What are the prospects of LNG for Brunei Darussalam?

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Abstract: LNG trade in the Asian market region, such as, Japan, South Korea, China, India and Taiwan, is set for rapid growth over the next two decades, with growth predominantly driven by the need for gas in power generation. Major LNG importers in the Asian market are already expanding their existing import capacity. Although this growth in demand is driven by the liberalisation of the energy market especially in Japan, S. Korea and Taiwan, nevertheless, the need to ensure greater security of energy supply and the capital cost advantages of the Combined Cycle Gas Turbine (CCGT) technology made natural gas a preferred choice for energy. As an LNG supplier, Brunei Darussalam can expect greater competition, with the unlikely prospect that its current long-term contract with Japan and S. Korea will be renewed under a similar term period (or even at a similar volume and price), when they expire in 2013. This paper analyses the prospects of LNG from Brunei into the Asian market under a climate of fierce competition.

Keywords: Asian LNG Market, Demand and Supply, Brunei Darussalam.

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ABBREVIATIONS

APERC	Asia Pacific Energy Research Centre.
BLNG Ltd.	Brunei Liquefied Natural Gas Company Limited.
Bcm	Billion cubic metres.
BP	British Petroleum.
CCGT	Combines Cycle Gas Turbine.
c.i.f.	cost, insurance, freight.
CO2	Carbon dioxide.
eg.	Example.
EIA	Energy Information Administration.
EU	European Union.
GHG	Greenhouse Gas.
GSFMC	Gujarat State Fuel Management Company.
IEA	International Energy Agency.
IFP	Institut Francais du Pétrole.
LNG	Liquefied Natural Gas.
MMBtu	Million British thermal units.
Mtoe	Million Tonnes of Oil Equivalent.
Mtpy	Million tonnes Per Year
m^3	Cubic metres.
S. Korea	South Korea.
Tcf	Trillion cubic feet.
UK	United Kingdom.
US	United States of America.
vs.	versus.

1. INTRODUCTION.

Liquefied Natural Gas (LNG), now a mature industry, is experiencing economic changes upon the various cost elements within its *chain* from the days of its first commercialisation in 1964[1]. Technological advances have resulted in cost reductions in plant development and liquefaction process. As LNG transportation by sea have been proven safe, reliable and cost effective over greater distances, further advances are going ahead in the LNG vessel design for a more efficient propulsion system and greater capacity. The advent of technology has also enabled the development of LNG vessels with re-gasification capabilities.

In terms of trend and outlook, LNG trade in the Asian market region (Japan, S. Korea, China, India and Chinese Taipei (Taiwan)), is set for rapid growth over the next two decades, with growth predominantly driven by the utilisation of natural gas for power generation. Amongst the major LNG importer in the Asian market, there are already plans for expanding existing import capacity by building extra storage capacity and new LNG receiving terminals.

This growing demand is driven by de-regulation of the domestic energy market (especially in Japan, S. Korea and Taiwan). However, the preference for natural gas over other sources of energy (e.g., coal and oil) is mainly encouraged by the environmental advantages of utilising natural gas and the need to ensure greater security of energy supply by having a balanced energy mix. The advantages of power generation

[1] Although LNG was first shipped from Louisiana to the Canvey Island (UK) in 1954, it was only traded on a commercial scale in 1964 with LNG being shipped from Algeria to the UK. See Gill T., *Liquefied*

using Combined Cycle Gas Turbine (CCGT) technology, in terms of efficiency and capital costs, have also helped to enhance the attractiveness of natural gas.

On the supply side, the increasing supply capacity for LNG, both through new greenfield developments and the increase in capacity from established LNG plants have given rise to greater LNG supplies chasing a limited market. Fears are already looming that the industry would see fierce competition in the near term.

The emergence of diverse sources of LNG supply for the Asian markets has prompted the existing LNG buyers to put pressure on the "Asian Premium" that the Asian LNG buyers pay for their LNG imports.

The recent surge in the number of orders for new-built LNG vessels due to low shipbuilding price and financing costs has been forecasted to put further downward pressure on transportation costs and challenge the continued need to purchase LNG under long-term agreements (20-25 years). LNG buyers in Japan and S. Korea are already seeking shorter-term contract with more flexible "take-or-pay" volume in order to better reflect seasonal periods of downside in demand. This trend is expected to further enhance the growth of short-term trading in the LNG industry, which will lead to the eventual convergence of prices between the markets of the Pacific basin and the Atlantic basin, albeit only to a certain degree.

Natural Gas: A Primer, in Vol.19 No.8, Ocean Resources (October 2001), <http://www.ocean-resources.com/backissues/or-oct01/articles/7.asp> (last visited January 4, 2003).

1.1 Justification for the Paper.

This paper will focus on the Asian LNG markets not only because Japan, S. Korea and Taiwan are currently the only importers of LNG in the Asia pacific region (see map in Appendix 1), but also collectively they represent the largest importers of LNG in the world. At the same time, China and India represent emerging markets for LNG, forecasted with significant growth demand in the next two decades. Also, although Japan and S. Korea are the current markets for Brunei LNG, China, India, and Taiwan represent future sales opportunities.

Despite the fact that Brunei Darussalam's LNG exports are small by comparison to LNG exporters in the region (Indonesia, Malaysia and Australia), the author believes that as an LNG producer/exporter, Brunei Darussalam is not immune from the effects of recent developments, trends and outlook for the LNG industry. Issues relating to the prospect facing the LNG trade are of crucial importance not only because LNG is the leading revenue earner for the country, but it is also the country's main source of foreign exchange - critical to its national development and economic well being.

1.2 Methodology.

After presenting a brief overview of the LNG industry in Brunei, this paper will try to present the technological developments that had impacted the various elements within the LNG business chain, and also its cost implications upon the LNG industry as a whole. Factors that helped sway government policies in favour of natural gas as a source of energy will also be highlighted in terms of its impact on the Asian Markets' choice of energy mix and as driver for the LNG demand growth.

Recent developments, industry trends and market outlook by leading institutions, as well as views from researchers and industry players will also be assessed to build a picture of the current LNG industry. Finally, the impact of these issues on the future prospects of Brunei Darussalam's LNG industry will be determined.

2. BACKGROUND TO THE LNG INDUSTRY IN BRUNEI DARUSSALAM

Brunei Darussalam LNG project started in 1963, following the discovery of vast amount of gas reserves. Coldgas Trading Ltd. (currently known as Brunei LNG Ltd.[2]) was established in December 1969. Its principal activity is the liquefaction of natural gas for sale abroad[3], from its five liquefaction "trains",[4] each capable of processing 5 million m³ of gas per day. The first LNG cargo was delivered to Japan in 1972 under a 20-year contract[5]. The first LNG cargo to S. Korea was delivered in 1994, under a Short-Term Agreement with Korea Gas Corp.[6] In 1997, the country's LNG exports account for 6.5% of Japan's LNG imports (or 5.6 Million tonnes) and 11.2% of S. Korea's LNG imports (or 700,000 Tonnes). By 2000, sales volume was reported at 6.71 Million

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[2] Brunei Liquefied Natural Gas: The Next Leap, (1998); and Brunei Shell Petroleum Group of Companies, Media Information Kit: Brunei LNG (BLNG) & Brunei Shell Tankers (BST), (2000).

[3] Transportation to buyers is currently done by seven B-Class LNG vessels (75,000 m³ capacity each) one A-Class LNG vessel (135,000 m³ capacity). See Brunei Shell Petroleum Group of Companies *supra* note 2; and Brunei LNG Ltd., *Together for a Better Future* (company information leaflet), (2001).

[4] LNG (which is 100% methane) is produced by refrigerating feed gas down to –160°C (however, BLNG and BP have published it at –162°C and –161°C respectively) in a liquefaction process facility (a parallel module), usually referred to as "trains". See Platts Global Energy, *Platts Guide to LNG* , in Platts Global Energy website, <http://www.platts.com/business/geb_back_issues.shtml> (last visited December 20, 2002); Brunei LNG Ltd., *supra* note 2; and Knott, T., *Cool future for gas*, in issue 2, Frontiers: BP Magazine of technology and innovation, pp.10-16, (December 2001). For more technical description see Royal Dutch/Shell Group of Companies, The Petroleum Handbook (6th ed.), pp.535-538, (1983).

