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LNG EXPORTS FROM BRUNEI TO JAPAN

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ABSTRACT

With little domestic gas resources and no pipeline natural gas imports, Japan has relied exclusively on imports of LNG to meet its natural gas requirements. Japan is the largest importer of LNG in the world. Brunei is abundant in natural gas and a net exporter of LNG to Japan. This paper looks at current status of LNG exports from Brunei to Japan and then looks at the prospects for further expansion of LNG exports from Brunei on the basis of projected demand for LNG in Japan. Based on secondary data, this paper finds that about 90 percent of LNG exports from Brunei goes to Japan and the remaining 10 percent to South Korea. Brunei has long term supply contract with Japan renewed in 1993 for another 20 years to 2013.

With the increase in demand for gas, Japan could face a gap in supply of natural gas of 24 million tons by 2015. This will provide opportunities for LNG suppliers for selling gas. Brunei has a plan to expand its existing LNG facility for increasing annual LNG supply capacity by 4 million tons to 11.2 million tons. However, expansion plan in Brunei is currently delayed because of insufficient quantities of natural gas supply to the LNG production plant. Expansion plan would also depend on supply of natural gas to methanol plant in Brunei, which will be in operation in early 2010. But this plan of producing additional 4 million tons of LNG a year may meet stiff competition from other suppliers in the region such as Malaysia, Indonesia and Australia.

1. BACKGROUND

LNG trade is about trade in natural gas that has been liquefied in order to transport it. Natural gas in its gaseous form can be carried efficiently only in pipelines. But when oceans get in the way, pipeline transport is not viable or possible. In this case natural gas is transported in the form of LNG (Liquefied Natural Gas). For example, Japan, South Korea, and Taiwan get their natural gas entirely via LNG ships. They are isolated due to their geographic location. This isolation has made pipeline connections between them and

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Note: The shorter name, Brunei, rather than Negara Brunei Darussalam, has been used in this paper solely in the interests of brevity.

possible suppliers both expensive and difficult to achieve. Consequently, the only way for these countries to obtain the gas supplies they needed was to import them as LNG. On the other hand, many of the major sources of exportable gas – Malaysia, Indonesia, Brunei and Australia – are also isolated. Lacking domestic uses for this gas the only alternative means of exploiting it was to export it as LNG [International Energy Agency, 1996, p. 57].

LNG imports have grown dramatically since the early 1970s. Japan, for example, currently imports 98 percent of its natural gas supply as LNG. South Korea, France, Spain, and Taiwan also import large amounts of LNG – 92 percent, 28 percent, 74 percent, and 94 percent respectively [BP 2009]. Major reasons for accelerating demand for LNG imports are the increased use of natural gas to make electricity, environmental concerns about other energy sources, and historically low gas prices. The increased use of gas within the electricity generation sector reflects its cost effectiveness against oil, and its lower green house gas emissions compared with coal.

Growth in LNG imports in Japan, South Korea and Taiwan is projected to increase in the next few years. LNG import is also expected to increase in the new markets, such as China and India because of their high rates of economic growth and increasing demand for energy (particularly electricity). By 2015, LNG imports into the Asian region are projected to reach 135.9 million tons. This expansion in LNG imports will provide opportunities for LNG suppliers for selling gas. The Asian region is currently the largest supplier of LNG in the world, and the four exporters – Brunei, Indonesia, Malaysia and Australia – accounted for 38 percent of the world market in 2008.

All of LNG exports from Brunei are delivered to Japan (89 percent) and South Korea (11 percent). At present Brunei sends 6.08 million tons (8.22 billion cubic meters) of LNG to Japan. Brunei was the first country in Asia to export gas as LNG to Japan in 1972[1].

[1] Apart from trade, Japan has close relationship with Brunei in several other areas, including investment, technical cooperation, and participation in ASEAN. The relations between Japan and Brunei and other neighbors in Southeast Asia are based on the "Fukuda doctrine" that emphasized the significance of "heart-to-heart understanding" between the region and Japan [see "The Return of the Fukuda Doctrine" in The *Economist*, 15 December 2007, p. 36]. As a result, Japan and Brunei signed the Brunei-Japan Economic Partnership Agreement (BJEPA) on 18 June 2007, to facilitate the free flow of goods, services, and investment. This agreement also includes a chapter on energy in order to maintain a stable supply of energy from Brunei to Japan.

With this background, our paper analyzes current status of LNG exports from Brunei to Japan. It then assesses prospects for further expansion of LNG exports from Brunei under the consideration of expected demand for LNG in Japan over the period to 2015. There is a lack of academic research on LNG from Brunei. In his paper, Yusof (2003) looks at the technological changes for reducing the cost of LNG production in general and at its impact on LNG supply from Brunei.

To address the two objectives of our paper, we have used data from secondary sources, such *BP Statistical Review of World Energy*, 1997 to 2009 editions; *EMDC Handbook of Energy and Economic Statistics in Japan*, 2007 edition, published by Energy Data and Modeling Center Tokyo; *Brunei Darussalam Energy Basics 101* (September 2007), published by Energy Division in the Prime Minister's Office); *Brunei Darussalam Statistical Yearbook 2008*; the *World Economic Outlook Database*, October 2009 edition, published by the International Monetary Fund. Some energy data are also obtained from unpublished information of the Energy Division in the Prime Minister's Office and the U.S Energy Information Administration.

The structure of our paper is as follows: Section 2 describes ongoing trends of world LNG trade. Position of Brunei and Japan in LNG trade is also shown. Section 3 looks at statistical comparison of Brunei and Japan as a background to their LNG trade. Section 4 describes LNG export infrastructure of Brunei. Section 5 discusses domestic gas production in Brunei and export of gas as LNG. Section 6 focuses on consumption of natural gas in Japan and imports of gas as LNG. Section 7 describes expected increase in LNG demand in Japan over the period to 2015. Section 8 analyses prospects for further expansion in LNG exports from Brunei. Section 9 shows some concluding observations.

