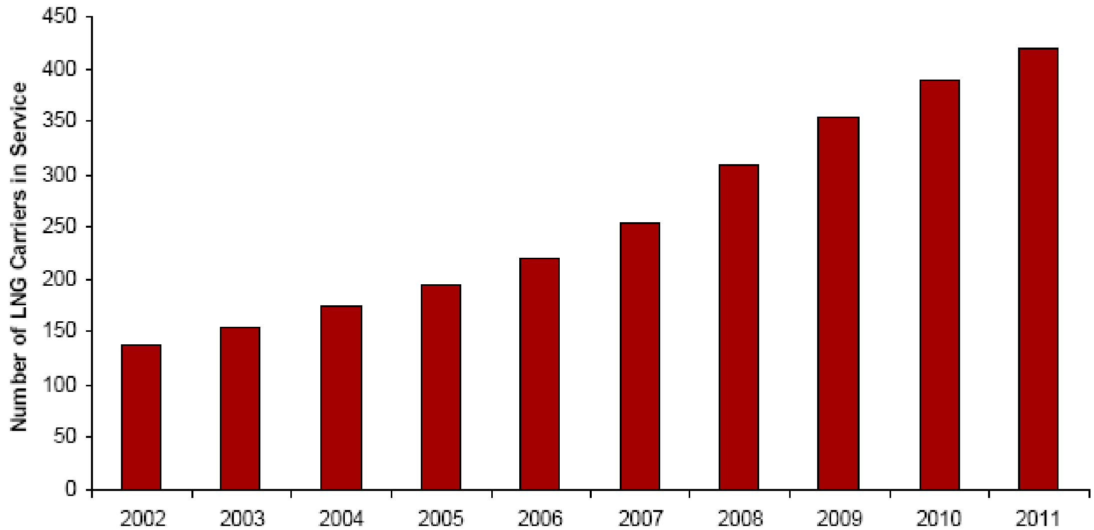

Figure B13 Growth in LNG Carrier Fleet Forecast. cf. /2/

- Huge growth in the carrier fleet.
- From less than150 units 2002 to more than 400 units 2011.

Figure B14 LNG Receiving and Re-gasification Process. cf. /2/

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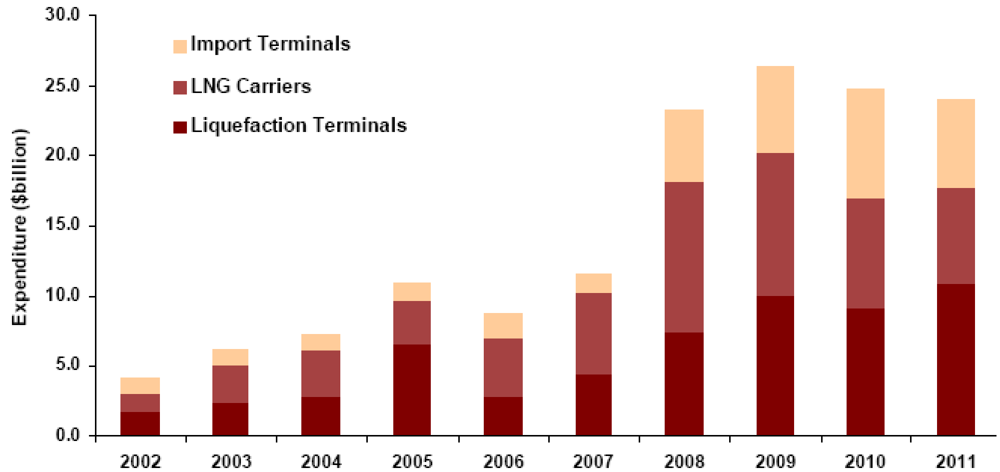

Figure B15 Global LNG Expenditure. cf. /2/

- More than 80 billion Euro business 2007-2011.

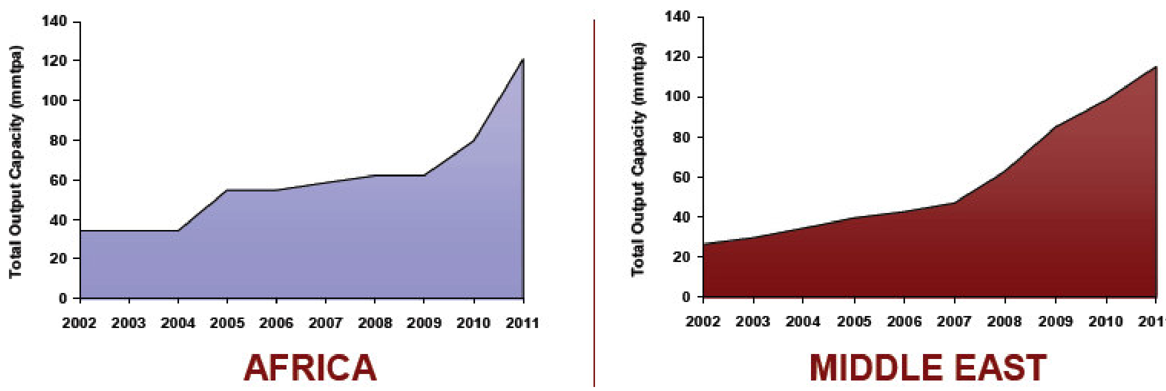

Figure B16 Africa and Middle East – Major Growth in LNG Export Capacity. cf. /2/
*mmtpa = Million metric ton per year