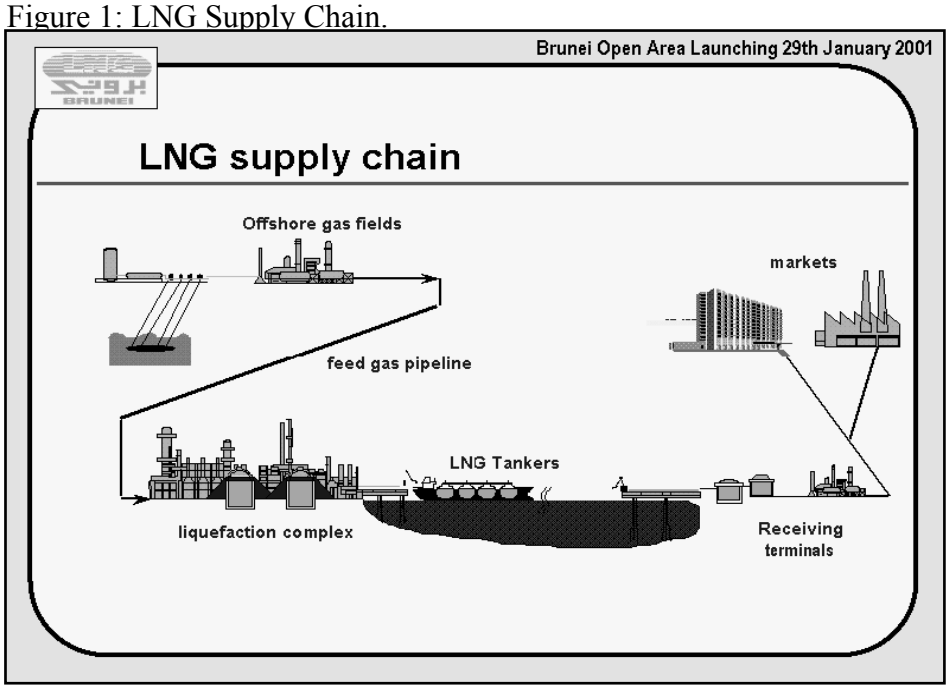
[5] This was later extended for another 20 years (1993-2013) April 1, 1993. See Brunei LNG Ltd., *supra* note 2.

tonnes per year (Mtpy)[7]. Today, it is the fourth largest LNG producer in the Asia Pacific region (after Indonesia, Malaysia and Australia) supplying to Japan, S. Korea, USA (Lake Charles), and Spain [8].

3. THE CHANGING ECONOMICS OF LNG CHAIN.

The LNG chain comprises of gas production, treatment, liquefaction, storage, loading, ocean transport, unloading, storage, re-gasification and transmission/distribution to end consumers.

Figure 1: LNG Supply Chain.



Source: BLNG Ltd., *Brunei LNG Master Plan*, a presentation at "Petroleum New Areas of Brunei Darussalam, Conference and Exhibition", Brunei Darussalam, January 29, 2001.

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[6] This was later replaced with a Long-Term Agreement signed in October 22, 1997(expiring in 2013) for LNG delivery of 700,000 tonnes per annum. See Brunei LNG Ltd., *supra* note 2.

[7] See Brunei Shell Petroleum Group of Companies, *supra* note 2. However, BP reported it at 8.79 Bcm (or 6.37 Million tonnes) and based on a BP conversion rate of 1 million tonnes LNG = 1.38 billion m³ of gas. See BP Plc., BP Statistical Review of World Energy, June 2001, p.28, (2001).

[8] Bushby, R.L., (ed.), International Petroleum Encyclopaedia 2002, p.167, (2002); and Garip, S., *BLNG Hails New Marts*, Borneo Bulletin, May 28, 2002, in National Chamber of Commerce & Industry Brunei Darussalam website, <http://www.nccibd.com/NewsArchive/2002/may/28/news12.html> (last visited December 20, 2002).

The costs of an LNG project require a substantial amount of investments in infrastructure facilities, e.g., liquefaction plant, harbour, loading facilities, tankers, and re-gasification terminal. Thus, they are usually several times larger than investment in field facilities. The cost of a "greenfield" LNG project (excluding field facilities), involving a 3 train liquefaction plant of 2 Mtpy capacity and tankers with 125,000 m³ storage capacity, was estimated at US$6 billion[9]. The liquefaction plant alone (with 2 trains of 5 Mtpy capacity) is estimated to require a capital cost of between 2-3 billion US$[10], with the "liquefaction process"[11] accounting for as much as 45% of plant production costs[12]. However, as the industry matures, the process becomes a routine resulting in companies reducing their "risk premiums" on LNG projects[13].

Additionally, technological advancements have also changed the economics of the various components within the LNG chain. On the upstream side of the LNG chain, advancements in LNG plant design coupled with breakthroughs in project management, has resulted in reduced production costs for LNG[14] and the trend is showing a reduction by as much as 50% (see figure 2). This trend of reducing capital costs, is set for even

[9]This estimated was based on 3 trains (of 2 Mtpy capacity each), tankers with 125,000 m³ storage capacity and a gas reserve commitment of 8 Trillion cubic feet (Tcf). See Jensen, J.T., *Gas Supplies for the World Market*, in The Changing World Petroleum Market, The Energy Journal (Special Issue), p.239, (1994).

[10] Gujarat State Fuel Management Co. (GSFMC), *LNG Industry*, in GSFMC website, <http://www.gujfuel.com> (last visited December 20, 2002).

[11]The three major LNG liquefaction technologies are, the '*Prico process*'; '*Propane Pre-cooled Multi-component Refrigeration (C3-MR) process*'; and '*Optimised Cascade process*'. Amongst them, the C3-MR process is the most widely used. See Knott, T., *supra* note 4.

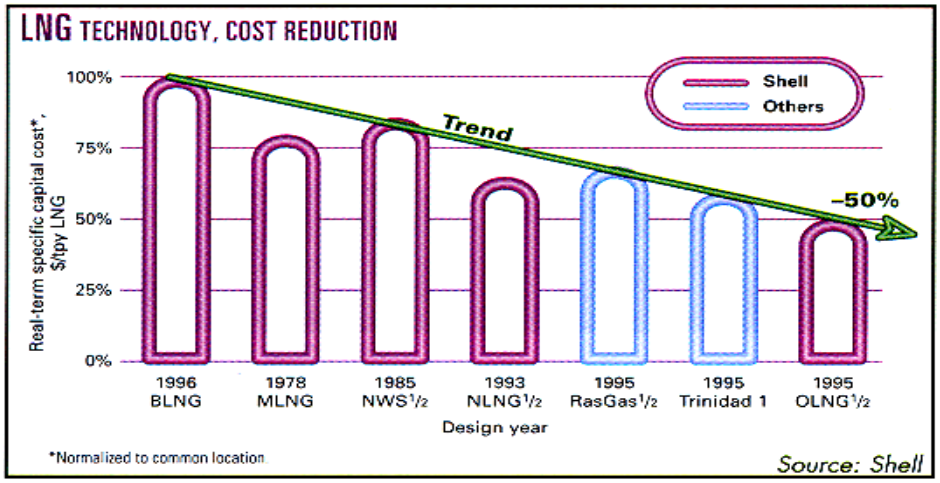
[12]See Knott, T., *supra* note 4.

[13]Jensen, J.T., (Jensen Associates, Inc.), *The Natural Gas Challenge to Oil's Stationary Energy Markets*, a presentation to the Centre for Global Energy Studies and Oil & Gas Journal Joint Conference, "Oil Price Challenges into the New Century", Houston, USA, September 9, 1999.

[14]In 1999. the production cost for Trinidad's Atlantic LNG plant (3.2 Mtpy capacity) was $235/tonne. In 2000, the Oman LNG plant (4.8 Mtpy capacity) claimed an even lower production cost of $200/tonne. See Thackeray, F., *New technologies cut costs*, in, Petroleum Economist, pp.18-19, (September 2001).

further reduction when current studies in *developing new liquefaction technologies and floating liquefaction plants* are successful[15].

Figure 2: LNG Technology, Cost Reduction Trend.



Source: Shell, published in Bushby, R.L., International Petroleum Encyclopaedia 2002, p.187, (2002).

Due to the fact that LNG projects require dedicated facilities at both ends of the chain, supply of LNG have been referred to as "project supply"[16]. Although the function of an LNG vessel can be said to be "akin" to a gas pipeline (see figure 3), however their costs implications are significantly different. The cost of transporting LNG can easily make up to 40% of the delivered cost of LNG supplied within the chain[17].