2. SOME NOTES ABOUT LNG TRADE

When natural gas is cooled to temperatures below minus 260 degrees Fahrenheit, it becomes a liquid (*liquefied* natural gas, or LNG). As a liquid, natural gas occupies only 1/600th the volume of its gaseous state, so it is stored more effectively in a limited space and is more readily transported by ship. One

ship, of recent design, can carry 140,000 cubic meters of LNG[2]. When LNG is warmed it "regasifies" and can be used for the same purposes as conventional natural gas such as heating, cooking and power generation.

As natural gas is 600 times less voluminous as a liquid than as a gas, this allows LNG to be transported via ship thousands of miles across the sea. Where long overseas distances are involved, transporting natural gas in its liquid state is more economical. Ruster and Neumann [2006, p. 7] notes that for shorter distances pipelines are more economic, for longer distances LNG is economically feasible. Foss [2007, p. 12] cites evidence that shipping LNG via ocean transport becomes cheaper than transporting natural gas in offshore pipelines for distances of more than 700 miles or in onshore pipelines for distances greater than 2,200 miles.

LNG has also environmental advantages compared with oil or coal. LNG is typically made up mostly of methane (over 90 percent). Methane is composed of one carbon and four hydrogen atoms, CH_4 [Foss 2007, p. 7]. Because LNG contains the least amount of carbon, when burned it produces less carbon dioxide (CO_2) than oil or coal, which are considered the main contributors to the greenhouse effect. LNG also produces fewer nitrogen oxides (NOx) and sulfur oxides (SOx), both of which cause air pollution. Because of its relatively lower impact on the environment, there is growing worldwide demand for LNG as an environmentally friendly source of energy [Mitsubishi Corporation 2006, p. 8].

As stated earlier, world LNG trade has increased steadily since the early 1970s[3]. In 1970, 2.69 billion cubic meters (bcm) of LNG was traded between 3 exporters and 5 importers [Suzuki and Morikawa, 2005]. In 2008, trading volume reached 226.51 bcm (168 million tons) and there are 15 exporting countries and 18 importing countries [BP 2009].

Table 1 presents data for world gas trade by pipeline and as LNG from 1998 to 2008. The worldwide trading volume of natural gas in 2008 was 813.77 billion

[2] A single tanker ship can carry huge quantities of LNG – enough to supply the daily energy needs of over 10 million homes in the United States [Parfomak 2003].
[3] International LNG trade began in 1964 with the export of LNG from Algeria to the UK. This was followed by exports of LNG from Algeria to France in 1965 and from Alaska to Japan in 1969.

cubic meters (equivalent to 602 million tons of LNG). The growth of LNG trade has been faster than world gas trade by pipelines since 1998. Over this period, LNG trade has expanded at an average annual rate of 7.27 percent, whereas world gas trade by pipeline has grown by an average 5.87 percent a year. With increasing volume of trade, the share of LNG in world gas trade has increased from 25 percent in 1998 to 28 percent in 2008. Over the same period, the LNG share of total world gas consumption has increased from about 5 percent to 7.50 percent.

Table 1: Growth of World LNG Trade, 1998-2008

Year	Consumption	World gas trade by pipelines	World LNG trade	International gas trade
Billion cubic meters (Bcm)				
1998	2268.2	333.10	113.00	446.10
1999	2322.8	360.51	124.20	484.71
2000	2424.8	389.31	136.96	526.27
2001	2453.3	411.32	142.95	554.27
2002	2529.7	431.35	149.99	581.34
2003	2595.5	454.87	168.84	623.71
2004	2683.9	502.06	177.95	680.01
2005	2769.8	532.65	188.81	721.46
2006	2842.7	537.06	211.08	748.14
2007	2938.0	549.67	226.41	776.08
2008	3018.7	587.26	226.51	813.77
Annual percent change				
1998	-	-	-	-
1999	2.41	8.23	9.91	8.66
2000	4.39	7.99	10.27	8.57
2001	1.18	5.65	4.37	5.32
2002	3.11	4.87	4.92	4.88
2003	2.60	5.45	12.57	7.29
2004	3.41	10.37	5.40	9.03
2005	3.20	6.09	6.10	6.10
2006	2.63	0.83	11.79	3.70
2007	3.35	2.35	7.26	3.73
2008	2.75	6.84	0.04	4.86
Average	2.90	5.87	7.27	6.21

Source: Data in billion cubic meters are from *BP Statistical Review of World Energy*, 1999 to 2009 editions.

Table 2 shows world LNG importing and exporting countries since 1996. The LNG exporting countries in 2008 were Abu Dhabi (UAE), Algeria, Australia, Brunei, Egypt, Equatorial Guinea, Indonesia, Libya, Malaysia, Nigeria, Norway, Oman, Qatar, Trinidad & Tobago and the United States. Egypt, Equatorial Guinea and Norway started exporting LNG within the past two years. In the same year, LNG importing countries, consisted of Argentina, Belgium, China, Dominican

Republic, France, Greece, India, Italy, Japan, Mexico, Portugal, Puerto Rico, South Korea, Spain, Taiwan, Turkey, United Kingdom and the United States. China, Mexico and the United Kingdom first started importing LNG in 2006, India and Dominican Republic in 2004, and Argentina in 2008.