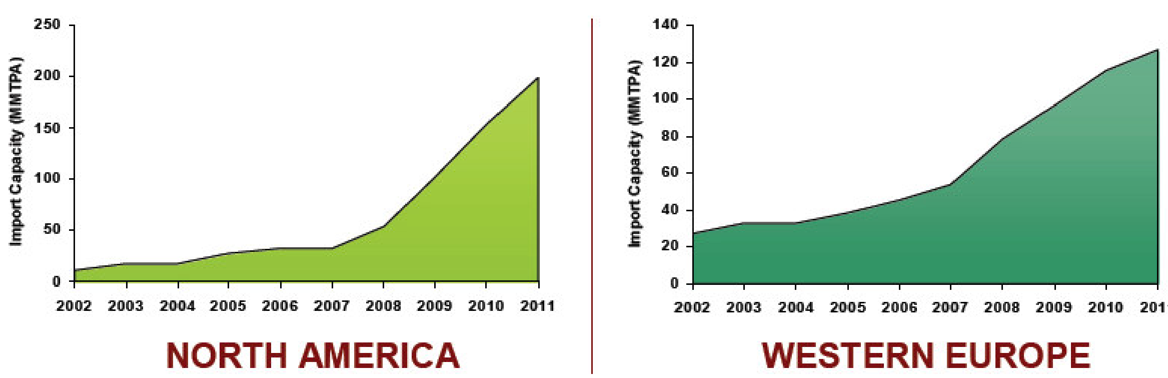

Figure B17 North America & West Europe – Rapidly Developing Import Capacity. cf. /2/
*MMTPA = Million metric ton per year

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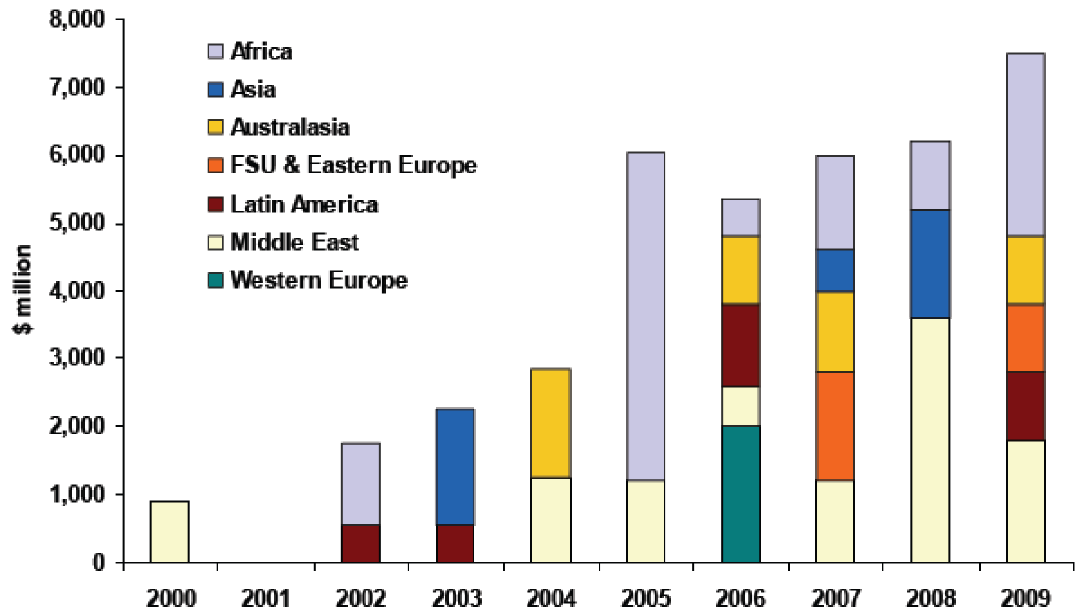

Figure B18 LNG Liquefaction Terminals 2005-2009. cf. /2/

- LNG Liquefaction Terminals 2005-2009 – a 23 billion Euro market.
- 27 new liquefaction trains adding 122 million metric tons per year to global output capacity.