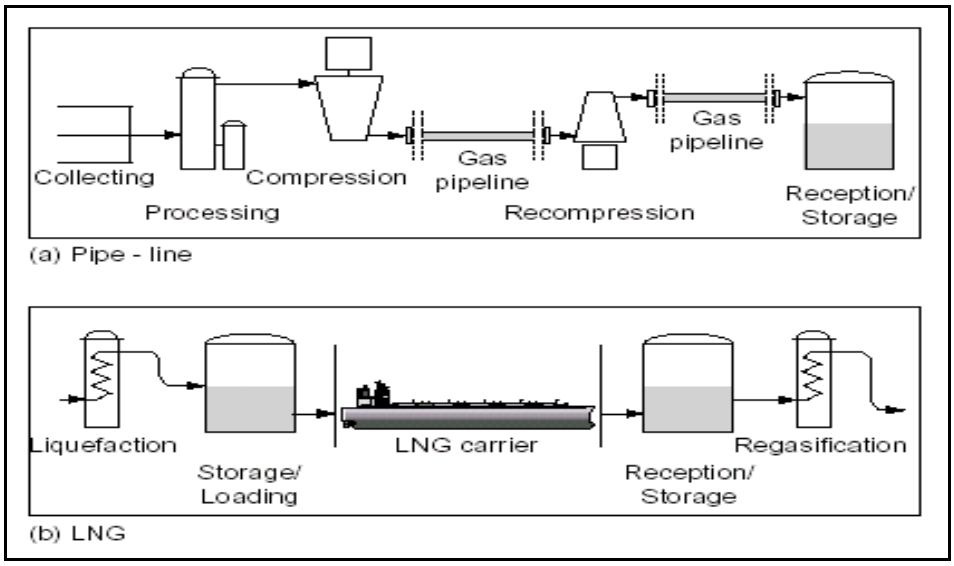
Also, due to the initial heavy investment already made in the development of the liquefaction/export facilities and import/re-gasification facilities (which are not distance

[15]BP Plc. is currently involved in the development of the "Liquefin Process" which it believes will further reduce the capital costs of LNG plant by 25% and enhancing output capacity from a single train to 6Mtpy. See Knott, T., *supra* note 4. Also, Shell (together with Woodside Petroleum, ConocoPhillips and Osaka Gas) is currently developing a floating LNG plant (with production, storage and offloading facility) for the Greater Sunrise Project in the Timor Sea, which is expected to reduce the development costs for the Project by as much as 40%. See Bedford, T., *Shell's floating LNG plant*, in Special Feature, Oil and Gas International website, (August 22, 2001), <http://www.oilandgasinternational.com/departments/special_features/shell.html> (last visited December 20, 2002).

[16]"*Project supply*" has been defined as a supply chain that "*integrate the…LNG transportation facilities with the investment in wells and field facilities in order to be able to market the gas*", See Jensen, J.T., *supra* note 9, at p.240.

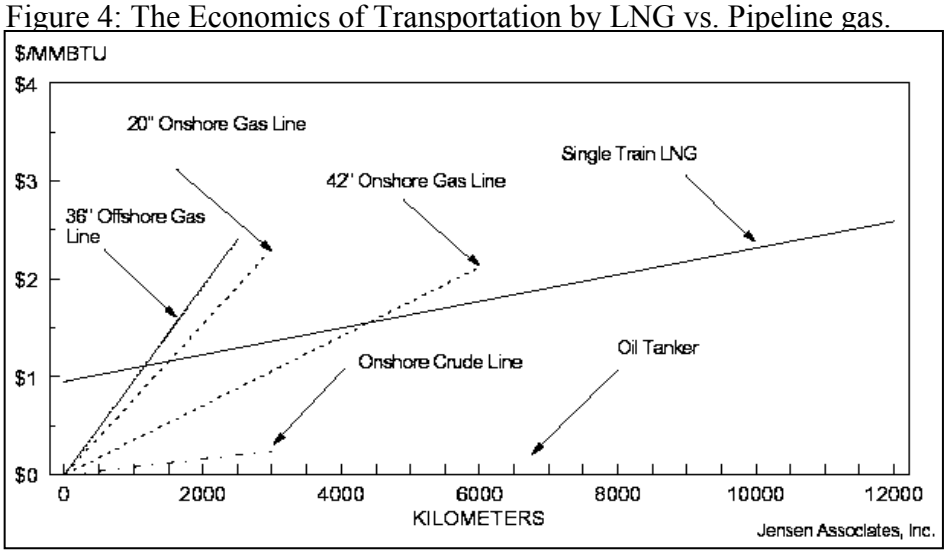
related), LNG transportation is only cost effective over long distances due to economies of scale[18] (see figure 4). As such, matters of vessel capacity and the number of ships required for a contract delivery are relevant. This brings us to the issue of the LNG vessel design.

Figure 3: Schematic comparison between LNG Carrier & Gas Pipeline.



Source: IFP, (published in Rojey, A., *Natural Gas Fundamentals*, Institut Francais du Pétrole, (September 25, 2002), in Cedigaz website, <http://www.cedigaz.org> (last visited December 20, 2002).

Figure 4: The Economics of Transportation by LNG vs. Pipeline gas.



Source: Jensen Associates, Inc., *The Growing Competition between Pipelines and LNG for Gas Markets*, presented to Gastech 2000, Houston, November 16, 2000.

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[17]See Townsend, D., *A tale of two markets*, in Petroleum Economist, pp.16-18, (November 2002).
[18]See Jensen, J.T., *supra* note 9, at p.247.

Apart from its specialised nature, which already has a significant impact on costs,[19] other aspects of its design can also influence the final cost of the LNG supplied. This is due to the impact the vessel designs have on the number of vessels required to meet a particular contract-volume delivery, and the number of days needed to complete a single round trip[20].

Here, advances in technology have also benefited the LNG supply chain, both in terms of improved propulsion system and greater capacity. In 2001, LNG vessels' capacity ranges from 18,000m³ to over 100,000m³ (see table 1); and there are expectations within the industry that this capacity could even exceed 200,000m³ in the near future. The LNG ship building industry is also anticipating future increase in the use of diesel-electric propulsion system (and a reduction in steam-turbines) for LNG vessels, which could further enhance efficiency and reduce fuel costs[21].

Table 1: World LNG vessel fleet capacity, end 2001.

Capacity (m³)	No. of Vessels
18,000 – 50,000	16
51,000 – 1000,000	15
> 100,000	97

Source: Barry Rogliano Salles (Shipbrokers), published in Townsend, D., *A tale of two markets*, in Petroleum Economist, p.16, (November 2002).

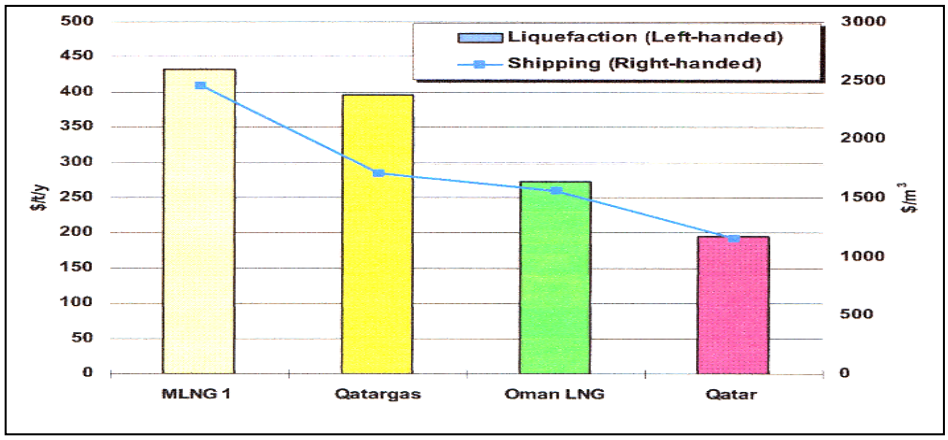
[19]A new-built LNG carrier vessel typically costs around $200 million, or 3 times the cost of a crude oil carrier of similar capacity. This high cost is due to the double hull design of the vessel and the specialised cryogenic containment system necessary to transport the LNG. See GSFMC, *supra* note 10; and *Platts Guide to LNG, supra* note 4.

[20]An LNG tanker travelling 20 knots at a distance of 3,000 nautical miles (eg. Australia-Japan), takes 17 to make a round trip (including port time). Thus, delivering 21 cargoes per year. If the LNG plant is 7,000 nautical miles away (eg. Middle East-Japan), then a round trip would take 35 days and more vessels are required to deliver a particular contract volume. See GSFMC, *supra* note 10.