Table 2: LNG Imports and Exports by Country, 1996 to 2008
(Billion Cubic Meters)

	1996	1998	2000	2002	2004	2006	2008
IMPORTERS							
Japan	63.8	66.1	72.46	72.74	76.95	81.86	92.13
South Korea	13.0	14.3	19.68	24.06	29.89	34.14	36.55
Taiwan	3.4	4.7	5.90	7.00	9.13	10.20	12.07
India	-	-	-	-	2.63	7.99	10.79
China	-	-	-	-	-	1.00	4.44
Asia	**80.2**	**85.1**	**98.04**	**103.80**	**118.60**	**135.19**	**155.98**
Spain	6.9	5.9	8.47	12.26	17.51	24.42	28.73
France	7.8	9.8	11.23	11.54	7.63	13.88	12.59
Turkey	2.3	3.6	3.70	5.35	4.27	5.72	5.31
Belgium	4.0	4.3	4.20	3.30	2.85	4.28	2.49
Italy	-	2.0	4.78	5.70	5.90	3.10	1.56
Portugal	-	-	-	0.43	1.31	1.97	2.63
United Kingdom	-	-	-	-	-	3.56	1.04
Greece	-	-	0.30	0.50	0.55	0.49	0.94
Europe	**21.0**	**25.6**	**32.68**	**39.08**	**40.02**	**57.42**	**55.29**
United States	1.2	2.3	6.24	6.48	18.47	16.56	9.94
Mexico	-	-	-	-	-	0.94	3.61
Puerto Rico	-	-	-	0.63	0.68	0.72	0.81
Dominican Republic	-	-	-	-	0.18	0.25	0.47
Argentina	-	-	-	-	-	-	0.41
Western Hemisphere	**1.2**	**2.3**	**6.24**	**7.11**	**19.33**	**18.47**	**15.24**
TOTAL IMPORTS	**102.4**	**113.0**	**136.96**	**149.99**	**177.95**	**211.08**	**226.51**
EXPORTERS							
Indonesia	35.9	36.1	35.70	34.33	33.49	29.57	26.85
Malaysia	17.7	19.4	21.03	20.52	27.68	28.04	29.40
Australia	10.1	9.9	10.11	10.03	12.17	18.03	20.24
Brunei	8.7	8.1	8.79	9.14	9.5	9.81	9.20
Asia-Pacific	**72.4**	**73.5**	**75.63**	**74.22**	**82.84**	**85.45**	**85.69**
Qatar	-	4.8	14.04	18.59	24.06	31.09	39.68
Oman	-	-	2.47	7.96	9.03	11.54	10.90
Abu Dhabi	7.4	7.1	6.93	6.85	7.38	7.08	7.54
Middle East	**7.4**	**11.9**	**23.44**	**33.40**	**40.47**	**49.71**	**58.12**
Nigeria	-	-	5.61	7.84	12.59	17.58	20.54
Algeria	19.6	24.9	26.32	26.88	25.75	24.68	21.87
Libya	1.2	0.9	0.80	0.63	0.63	0.72	0.53
Egypt	-	-	-	-	-	14.97	14.06
Equatorial Guinea	-	-	-	-	-	-	5.18
Africa	**20.8**	**25.8**	**32.73**	**35.35**	**38.97**	**57.95**	**62.18**

Trinidad & Tobago	-	-	3.51	5.32	13.99	16.25	17.36
United States	1.8	1.8	1.65	1.70	1.68	1.72	0.97
Western Hemisphere	**1.8**	**1.8**	**5.16**	**7.02**	**15.67**	**17.97**	**18.33**
TOTAL EXPORTS	**102.4**	**113.0**	**136.96**	**149.99**	**177.95**	**211.08**	**226.51**

Source: *BP Statistical Review of World Energy* 1997 to 2009 editions.

Note: Asian LNG exports of 74.22 billion cubic meters for 2002 include Japanese re-export of 0.15 billion cubic meters (received from Indonesia) to South Korea, and South Korean re-export of 0.05 billion cubic meters (received from Indonesia) to Japan. Total LNG exports of 226.51 billion cubic meters for 2008 also include export from Norway (2.19 billion cubic meters).

Asia has continued to dominate global LNG import and export markets. As per Table 2, Asian importers received 155.98 billion cubic meters of LNG, Europe 55.29 billion cubic meters and Western Hemisphere 15.24 billion cubic meters. Similarly, the Asian region including Australia (Brunei, Indonesia, Malaysia and Australia) is the largest source of LNG to the world. In 2008, Asian export countries (including Australia) supplied 85.69 billion cubic meters of the world total, while Africa 62.18 billion cubic meters, Middle East 58.12 billion cubic meters and Western Hemisphere 18.33 billion cubic meters.

Table 3 shows sources of LNG imports to Asia since 1996. About 55 percent of LNG imports to Asia came from within the region in 2008. Imports from outside the region come from the Middle East (32 percent) and Africa (11 percent), and Western hemisphere (2 percent). Asian importers (Japan, South Korea, Taiwan and India) have imported increasing volume of LNG exports from the Middle East and U.S. sources. LNG imports from the Middle East have increased to 49.88 billion cubic meters in 2008 from 6 billion cubic meters in 1996. Imports from the U.S. and Trinidad & Tobago (Western Hemisphere) have increased from 1.80 billion cubic meters in 1996 to 2.94 billion cubic meters in 2008. These figures indicate that the Asian import requirement is exceeding export capacity of the region.

Table 3: Sources of LNG to Asian Import Countries, 1996 to 2008
(Billion cubic meters)

Year	From				
	Asia*	Africa	Middle East	Western Hemisphere	Total imports
1996	72.40	0	6.00	1.80	80.20
1997	73.50	0	8.90	1.70	84.10
1998	73.30	0	10.00	1.80	85.10
1999	77.45	0	13.05	1.65	92.15

Year	From				
	Asia*	Africa	Middle East	Western Hemisphere	Total imports
2000	75.25	0	21.14	1.65	98.04
2001	72.25	0	28.16	1.79	102.20
2002	73.93	0	28.17	1.70	103.80
2003	79.08	0.23	32.45	1.72	113.48
2004	81.67	0.78	34.47	1.68	118.60
2005	83.49	0.38	36.71	1.84	122.42
2006	85.45	4.24	43.27	2.23	135.19
2007	87.12	8.59	50.09	2.18	147.98
2008	85.69	17.05	49.88	2.94	155.98
Shares (%)					
1996	90.27	0	7.48	2.25	100
1997	87.40	0	10.58	2.02	100
1998	86.13	0	11.75	2.12	100
1999	84.05	0	14.16	1.79	100
2000	76.76	0	21.56	1.68	100
2001	70.70	0	27.55	1.75	100
2002	71.22	0	27.14	1.64	100
2003	69.68	0.20	28.60	1.52	100
2004	68.86	0.66	29.06	1.42	100
2005	68.20	0.31	29.99	1.50	100
2006	63.21	3.14	32.00	1.65	100
2007	58.87	5.81	33.85	1.47	100
2008	54.94	10.93	31.98	1.88	99.73

Source: *BP Statistical Review of World Energy*, 1997 to 2009 editions
*includes LNG exports from Australia.
Note: Total imports of 155.98 billion cubic meters (bcm) for 2008 are not equal sum of components. The difference of 0.42 bcm is export from Norway and Belgium to Japan, South Korea and India.