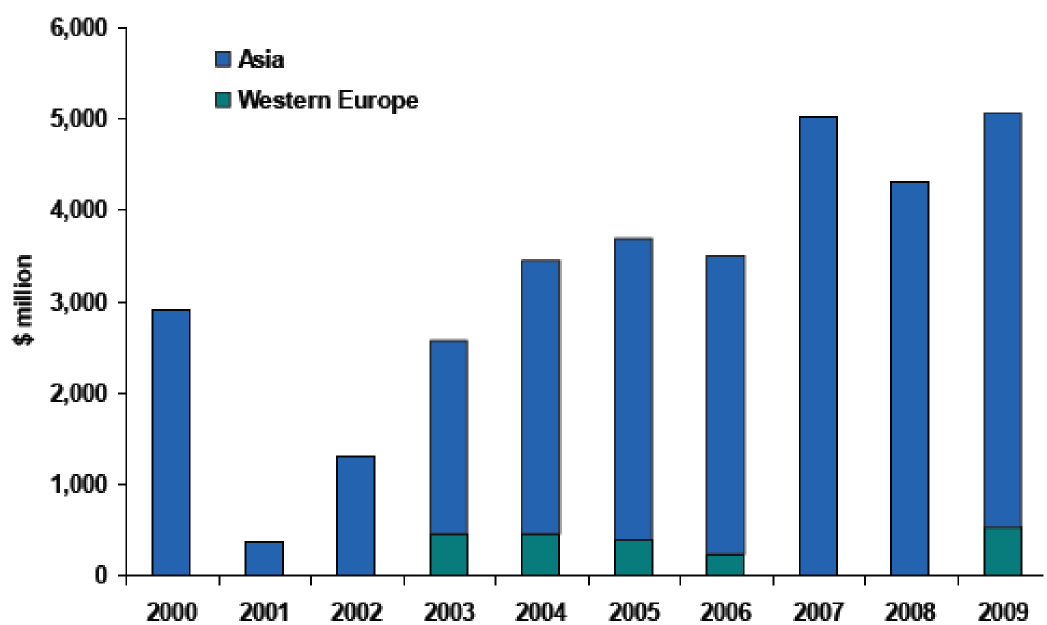

Figure B19 LNG Carriers 2005-2009. cf. /2/

- LNG Carriers 2005-2009 – a 16 billion Euro market.

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- 126 LNG carriers expected to be delivered over the 2005-2009 period.
- Total expenditure for the 2005-2009 period expected to double previous five-year spend.

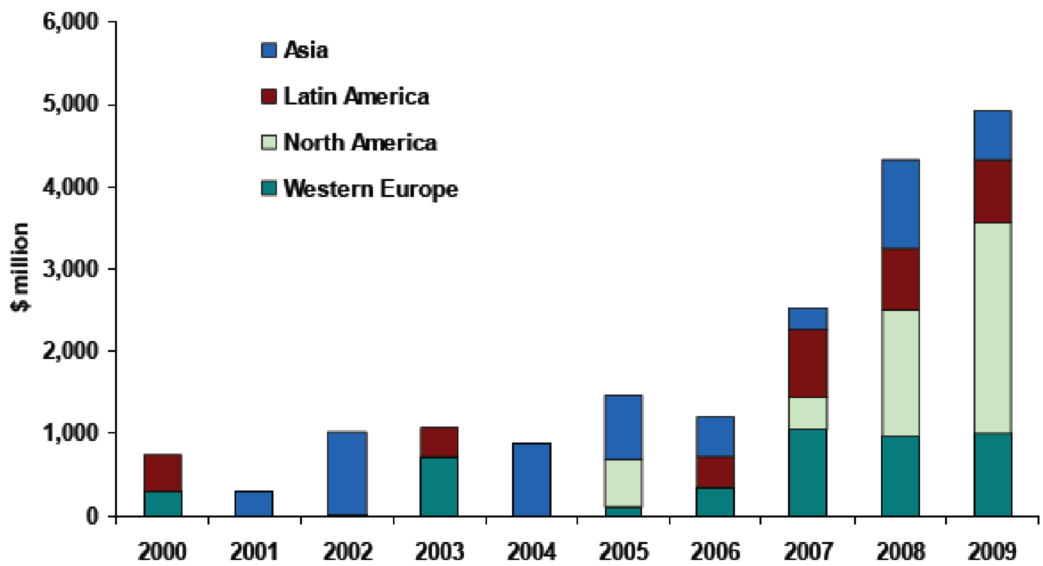

Figure B20 LNG Import Terminals 2005-2009. cf. /2/

- Import Terminals 2005-2009 – an 11 billion Euro market.
- Western Europe and North American together account for 59% of forecast spend.
- Total of 37 new terminals (8 offshore) with 191 million metric tons per year of new import capacity.

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10 References

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/9/ Documents from Previous Project Meetings

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