[21]See Townsend, D., *supra* note 17.

The costs reducing implications of all these developments are evident from the resulting 50% reduction in liquefaction costs (from over $400/tonne to $200/tonne) and also a 50% reduction in shipping cost (from over $2,500/m³ to less than $1,250/m³). Additionally, the current *low shipbuilding price and financing costs* for new-built LNG vessels[22], which have resulted in increased orders for new-built vessels, can result in a further reduction in LNG shipping costs in the near future.

Figure 5: Cost reduction trend in LNG liquefaction and shipping.



Source: Poten & Partners, Inc., published in APERC, APEC Energy Demand and Supply Outlook 2002, p.68, (2002).

At the receiving (downstream) end of the LNG chain, the advent of technology also enables the development of LNG vessels with re-gasification capabilities for the delivery of LNG to the market without the need for an onshore re-gasification terminal[23]. This allows future capital investments in fixed infrastructure facilities to be greatly reduced, providing possibilities for future expansion of the LNG markets.

[22]See Townsend, D., *supra* note 17.

4. LNG TRENDS AND OUTLOOK

4.1 Promising Growth in Demand.

Although natural gas consumption in Japan, S. Korea and Taiwan are driven by the need to diversify their energy mix (due to concerns over security of energy supply), it is the concerns over global warming and climate change, that has helped make natural gas a preferred choice of fuel for power generation.

The capital costs advantages (both in terms of high output efficiency and low maintenance costs) of adopting combined cycle gas turbine (CCGT) technologies, also helped to encourage the use of natural gas for electricity generation (especially in China and India), over more traditional sources, such as, coal[24].

These factors would boost the previously gradual growth trend for natural gas (see figure 6). In fact, The Energy Information Administration had forecasted the use of natural gas to nearly double from 84 Tcf (or 2,352 Bcm) in 1999 to 162 Tcf (or 4,536 Bcm) in 2020[25], with Asia[26] leading in terms of growth increments (see figure 7).

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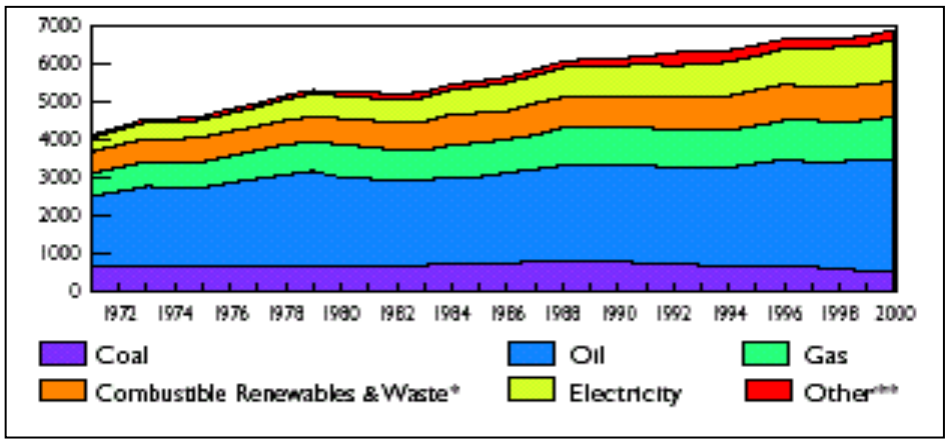
[23] This "*EnergyBridge*" concept involves an LNG carrier with onboard re-gasification capability and pumping the re-gasified LNG to shore through dedicated offshore buoys. Orders have already been placed for 3 of such vessels. See Townsend, D., *supra* note 17.

[24] The Emirates Center for Strategic Studies and Research, The Future of Natural Gas in the World Energy Market, pp.1-8, (2001); and Bamber, D., *Gas closes in on coal*, in Petroleum Economist, pp.8-10, (September 2002).

[25] The Energy Information Administration (EIA), International Energy Outlook 2002, pp.43-44, (March 2002).

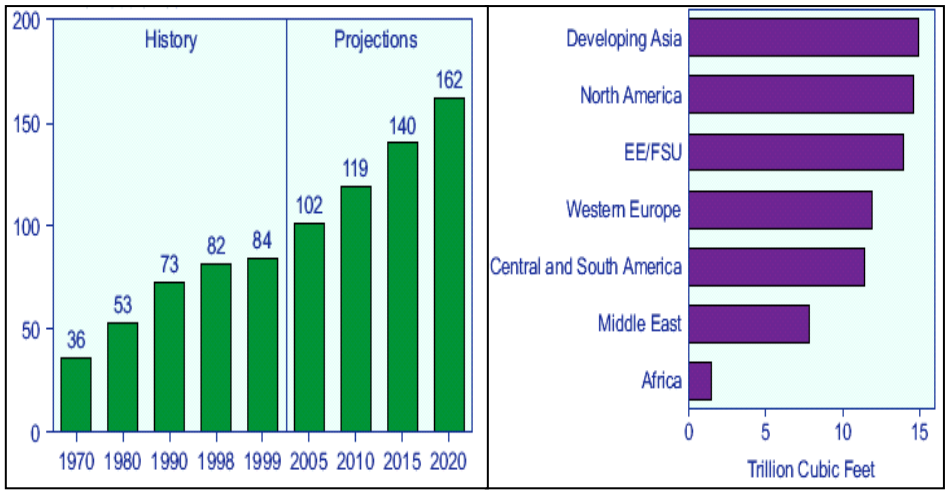
[26] The EIA defines "developing Asia" as including China, India, Taiwan and S. Korea, but excludes Japan. See EIA, *supra* note 25, at p. *x*.

Figure 6: Evolution of World Total Final Consumption by Fuel, 1971-2000, (Mtoe).



Source: IEA, Key World Energy Statistics 2002, p28, (2002).

Figure 7: World Natural Gas Consumption: Growth Projections, 2005-2020 & Regional Increments.

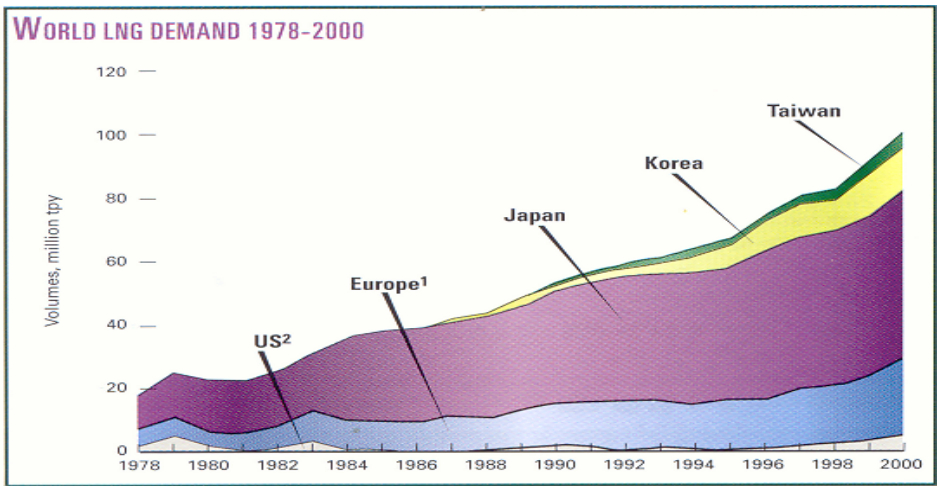


Source: EIA, International Energy Outlook 2002, pp.43 & 44, (March 2002).

LNG, as a mode of transporting gas, competes with Pipeline gas in terms of demand for gas. But the problems associated with Pipeline gas, (in terms of its low cost effectiveness over long distances and the geopolitical problems associated with Pipeline gas crossing international boundaries) [27] has ensured LNG's attractiveness as a preferred means of importing natural gas in Japan, S. Korea and Taiwan. This had resulted in the

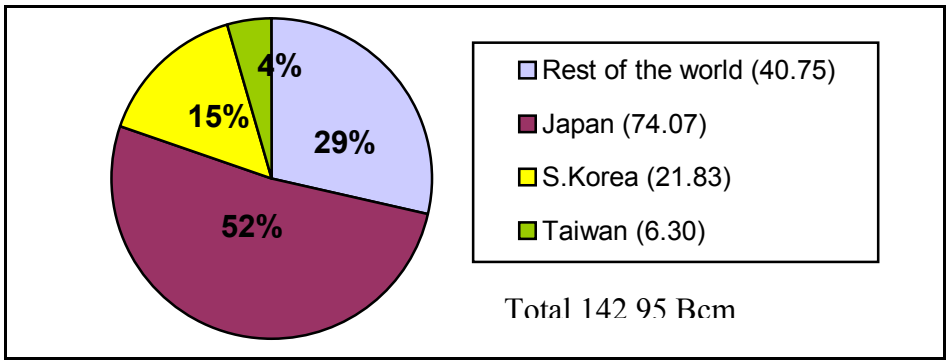
growing volume of imported LNG by Japan, S. Korea and Taiwan since the 1980s (see figure 8), and by 2001, imports from these countries already make up 102.20 Bcm (or more than 70%) of world total LNG trade volume[28] (see figure 9).