In the Asian region and the world, Japan is the biggest buyer of LNG, followed by South Korea and Taiwan. In 2008, LNG imports to Japan originated primarily in Indonesia (20%), Malaysia (19%), Australia (17%), Qatar (12%) and Brunei (9%). The remaining 23 percent of Japan LNG imports came from Abu Dhabi, Oman, Nigeria, Egypt, Equatorial Guinea, Algeria, U.S. and Trinidad & Tobago. Norway was also LNG exporter to Japan in 2008 [BP 2009].

3. STATISTICAL COMPARISON OF BRUNEI AND JAPAN

Factors such as domestic gas supply and demand situations, population, and economic activities affect LNG imports to Japan and LNG exports from Brunei.

This section shows differences of these factors between Brunei and Japan. For example, due to small population, domestic demand for natural gas is little in Brunei; therefore most natural gas production of Brunei is exported. Secondly, Brunei has a very small manufacturing sector, demand for electricity is little in this sector, and thus consumption of natural gas for making electricity is low. Similarly, for the level of LNG imports into Japan, the gap between consumption and domestic production of natural gas is a main driving force. Economic activity is also a key driver of demand for natural gas in Japan. With economic growth assumed to decline by 2.5 percent in 2009 (Sandu and Copeland 2009, p. 143), this is expected to result in lower gas consumption associated with lower demand for electricity and weaker consumption in industrial sectors. This in turn could result in lower imports of LNG.

Table 4 shows some factors for Brunei and Japan for 2008. Brunei is a small country slightly larger than Mie Prefecture of Japan. Situated on the northern end of the island of Borneo, Brunei has a total area of 5765 square kilometers, some 80 percent of it forested[4]. The country is surrounded by the South China Sea on the north, and by the Malaysian state of Sarawak on all other sides. Brunei acquired full independent status from the United Kingdom in January 1984, following nearly 80 years as a British protectorate.

The population of Brunei in 2008 was estimated at 393,000. Brunei has a multi-racial society, comprising of 67 percent Brunei Malays (*bumiputera* or "sons of the soil") and 15 percent Chinese. Other races such as Indians, indigenous ethnic groups and expatriates make up the rest of the population. In contrast, Japan has a fairly homogeneous society – 99 percent of its population is Japanese.

Brunei, with a population of 393,000 and a GDP of US$ 14,553 million therefore has GDP per capita of US$37,053. These figures are estimated by International Monetary Fund in its *World Economic Outlook Database* (October 2009 edition). The high per capita income of Brunei is comparable to per capita GDP of Japan (US$38,457). High per capita income in Brunei is derived from exports of oil

[4] The island of Borneo (some 750,000 square kilometers) is politically divided between three-nation states: Sabah and Sarawak states of Malaysia, Brunei Darussalam, and Kalimantan province of Indonesia. The largest part of the island is Kalimantan.

and LNG. Citizens of Brunei continue to enjoy a life style that is free from income tax and greatly benefit from free medical care and education up to university level.

Table 4: Statistical Comparison of Brunei and Japan, 2008

	Brunei	Japan
Basic Indicators		
Land Area (square kilometers)	5 765	377 923
Population (thousands)	393	127 692
GDP (million current US$)	14 553	4 910 692
Per capita GDP (current US$)	37 053	38 457
Merchandise Trade		
Merchandise exports, f.o.b. (million US$)	11 100	782 047
Merchandise imports, c.i.f. (million US$)	2 300	762 589
Breakdown in economy's total exports (%)		
Agricultural products	0.1	1.1
Fuels and mining products	96.4	4.8
Manufactures	3.3	88.6
Breakdown in economy's total imports (%)		
Agricultural products	17.2	10.6
Fuel and mining products	3.0	42.8
Manufactures	79.3	44.9
Energy Commodities		
Petroleum (thousand barrels per day)		
Production	157.41	133.11
Imports	0	4 651.74
Exports	142	0
Consumption	15	4 784.85
Natural gas (billion cubic feet)		
Production	473	189
Imports	0	3 369
Exports	325	0
Consumption	148	3 572
Coal (million short tons)		
Production	0	0
Imports	0	206
Exports	0	0
Consumption	0	204
Government type	Constitutional monarchy	Constitutional monarchy with a parliamentary govt

Sources: Land area and government type are from *ASEAN-JAPAN Statistical Pocketbook 2008*. Population, GDP, and per capita GDP are from International Monetary Fund, *World Economic Outlook Database*, October 2009 edition (http://www.imf.org/external/pubs/ft/weo/2009/02/weodata/index.aspx). Data for merchandise trade from World Trade Organization, *Trade Profiles 2009* (http://www.wto.org/english/res_e/booksp_e/anrep_e/trade_profiles09_e.pdf). Energy commodities data from U.S. Energy Information Administration, *International Energy Statistics* (http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm, and *Country Energy Profiles* [updated 6 January 2010] (http://tonto.eia.doe.gov/country).

Brunei produces two energy commodities – oil and gas. The country consumes little energy domestically and most of its oil and natural gas are exported. The export earnings from crude oil, petroleum products and LNG accounted for 96.4 percent of total export earnings in 2008 (Table 4). Natural gas production in Brunei in 2008 was 473 billion cubic feet, consumption 148 billion cubic feet and export (production minus consumption) 325 billion cubic feet. The destinations of LNG exports from Brunei are mainly Japan (90 percent) and South Korea (10 percent). The excess of production over consumption is also a factor for oil exports from Brunei. Main importers of crude oil exports from Brunei are Indonesia, Australia, South Korea and Japan. Yearly production, consumption and export of natural gas as LNG since 1990 is discussed in section 5.

Due to its gap between domestic consumption and production, Japan imports most of its oil and natural gas supply. In 2008, Japan produced 189 billion cubic feet of natural gas, consumed 3,572 billion cubic feet and imported (consumption minus production) 3,369 billion cubic feet of natural gas as LNG. In the same year, production of crude oil in Japan was 133.11 thousand barrels per day, consumption 4784.85 thousand barrels per day and import 4651.74 thousand barrels per day (Table 4).

As for imports to Brunei, machinery & transport equipment and manufactured goods accounts for 79.3 percent of all imports, followed by agricultural products (17.2 percent) (Table 4). Brunei imports most of its food items (80%) from neighboring countries like Malaysia, Thailand and China. Major import markets for other products are Singapore, Japan and the United States.

4. LNG EXPORT INFRUSTRUCTURE IN BRUNEI

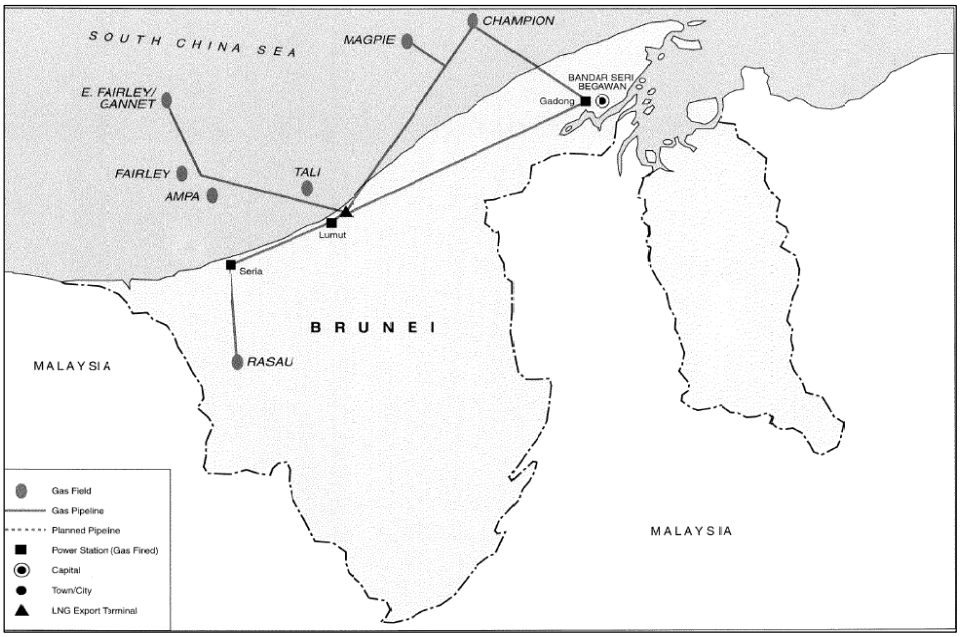
Since the discovery of oil in 1929, Brunei has been known as an oil exporting country. Before that time Brunei had to rely on other products for its exports

namely timber, rubber and coal. But oil has come to play a steadily increasing role since the sinking of the first exploratory well in 1899. The first commercial well was sunk in Seria in 1929, came on stream in 1931 and, by 1938, formed part of the most productive field in the British Empire. By the late 1930s, oil exports accounted for around three-quarters of all state exports by value and the transformation of the economy of Brunei had begun [Cleary and Wong, 1994, pp. 8, 35-37].

Gas production for domestic use began in the late 1950s but production easily began to outstrip demand. A decision was taken to liquefy for export production, and this began in the early 1970s with the opening of a liquefied natural gas plant at Lumut (Brunei LNG Sendirian Berhad, in short, Brunei LNG).

Figure 1 shows the existing gas infrastructure in Brunei as appeared in *Asia* Gas Study, published by International Energy Agency (1996). Gas reserves are located offshore and natural gas is piped ashore through two main underwater trunk lines to the LNG plant at Lumut. Gas is transported from the landfall to the only major domestic user of natural gas, namely the electricity generation sector. The pipeline is jointly owned by Brunei Shell Petroleum and Brunei LNG.

Figure 1: Gas Infrastructure in Brunei, 1996



Source: International Energy Agency (1996), *Asia Gas Study*, Organisation for Economic Cooperation and Development, Paris, France, Figure A1.1, p. 103 (http://www.iea.org/textbase/nppdf/free/1990/asia_gas 1996.pdf).

Most of the natural gas supply to Brunei LNG plant at Lumut comes from four fields of Brunei Shell Petroleum Company – South West Ampa, Fairley, Gannet and Champion West fields. Since 1 April 1999, a small amount of natural gas to BLNG plant also comes from the Jamalul Alam and Maharaja Lela offshore fields of Total S.A (not shown in Figure 1).

The Lumut LNG plant has 5 trains with a nameplate capacity of 5.3 million tons a year. The 1994 overhaul of the plant has increased its thermal efficiency and offtake flexibility and actual capacity is now closer to 7.2 million tons a year. The Lumut plant has three LNG storage tanks with a total capacity of 195,000 cubic meters [Brunei LNG, 2008, p. 5].

LNG is transported in a fleet of 8 tankers, seven with a capacity of 75,000 cubic meters each, while the eighth which was established in 1998, has a capacity of 135,000 cubic meters. The seven B-Class tankers are named after species of local fish – *Bebatik*, *Bekalang*, *Bekulan*, *Belais*, *Belana*k, *Bilis* and *Bubuk*. The A-Class 137,000 cubic meter capacity LNG carrier is named ABADI (meaning everlasting and evergreen) [Brunei LNG, 2008, pp. 12-14].