Figure 8: World Demand for LNG, 1978-2000, (Mtpy).



Source: Shell, published in Bushby, R.L., International Petroleum Encyclopaedia 2002, p.188, (2002).

Figure 9: World Total LNG Trade Volume vs. Asia Pacific Imports, 2001, (Bcm).



Source: Cedigaz, data published in BP Plc., BP Statistical Review of World Energy, June 2002, p.28, (2002).

[27]Jensen, J.T., (Jensen Associates, Inc.), *The Growing Competition between Pipelines and LNG for Gas Markets*, a presentation to "GASTECH 2000", Houston, USA, November 16, 2000.
[28]BP Plc., BP Statistical Review of World Energy, June 2002, at p.28, (2002).

Despite its increase in total trade volume[29], the LNG growth rate is slowing down from 9% (1999-2000), to 4% (2000-2001) and for 2002, lower import volume by Japan is bringing world LNG *trade volume* down to almost 10%, with total LNG trade volume amounting to 129 Bcm[30]. Nevertheless, due to Japan's commitment under the Kyoto Protocol[31], natural gas will still be the preferred choice in the country's energy mix[32]. And LNG imports, which accounts for 96.7% of all natural gas consumed in the country in 2000 (by electric power utilities, city gas utilities and as industrial fuels), will still play a dominant role in satisfying the country's demand for gas[33].

Although pipeline gas (namely the Sakhalin gas pipeline) is expected to become a strong competitor to LNG in Japan[34], estimates have shown that the cost of transportation will not be competitive with LNG in the near term, and therefore, LNG is still expected to meet most of Japan's future gas demand[35] (see figure 10). And with a forecasted annual average growth of 2% per annum until 2020[36], there are already plans

[29]Global LNG trade volume increased from 124.42 Bcm in 1999 to 142.95 Bcm in 2001. See Cedigaz, Natural Gas in the World: 2000, (electronic version), (2000), <http://www.cedigaz.org> (last visited January 4, 2003); and BP Plc., *supra* note 28, at p.28.

[30]This decrease (the first time in nine years) is attributed to the economic problems in Japan. See Thackeray, F., *LNG looks good-for some*, in Petroleum Review, pp.27-28, (November 2002).

[31]Japan ratified the Kyoto Protocol in June 4,2002 with commitments to reduce its CO2 emissions by 6% to below its 1990 level, during the period 2008-2012. See International Energy Agency (IEA), World Energy Outlook 2002, p.205, (2002).

[32]Hayes, D., *Japan to increase energy imports*, in Petroleum Review, pp.14-15, (November 2002).

[33]Wybrew-Bond, I., and Stern, J., (eds.), Natural Gas in Asia: The Challenges of Growth in China, India, Japan and Korea, pp.106-187, (2002); and Kato, K., *A Perspective of the LNG Market in Japan*, Japan Energy Research Centre, in Vol.12 No.3, Hydrocarbon Asia, pp.26-33, (April 2002), <http://www.hcasia.safan.com/mag/hapril02/r26.pdf> (last visited January 6, 2003).

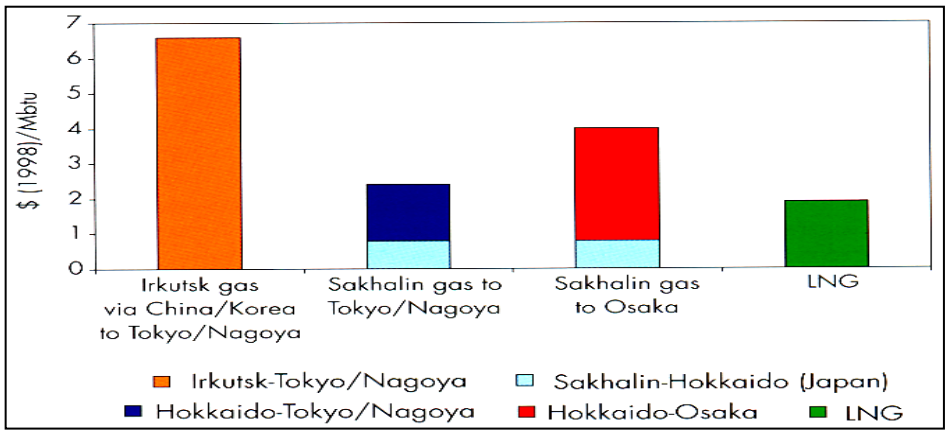
[34]See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.176.

[35]See IEA, *supra* note 31, at pp.213-215.

[36]Asia Pacific Energy Research Centre (APERC), APEC Energy Demand and Supply Outlook 2002, p.166, (2002).

to expand existing import capacity[37], (see Appendix 2 for list of existing and planned LNG terminals in the Asian market).

Figure 10: Indicative Pipeline and LNG Transportation Costs to Japan.



Source: IEA, World Energy Outlook 2002, p.215, (2002).

In contrast to Japan, S. Korea (the world's second largest importer of LNG[38]), which already has a nationwide gas transmission system[39], is forecasted to increase its gas demand from a previous growth rate of 10% (for the past fifteen years up to 2000), to a growth rate of 15% by 2020[40]. And since its natural gas demand is currently met entirely by LNG, the S. Korean government had projected the country's LNG demand

[37]Japan is currently building new LNG storage tanks to add 3.8 million m³ to existing capacity by 2006. Also, 6 new LNG receiving terminals are already at construction or planning stages. See APERC, *supra* note 36, at p.66; and Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.165.

[38]See IEA, *supra* note 31, at p.220.

[39]Unlike Japan (where gas demand growth is driven by power generation), S. Korea is in a better position to rapidly expand its natural gas demand through city gas consumption, due to its earlier investment in a national distribution network linking several major cities. See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.229; and Manning, R.,A., The Asian Energy Factor: Myths and Dilemmas of Energy Security, and the Pacific Future, p.164, (2000).

[40]See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at 307-308. However, the IEA forecasted S. Korea's primary gas demand to grow 4.4% per year from 19.6 Bcm in 2000 to 70.2 Bcm in 2030. See IEA, *supra* note 31, at p.229.

to reach 21 Mtpy by 2010, thus increasing LNG's share in the country's energy mix from 9.8% in 1999 to 12.1% in 2010[41].

Meanwhile, in Taiwan, natural gas consumption has been forecasted to grow at an annual average rate of 4.4% until 2020[42] and since it is also dependent on LNG imports for its gas supply, LNG consumption is expected to increase to 7 Mtpy by 2005 and to 10.8 Mtpy by 2010[43].

Thus, in order to meet with their respective projected increase in demand for natural gas, both S. Korea and Taiwan have also plans to expand the capacity of their existing import/re-gasification terminals and for the development of new ones[44].

The need for gas in power generation has also resulted in forecasted growth of natural gas consumption both in China and India[45]. However, issues relating to domestic gas pricing and infrastructure have created constraints in gas demand growth and uncertainties as to its outlook[46]. Further uncertainties concerning the ability to raise

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[41]Park, E-S., Kim, H-S., and Hong, S-B, *Overview on the Korean LNG industry: present and future*, in Vol.12 No.2, Hydrocarbon Asia, pp.35-39, (March 2002), <http://www.hcasia.safan.com/mag/hcmar02/r35.pdf> (last visited December 20, 2002). The Petroleum Economist however, reported a forecasted demand of 25 Mtpy by 2010 with an annual average growth of 5%. See Thackeray, F., *Competition steps up a gear*, in Petroleum Economist, pp.14-15, (September 2002).

[42]See APERC, *supra* note 36, at pp.223-224.

[43]See Bushby, R.L., *supra* note 8, at p.182.