The Brunei LNG project is a joint venture project between the Bruneian government (50% share), Royal/Dutch Shell Group of Companies (25% share) and Mitsubishi Corporation of Japan (25% share). The main business of Brunei LNG Project is natural gas liquefaction and sales. Japanese connection with LNG project in Brunei started with the participation of Mitsubishi Corporation. The participation came about through a decision to partner with Shell for LNG production and export to Japan. Shell had discovered promising gas fields off the shores of Brunei in 1963. The partnership between the two companies led to the establishment of Brunei LNG Sendirian Berhad (in short, Brunei LNG) in December 1969 together with full support and investment from the Bruneian government. The newly established company set about building an LNG infrastructure with facilities ranging from a natural gas liquefaction plant and pier-docking facilities for ship transport to LNG pipelines. The first LNG shipment from this joint venture in Brunei to Japan arrived in 1972 and a stable supply has been provided ever since.

5. EXPORTS OF LNG FROM BRUNEI

The gas sector in Brunei has since its inception been dominated by the production and export of LNG. The trade in LNG has in turn been dominated by the long term supply contract signed by Brunei and Japan. However, in 1994, 1995 and 1996 Brunei sold a number of spot cargoes of LNG and later in 1997 Brunei signed a long term 16 year contract with South Korea for the supply of small quantities of LNG.

According to the *BP Statistical Review of World Energy 2009*, Brunei contained proven gas reserves of 0.35 trillion cubic meters at the end of 2008. This is equal to 2.27 percent of proven recoverable reserves in the Asia Pacific region and 0.2 percent of world reserves. Natural gas reserves in Brunei are mostly located off the coast of Lumut, about 80 kilometers from the Capital, Bandar Seri Begawan.

Production of natural gas in Brunei was 9.18 million tons in 2008 (Table 5). Gas production has fluctuated in Brunei over the past three decades. In 2008, more than 83 percent of natural gas produced in Brunei is exported as LNG, and the remaining 17 percent was consumed domestically. The gas requirement for the domestic consumption amounted to 1.39 million tons per annum (66.352 billion cubic feet).

Table 5: Gas Production and Gas Exports as LNG from Brunei, 1980 to 2008
(Million tons per year and Percentage)

Year	Gas Production	LNG production	Gas consumption	Gas export as LNG	LNG exports as % of gas production	Consumption as % of gas production
1980	7.90	6.16	..	..	..	..
1981	6.96	5.83	..	..	..	..
1982	7.00	5.72	..	..	..	..
1983	7.20	5.82	..	..	..	..
1984	6.75	5.88	..	..	..	..
1985	6.63	5.70	..	..	..	..
1986	6.43	5.71	..	..	..	..
1987	6.76	5.81	..	..	..	..
1988	6.65	6.00	..	..	..	..
1989	6.76	5.90	..	..	..	..
1990	7.01	5.94	..	5.80	82.74	..
1991	7.16	5.91	..	5.77	80.61	..
1992	7.30	6.01	..	5.80	79.37	..
1993	7.37	6.11	..	6.01	81.60	..
1994	7.58	6.33	..	6.25	82.39	..
1995	8.28	6.93	..	6.78	81.89	..

1996	8.18	..	1.40	6.74	82.37	17.07
1997	8.21	..	1.45	6.70	81.55	17.67
1998	7.97	..	1.48	6.45	80.91	18.63
1999	8.29	..	1.59	6.70	80.78	19.20
2000	8.59	7.24	1.45	7.06	82.24	16.89
2001	8.64	7.42	1.35	7.27	84.14	15.63
2002	8.72	7.50	1.37	7.40	84.85	15.65
2003	9.40	8.04	1.40	7.71	82.02	14.95
2004	9.24	7.79	1.50	7.65	82.82	16.20
2005	9.05	7.61	1.47	7.49	82.80	16.29
2006	9.51	8.12	1.47	7.91	83.21	15.48
2007	9.26	7.83	..	7.64	82.43	..
2008	9.18	7.21	1.39	7.66	83.51	15.18

.. = Not available

Sources: Based on data in unpublished information of Energy Division (Brunei Government); *Brunei Darussalam Energy Basics 101*, September 2007 (Energy Division); *Brunei Darussalam Statistical Yearbook 2008*, Table 10.4 (Brunei Government); and *Brunei Economic Bulletin*, Vol. 6, Issue 2, December 2008, Annex 6.4 (Brunei Government).

Note: Original data on natural gas production are in million cubic meters per day (million m^3/day), LNG production and exports in million Btu (British thermal unit) per day, and gas consumption in billion cubic feet (Bcf) per year. We have converted the different data to the same unit, million tons per year, in the following way:

Natural gas: Million m^3 per day x 365 days x 0.74 x 10^{-3} = Million tons per year.

LNG exports: Million Btu per day x 365 days x 0.021 x 10^{-6} = Million tons per year.

Natural gas consumption: Bcf x 0.021 = Million tons per year.

The conversion ratios (0.74 and 0.021) are based on the *BP Statistical Review of World Energy 2009* norms of 1 billion cubic meters natural gas = 0.74 million tons LNG, 1 trillion British thermal units = 0.021 million tons LNG, and 1 billion cubic feet natural gas = 0.021 million tons LNG. Earlier editions of the *BP Statistical Review of World Energy* (for example, 2004 to 2008 editions) use slightly different conversion ratios.

Domestic demand for gas in Brunei is dominated by the power sector which in 2008 took more than 58 percent (38.571 billion cubic feet) of all the gas consumed in the country. Forty percent (26.710 billion cubic feet) of the gas is consumed as operator fuel own use. The remaining 2 percent (1.071 billion cubic feet) was used in the residential sector (domestic piped gas) principally for cooking. In the eastern part of the country LPG (produced as a by-product at the LNG plant) is distributed to consumers by bottle. In the western part of the country, in the Kuala Belait and Seria area, there is well developed gas distribution system. The use of gas for power generation grew at around 2 percent a year during the period 2004 to 2008. Brunei has a close to 100 percent electrification rate. In 2008, the consumption of electricity was as follows: the residential sector 16 percent (480.32 GWh), government sector 57 percent (1698.70 GWh); commercial sector 20 percent (602.19 GWh), and industrial sector 7 percent (199.11 GWh) [Energy Division, Brunei Government, unpublished information].

Like natural gas, a small amount of oil is used in Brunei domestically, the rest is exported. A refinery at Seria processes some 10,000 barrels per day specifically for this, producing gasoline, lubricants, jet fuel, bitumen and bottled gas. Energy is also heavily subsidized in Brunei. In July 2008 a liter of Premium 97 went for B$0.53 (US$0.38) at the pumps, which represented a subsidy of B$0.33 (US$0.24) per liter, while a liter of diesel went for B$0.31 (US$0.22), indicating a subsidy of B$0.50 (US$0.36) a liter. [Oxford Business Group 2008, p. 47]. The subsidy and price for Premium 97 and diesel also remains the same at this time (March 2010). The following Table shows more information about energy subsidy in Brunei.

Gasoline and Diesel Subsidies in 2007

	Premium 97	Super 92	Regular 85	Diesel
Market price	$0.8593	$0.8397	$0.7727	$0.8090
Pump price	$0.5300	$0.5190	$0.3600	$0.3100
Subsidy	$0.3293	$0.3207	$0.4127	$0.4990

Source: Energy Division, *Energy Matters*, Issue One, May 2009, p.18 (Prime Minister's Office, Brunei Darussalam)

Export is excess of production over consumption. Since gas production in Brunei has exceeded domestic consumption every year, the country has become a net exporter of natural gas as LNG. Brunei started to export LNG in 1972, and was the first country in Asia to export gas as LNG. Gas is a significant export earner for Brunei. It currently provides about 45 percent of total export earnings of Brunei. In 2008 exports of LNG provided export revenue of B$6666.85 million (US$4662 million) [Brunei Government, 2009a, Table 5.11, p. 97].

Brunei is currently the fourth largest LNG supplier in the Asia Pacific region and the tenth-largest exporter of LNG in the world. As shown in Table 6, Brunei exported 6.81 million tons of LNG in 2008. This constituted around 4.1 percent of world LNG trade, and 10.74 percent of Asia Pacific trade. The most significant LNG trade relationship of Brunei is with Japan, which imported 89.35 percent of LNG exports from Brunei in 2008 (Table 6). Korea accounted for the remaining LNG exports in that year. Brunei has long term sales contract with Japan and Korea for around 6.7 million tons a year, both of which are due to expire in 2013.

Table 6: Exports of LNG from Brunei to Japan and South Korea, 1996 to 2008

Year	LNG exports in million tons			LNG exports in percent (%)		
	Japan	S. Korea	Total	Japan	S. Korea	Total
1996	5.70	0.74	6.44	88.51	11.49	100
1997	5.33	0.74	6.07	87.80	12.20	100
1998	5.40	0.59	5.99	90.12	9.88	100
1999	5.48	0.75	6.22	87.99	12.01	100
2000	5.71	0.80	6.50	87.71	12.29	100
2001	6.07	0.59	6.66	91.11	8.89	100
2002	5.88	0.77	6.65*	88.43	11.57	100
2003	6.61	0.55	7.16	92.35	7.65	100
2004	6.13	0.90	7.03	87.26	12.74	100
2005	6.18	0.59	6.77	91.26	8.74	100
2006	6.40	0.86	7.26	88.18	11.82	100
2007	6.34	0.58	6.92	91.66	8.34	100
2008	6.08	0.73	6.81	89.35	10.65	100

Source: Based on data in *BP Statistical Review of World Energy*, 1997 to 2009 editions. Figures in million tons are derived by multiplying billion cubic meters by 0.74. The conversion ratio (0.74) is based on *BP Statistical Review of World Energy 2009* edition, p. 44.

*In 2002, total export of LNG from Brunei was 6.7636 million tons (or 9.14 billion cubic meters). This includes 6.6526 million tons (8.99 bcm) to Japan and South Korea together, 0.0518 million tons (0.07 bcm) to United States and 0.0592 million tons (0.08 bcm) to Spain.

The first LNG cargo was exported to Japan in 1972. From 1993 to 2013, a 20 year contract is in place to supply 5.14 million tons per annum LNG to Japanese customers. The contract was renewed in 1993 for another 20 years with an increase in actual contract quantity of 5.54 million tons per annum LNG. With effect from second quarter of 1999, the yearly cargo increased to 6.01 million tons (Table 7). In 1994, Brunei also exported 0.27 million tons LNG to South Korea. In 1995 and 1996, 0.7 million tons LNG was exported each year. Later in 1997, a long term 16 year contract was signed for an annual supply of 0.7 million tons from 1997 to 2013 [World Trade Organization, 2008, p. 73].

Table 7: Existing Long Term LNG Supply Contracts of Brunei

Purchaser	Volume (million tons per year)	Contract length	First long-contract year
Tokyo Electric Power	4.03	20 years* (1993-2013)	1973
Tokyo Gas	1.24	20 years* (1993-2013)	1973
Osaka Gas	0.74	20 years* (1993-2013)	1973
KOGAS (South Korea)	0.70	16 years (1997-2013)	1997
Total	6.71		

*Denotes extended contracts with Japanese buyers

Source: Brunei LNG, *Company Profile 2008*, p. 15

6. IMPORTS OF LNG TO JAPAN

Japan receives more than 40 percent of worldwide LNG deliveries (92.13 billion cubic meters in 2008) and thus forms the largest importing country. It started LNG imports with its first terminal Nigeshi in 1969 receiving deliveries from Alaska in the U.S. Today, 27 terminals are operating with a total capacity of 176 million tons (238.09 billion cubic meters) per year. Seven new plants are planned.