[44]Korea planned to expand to add 3.7 million m³ additional capacity to its existing LNG import/re-gasification terminals by 2010. A new LNG terminal of 1.7 Mtpy, is also expected to be completed by March 2005. Plans for capacity expansion and development of a new LNG terminal are also underway in Taiwan. See APERC, *supra* note 36, at p.66; Bushby, R.L., *supra* note 8, at p.182-183; and Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.192.

[45]China's consumption of natural gas was forecasted to increase fivefold reaching 162 Bcm by 2030. India's consumption of natural gas was forecasted to reach 97 Bcm by 2030, grow at an average rate of 5.1%. See IEA, *supra* note 31, at pp. 255-256 & 293-295.

[46]Mitchell, J., *et al*., The New Economy of Oil: Impacts on Business, Geopolitics and Society, p.106, (2001) and Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.310-311.

funding for proposed new LNG terminals and the potential competition from Pipeline gas, has resulted in an equally uncertain demand growth for LNG[47].

Nevertheless, growth in LNG imports for the near term (5-10 years) is expected to soar significantly in the Asian markets (with demand ranging from 82.9-101.6 Mtpy by 2005, and 100.2-141.5 Mtpy by 2010) with S. Korea and India contributing to the greatest growth[48]. Thus, the demand outlook for LNG in the near term seems promising.

Table 2: Forecasted LNG demand in the Asian market, 2005-2010, (Mtpy).

Country	2005			2010		
	Low	Base	High	Low	Base	High
Japan	55.0	55.9	60.2	56.5	60.9	66.7
S. Korea	16.9	18.2	19.9	18.2	25.7	27.7
Taiwan	6.0	7.0	8.0	9.5	10.8	13.5
India	5.0	7.5	10.5	13.0	18.0	25.6
China	0.0	0.0	3.0	3.0	5.0	8.0
Total	82.9	88.6	101.6	100.2	120.4	141.5

Source: Facts Inc., published in Bushby, R.L., International Petroleum Encyclopaedia 2002, p.188, (2002).

4.2 Excess Supply Capacity.

In anticipation of an increased demand by 2005 and 2010, existing LNG exporters are already planning to expand their capacity (see Appendix 3). And if all the announced schedules for expansion and planned new developments are met, world liquefaction and

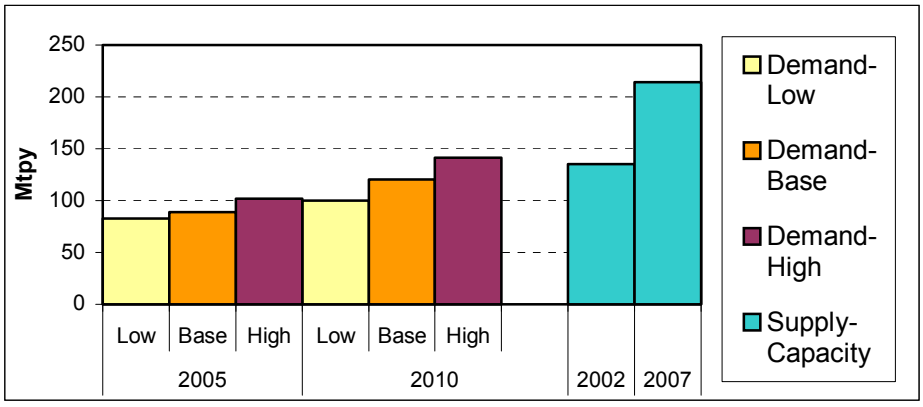
[47]See IEA, *supra* note 31, at pp.256-257 & 295; Mitchell, J., Morita, K., Selley, N., and Stern, J., *supra* note 46, at p.90; Andrews-Speed, P., *The challenges facing China's LNG industry*, in Vol.8 Art.11, On-line Journal, CEPMLP website, (April 18, 2001), <http://www.dundee.ac.uk/cepmlp/journal/html/article_8-11.html> (last visited January 6, 2003); and Sunder, S., Ahuja, M.M., and Gautier, J., *India ensures adequate availability of natural gas*, in Vol.12 No.8, Hydrocarbon Asia, pp.12-20, (November/December 2002), <http://www.hcasia.safan.com/mag/hnov02/r12.pdf> (last visited January 6, 2003).

[48]See Bushby, R.L. *supra* note 8, at p.188. Earlier, the Petroleum Economist had published a forecast of 85.4 Mtpy to 102.2 Mtpy by 2005, and 97.2 Mtpy to 133.4 Mtpy by 2010 from the same source. See Townsend, D., *Asia fuels demand growth*, in Petroleum Economist, pp.37-38, (July 2001).

export capacity will further increase by approximately 79 Mtpy, to a total of around 214 Mtpy by the end of 2007 (compared with 135 Mtpy at the end of 2002)[49].

This, almost 60% increase of potential world export, is far beyond the total forecasted demand for the Asian market during the periods of 2005-2010 (even at a high-case scenario), (see Figure 11). And with demand currently not rising in line with forecasts, there are already fears that the LNG business could be facing tough times ahead, with surplus supplies and stiff competition[50].

Figure 11: Demand Growth, 2005-2010 vs. Supply Growth, 2002-2007, (Mtpy).



Source: Compiled by the Author.
Data Source: Facts Inc., Facts Inc., (published in Bushby, R.L., International Petroleum Encyclopaedia 2002, p.188, (2002)); and Thackeray, F., *Surplus supply, fierce competition*, in Petroleum Economist, pp.12-14, (November 2002).

4.3 Downward Pressure on Price.

Expectations of impending fierce competition, resulting from *abundant supply chasing limited markets, and the liberalisation of the energy markets* are putting pressure on the

[49]Thackeray, F., *Surplus supply, fierce competition*, in Petroleum Economist, pp.12-14, (November 2002). Cedigaz however reported the existing world liquefaction capacity at 124.4 Mtpy, with additional 46-50 Mtpy coming from LNG projects under construction/planned and a further addition of 138-159 Mtpy from potential projects. See Chabrelie, M.F., (Cedigaz), *Prospects for Growth of the Gas Industry: Trends and Challenges*, a presentation to OAPEC-IFP Joint Seminar "The Future of Gas", Rueil Malmaison, June 25-27, 2002.

"*Asian Premium*" that is associated with the higher import price of LNG in Japan and S. Korea[51].

LNG price is also facing downward pressure from greater competition between energy suppliers of the Asian markets (especially in Japan, S. Korea and Taiwan), brought about by the liberalisation of their respective domestic energy markets[52].

Although, arguably the markets in the Pacific Basin and the Atlantic Basin are separate from each other, thus making the principle of "one-price-for-one commodity" inapplicable, lower LNG prices are essential if the industry is to compete against coal in a price competitive de-regularised energy market[53]. Therefore, as surplus capacity in the LNG supply market is transforming the LNG trade into a buyer's market[54], buyers in Japan and S. Korea are seeking lower prices. Achievements have already been made by both Japan and S. Korea in getting their LNG suppliers to agree to the *removal of "price floor"* from their LNG supply contracts[55].

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[50]See Thackeray, F., *supra* note 49.

[51]Japan's LNG c.i.f. price (which is linked to Japan's crude oil import price) is higher than prices of gas in North America and Europe by approximately US$1/MMBtu. However, amongst the major LNG importers, S. Korea pay an even higher LNG price than Japan (reaching above US$5/MMBtu for the years 1990 and 1992-1996). See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.153-155 and 215-216; and Fujime, K., *LNG Market and price Formation in East Asia*, in The Institute of Energy Economics Japan website, (April 2002) <http://eneken.ieej.or.jp/en/data/pdf/127.pdf> (last visited January 4, 2003).

[52]See Mitchell, J., *et al*., *supra* note 46, at p.103.

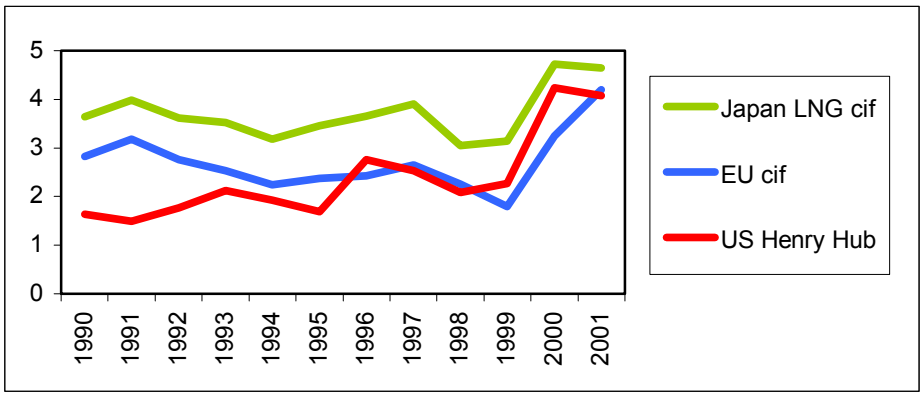
[53]The Japan LNG c.i.f. (2000) price is more than the import price for steaming coal by approx. $25/ton steaming coal equivalent. See Fujime, K., *supra* note 51.

[54]The current Japan LNG c.i.f. pricing formula (LNG price=Constant x Reference crude oil price + Adjusting term) was regarded as favouring the LNG producers. See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.130; and Fujime, K., *supra* note 51. However, competition in the industry are changing prices and contract terms in favour of buyers. See Gulf News Online, (organisation), *North East Asian LNG imports may rise 18% by 2005*, Gulf News Online, August 28, 2002, in Vol.7 No.18, Alexander's Gas & Oil Connections website, (September 19, 2002), <http://www.gasandoil.com/goc/history/welcome.html> (last visited December 20, 2002).

[55]Both Japan and S. Korea have managed to get their supplier in Qatar (RasGas) to agree to remove "price floor" from their LNG supply contract. See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at pp.200-2001; and Petroleum Economist, (organisation), *Rapid growth possible*, (summarising a report,

However, in terms of its comparability with gas prices in the Atlantic basin market, LNG prices in the Asia Pacific basin will still remain higher than the gas price in USA and EU[56]. However, the International Energy Agency recently projected that the increasing short-term trading in LNG will allow for arbitrage between the regional LNG markets of the world (North America, Europe and Asia Pacific), thus causing prices between them to "converge to some degree over the next three decades"[57].

Figure 12: Japan LNG Price vs. EU & US Gas Prices, 1990-2001, ($/MMBtu).



Source: Compiled by the Author.
Data Source: BP Plc., BP Statistical Review of World Energy, June 2002 p.29, (2002).

4.4 Shorter Contract Term and Flexible Take-or-Pay Volume.

In addition to the already ample availability of LNG supply and the opening-up for competition in the Asian domestic energy market, increased capacity and the recent 14% rise in number of LNG vessels in the market[58] can also place downward pressure

LNG Enters New Phase of Powerful Expansion, by Thackeray, F.), in Petroleum Economist, p.19, (January 2002).

[56] As long as Japan LNG c.i.f. price is linked to the price of imported crude oil, it will remain higher than the gas price in the Atlantic basin. See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.171.

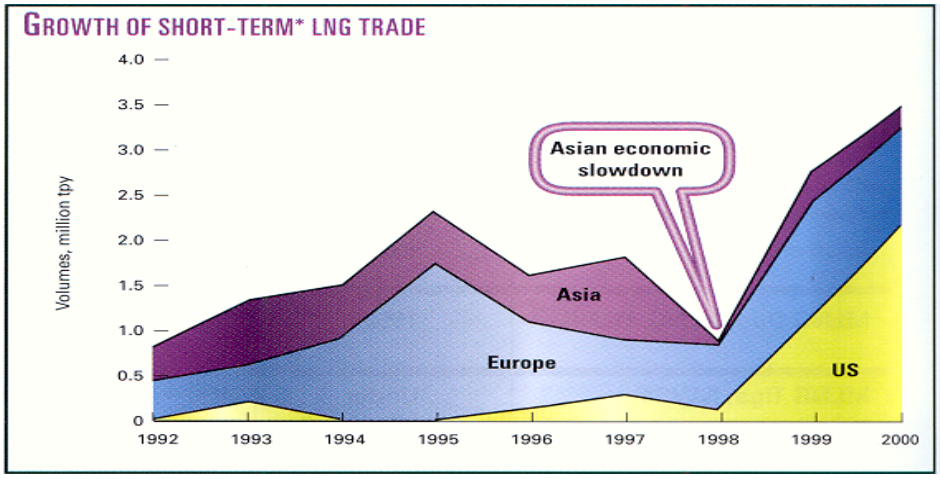
[57] See IEA, *supra* note 31, at pp.50-51.

[58] Shipping capacity can increase due to increased vessel capacity (through improvements in ship design), increased in the number of LNG vessels, optimisation of supply routes (by swapping cargoes), or even the failure to extend expiring contracts. Currently, there are 146 LNG vessels in operation (current fleet 137 + 9 new deliveries in 2002), compared to 128 at end of 2001. There are also 56 book orders and 12 new orders made in 2002. See Townsend, D., *supra* note 17; Thomas, V., *There will be too much LNG*

on the continued need for LNG to be supplied under the traditional long-term contract period and with fixed take-or-pay volumes, (typically associated with LNG supply contracts)[59]. Traditional LNG buyers (Japan and S. Korea) are already trying to negotiate more flexible supply volume under shorter contract period[60].

This development can further encourage the growth of short-term LNG trading in the region. Thus, despite its abrupt decline in 1999[61], short-term LNG trading in Asia has been projected to enjoy continued growth. This is due to the excess supply and shipping capacity, which will help satisfy the projected increase in demand for LNG under short-term trade[62] and solve the current shortage in LNG vessels to service them[63].

Figure 13: Growth of Short-Term LNG Trade, 1992-2000, (Mtpy).



Source: Shell, published in Bushby, R.L., International Petroleum Encyclopaedia 2002, p.188, (2002).

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about, in Petroleum Economist, pp.35-36, (May 2000); and LNG OneWorld website <http://www.lngoneworld.com/lngv1.nsf/portal/index.html> (last visited December 11, 2002).

[59] The traditional long-term contract period and fixed take-or-pay volumes associated with LNG supply contracts are due to the traditional basis for obtaining financings for LNG import infrastructures. See Mitchell, J., *et al*., *supra* note 46, at p.259.

[60] See Thomas, V., *supra* note 58; and Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.127.

[61] Short-term LNG trading in Asia, experienced a sudden decline in Asia in 1999 due to the Asian economic slowdown. See Bushby, R.L., *supra* note 8, at p.188.

[62] According to the IEA, as competition weakens the need for LNG supplies under long-term arrangements, the expiry of several long-term agreements over the next few years will give LNG buyers in Japan demand lower prices in new contracts and to seek cheaper spot supplies. See IEA, *supra* note 31, at pp.51 & 205

[63] See Townsend, D., *supra* note 17. The APERC reported that by 2005, between 27-44 ships will be looking for employment. See APERC, *supra* note 36, at p.66.

However, short-term LNG trade has been forecasted to never reaching more than 15-20% of the total LNG trade volume, and that most deals will still being done under "traditional lines"[64].

Although it has been said that cargo or spot trading (corresponding to the spot trade in US and Europe) will develop as the LNG trade in Asia expands and more suppliers and buyers are brought into the industry,[65] however, despite continuing to flourish on an ad hoc basis, it is doubtful that the short-term LNG trade will develop into a spot market. Instead, the long-term market and the short-term market will co-exist within the LNG trade industry. This is because LNG suppliers in the Asia pacific region are unlikely to voluntarily destroy the current long-term pricing arrangement under which they have secured a reliable and predictable profit stream, and also the LNG vessels will prefer to book capacity in advance in order to hedge against price fluctuations[66].

5. CONCLUSION

Recently, BLNG announced its "Master Plan" which involves:

a. Expansion of its production capacity with a 6th train, adding another 4 Mtpy to its existing 7.2 Mtpy capacity by 2008;

b. Rejuvenation of its LNG plant in order to extend its operating life for another 20 years to 2033, when its existing contract expires in 2013; and

[64]See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.171; and Thomas, V., *The way ahead for LNG*, in Petroleum Economist, pp.9-11, (January 2001).
[65]See Mitchell, J., *et al*., *supra* note 46, at p.88.
[66]See Wybrew-Bond, I., and Stern, J., (eds.), *supra* note 33, at p.171; and Townsend, D., *supra* note 17.

c. Replacing its fleet of existing 7 B-Class LNG vessels (of 75,000 m³ capacity each) with 6 new A-Class vessels (of 135,000 m³ capacity each)[67].

On the basis of the earlier findings, especially with regard to the Asian market in particular, Brunei Darussalam can expect greater competition stemming from existing LNG suppliers within the Asia Pacific region, as well as from the suppliers in the Middle Eastern region. With abundant supplies now chasing limited markets (albeit a growing one), and buyers (especially Japan and S. Korea) already seeking shorter contract terms with greater flexibility in take-or-pay volume, it is unlikely that Brunei Darussalam will achieve a contract extension of similar term period (or even of similar volume and price), when both of its contracts with Japan and S. Korea expire in 2013.

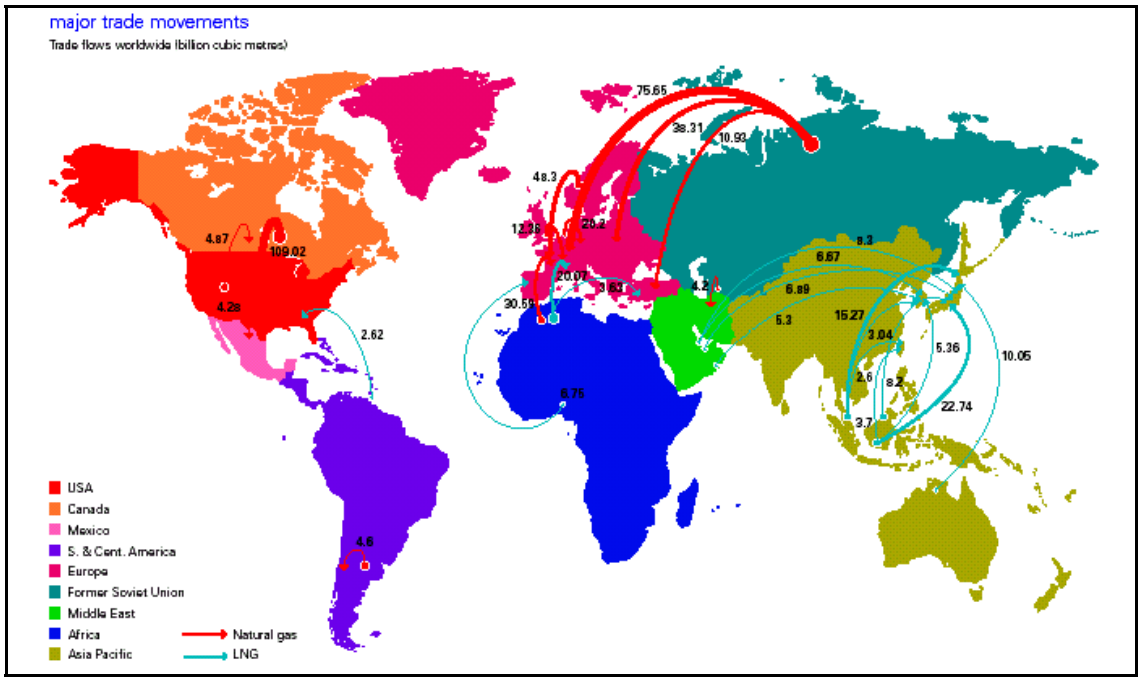
Also, since buyers are currently seeking lower prices for their LNG imports, this should give a clear indication of the need to have due regard to the issue of price reduction. Since this should be considered together with the need to secure sufficient returns on its investments, efforts towards further cost reductions within its LNG chain will be a significant factor to focus on. This is crucial, not only to ensure continuing sales to its current buyers, but also in order to have a competitive chance for new sales opportunities in Taiwan and the emerging LNG markets of China and India.

The growing short-term market for LNG is undoubtedly promising, and Brunei Darussalam should strive to have a mixed portfolio of short and long-term sales if it

[67]Wahab, H.H.A., (Brunei LNG Ltd.), B*runei LNG Masterplan*, a presentation to "Petroleum New Areas of Brunei Darussalam, Conference and Exhibition", B.S. Begawan, Brunei Darussalam, January 29, 2001.

were to sustain its current level of LNG sales and to ensure further sales for its extra capacity planned in 2008.

Appendix 1: Major Global Gas & LNG Movements, 2001 (Bcm).



Source: BP Plc., BP Statistical Review of World Energy, June 2002, p.29, (2002).

Appendix 2: LNG Terminals in the Asian Market, (Existing, Planned & Proposed).

Japan

A. Existing LNG Terminals.

1.	Chita	13.	Midorihama
2.	Chita LNG Joint	14.	Negishi
3.	Fukuoka	15.	Ohgishima
4.	Futtsu	16.	Senboku I
5.	Hatsukaichi	17.	Senboku II
6.	Higashi-Niigata	18.	Shin-Minato
7.	Higashi-Ohgishima	19.	Shin-Oita
8.	Himeji I	20.	Sodegaura
9.	Himeji II	21.	Sodeshi/Shimizu
10.	Kagoshima	22.	Yanai
11.	Kawagoe	23.	Yokkaichi LNG
12.	Kitakyushu	24.	Yokkaichi Works

B. New & Future LNG Terminals.

New Terminals planned for 2002	
1. Chita-Midorihama 2. Nagasaki	
Planned/Under Construction	Expected start-up date
1. Wakayama 2. Jouetsu, Aomori Perfecture	2005-2006 2007
FutureProjects/Proposal	
1. Mizushima 2. Sakai	3. Tsugura

S. Korea

A. Existing LNG Terminals.

1. Pyeong Taek 2. Incheon

B. New Terminals & Future LNG Terminals.

New Terminals planned for 2002	
1. Tong Yeong	
Planned/Under Construction	Expected start-up date
1. Kwangyang	2005

Taiwan

A. Existing LNG Terminal.

1.	Yung An

B. Future LNG Terminals.

Planned/Under Construction	Expected start-up date
1. Tao-Yuan 2. Tatan	2004 2005

India

A. New & Future LNG Terminals.

New Terminals planned for 2002	
1. Dabhol	
Planned/Under Construction	Expected start-up date
1. Cochin 2. Dahej 3. Hazira 4. Pipavav	2003 2004 2004 2005
Future Projects/Proposal	
1. Ennore 2. Gopalpur 3. Jamnagar 4. Vizag	5. Kakinada 6. Mangalore 7. Trombay 8. Tuticorn

China

A. Future LNG Terminals.

Planned/Under Construction	Expected start-up date
1. Guangdong (Phase I)	2005
2. Fujian	2006-2007✠
3. Guangdong (Phase II)	2009
Future Project/Proposal	
1. Shangdong	
2. Zhejiang	

✠ Latest published start-up date due to recent developments.

Source: Compiled by the Author.
(*Note: Due to conflicting data from the sources below, this Author has omitted to include the capacity for planned/proposed projects from the above tables in order to avoid inaccuracies*).

Data Sources: Petroleum Economist, World Gas to Power Map, 2002 edition, (2002); Wybrew-Bond, I., and Stern, J., (eds.), Natural Gas in Asia: The Challenges of Growth in China, India, Japan and Korea, pp.31, 64, 67, 80-83, 131, 165, 192, (2002); International Energy Agency (IEA), (organisation), Key World Energy Statistics from the IEA , 2002 edition, pp.258, 294-295, (2002); Andrews-Speed, P., *The challenges facing China's LNG industry*, in Vol.8 Art.11, On-line Journal, CEPMLP website, (April 18, 2001), <http://www.dundee.ac.uk/cepmlp/journal/html/article_8-11.html> (last visited January 6, 2003); Bushby, R.,L., (ed.), International Petroleum Encyclopaedia 2002, pp.158, 169, 181-182, (2002); Energy Information Administration (EIA), (organisation), International Energy Outlook 2002, pp.58-62, (2002); and Thackeray, F., *Surplus supply, fierce competition*, in Petroleum Economist, p.12, (November 2002).

Appendix 3: Additions to name-plate liquefaction capacity (year-end), (Mtpy).

	2002	2003	2004	2005	2006	2007
Angola						4.0
Australia* *North West Shelf* *Sunrise/Bayu Udan*			4.2		4.2± 3-5.0	
Egypt *Union Fenosa* *BG/Edison*			5.0	 3.6		
Indonesia (*Tangguh*)					3.5	3.5
Malaysia	3.8	3.8				
Nigeria	2.9			8.0		
Norway (*Snøhvit*)					4.1	
Oman					3.7	
Qatar (*Qatargas*)				1.0		7.0Φ
Russia (*Sakhalin*)					5.3	
Trinidad	3.3	3.3		5.2		
Venezuela						4.7
Total	10.0	7.1	9.2	17.8	23.8- 25.8	19.2

** Excludes ChevronTexaco's planned Australian plant expected to be operational in 2005/2006. ± Assumed.Φ ExxonMobil recent announcement on the new train in Qatar("the largest ever built") has not specified the size.*

Source: Company announcements, (published in Thackeray, F., *Surplus supply, fierce competition*, in Petroleum Economist, pp.12-14, (November 2002).

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