Due to supply security and environmental concerns, natural gas demand is increasing in Japan. Table 8 shows primary energy consumption in Japan since 1995. Over this period, natural gas consumption increased by 3.46 percent a year to reach 84.4 million tons oil equivalent (93.7 billion cubic meters) in 2008, compared with 55 million tons of oil equivalent (61.2 billion cubic meters) in 1995. In 2008, the share of natural gas in primary energy mix of Japan was 17 percent, compared with 11 percent in 1995. Oil imports (44%) have continued to dominate the energy mix, with the share of coal at 25 percent.

Table 8: Primary Energy Consumption and Natural Gas Production in Japan, 1995 to 2008 (Million tons oil equivalent)

	Oil	Natural gas	Coal	Nuclear energy	Hydro-electricity	Total	Nat. gas production
Million tons oil equivalent							
1995	268.6	55.0	86.2	74.3	7.6	491.7	5.57
1996	269.9	59.5	88.3	76.8	7.5	502.0	5.32
1997	266.3	58.6	89.8	83.1	8.1	506.0	5.14
1998	254.9	62.5	88.4	84.4	9.0	499.3	4.95
1999	257.3	67.1	91.5	82.0	8.0	505.9	5.03
2000	255.4	68.6	98.9	72.3	20.7	515.9	5.13
2001	247.5	71.1	103.0	72.7	20.4	514.8	4.83
2002	243.6	64.7	106.6	71.3	20.5	506.6	5.47
2003	248.9	68.9	112.2	52.1	22.8	504.9	4.62
2004	241.4	70.9	120.8	64.7	23.1	520.8	4.53
2005	244.0	71.1	121.3	66.3	19.8	522.5	4.47
2006	237.1	75.4	119.1	68.9	21.8	522.3	4.35
2007	229.3	81.2	125.3	63.1	16.8	515.8	3.29
2008	221.8	84.4	128.7	57.0	15.7	507.5	..
Shares (in percentage)							

1995	54.63	11.19	17.53	15.11	1.55	100
1996	53.76	11.85	17.59	15.30	1.49	100
1997	52.63	11.58	17.75	16.42	1.60	100
1998	51.05	12.52	17.70	16.90	1.80	100
1999	50.86	13.26	18.09	16.21	1.58	100
2000	49.51	13.30	19.17	14.01	4.01	100
2001	48.08	13.81	20.01	14.12	3.96	100
2002	48.09	12.77	21.04	14.07	4.05	100
2003	49.30	13.65	22.22	10.32	4.52	100
2004	46.35	13.61	23.20	12.42	4.44	100
2005	46.70	13.61	23.22	12.69	3.79	100
2006	45.40	14.44	22.80	13.19	4.17	100
2007	44.46	15.74	24.29	12.23	3.26	100
2008	43.70	16.63	25.36	11.23	3.09	100
Average	48.89	13.43	20.71	13.87	3.09	

.. = not available
Sources: *BP Statistical Review of World Energy*, 1997 to 2009 editions.
Natural gas production data are based on data (in billion cubic feet, bcf) in U.S. Energy Information Administration, *Japan Energy Profile*, (Updated: 15 May 2009). Production data in million tons oil equivalent are derived as: Natural gas production: bcf x 0.025 = million tons oil equivalent.

About 59 percent of the natural gas is used as fuel in power generation sector, 20 percent is used in the industrial sector, 18 percent in the residential sector and commercial sectors and 3 percent in other sector. The natural gas consumption in the power sector fell slightly from 2005, as a result of the increased share of nuclear power in total power generation (12% in 2006, up from 11% in 2005). On the other hand, the gas consumption in the industrial sector grew a significant 13 percent in 2006, for the following reasons: (1) Economy of Japan continued to improve, increasing productivity significantly in areas such as Chubu where many large-scale, energy-intensive manufacturing industries are located; and (2) Industrial customers nationwide continued to switch from fuel oil to natural gas, supported by attractive gas prices relative to oil prices and also by government subsidy programs [Hosoe, 2007].

Although Japan is a large natural gas consumer, it has a limited domestic production of natural gas. According to the U.S. Energy Information Administration (Energy Information Administration, 2008, 2009), Japan had 738 billion cubic feet of proven natural gas reserves as of January 2008. Natural gas proven reserves have declined since 2007, when they measured 1400 billion cubic feet. Natural gas is produced from fields near Niigata in the northern

part of the country and domestic gas production was 131.7 billion cubic feet (or 3.29 million tons of oil equivalent as in Table 8, or 2.77 million tons of LNG) in 2007. However, this accounted for only 4.05 percent of total gas consumption in Japan. Production has declined from 5.57 million tons oil equivalent (or 222.6 billion cubic feet) in 1995 to 3.29 million tons oil equivalent (131.7 billion cubic feet) in 2007.

Natural gas consumption in Japan is supplied almost entirely by imported LNG. The first shipments of LNG to Japan came from Alaska in 1969. Later Japan started to import LNG from Brunei in 1972. Table 9 shows imports of LNG to Japan since 1969. LNG imports increased at a blistering 40.47 percent per year in the period 1972 to 1980. Then 1981 and 1982 growth in LNG imports slowed to relatively anemic 2.15 percent per year, as the energy price increases of the early 1980s were stalling growth in energy demand in Japan. In the period from 1985 through 2003, Japanese imports of LNG increased at 4.21 percent per year (Table 9). Growth in LNG imports in 2006 in Japan increased by 7.6 percent to 62.19 million tons from a negative growth of 0.4 percent in 2005. However, the increase in LNG demand was 3.7 percent in 2008.

From Table 9, majority of imports are sourced from Indonesia, Malaysia and Brunei, which collectively account for 48 percent of LNG supply to Japan in 2008. Australia accounted for 17 percent of total LNG imports in 2008, while Middle East countries accounted for 24 percent. Japan also imported LNG from Trinidad and Tobago for the first time in 2003. This represents a significant diversification of LNG sources compared with 1975 when about 80 percent of import was sourced from Brunei.

Table 9: Imports of LNG to Japan, 1969-2005 (in 1000 Metric Tons per Annum)

Fiscal Year	USA	Brunei	Abu Dhabi	Indonesia	Malaysia	Australia	Qatar	Oman	Total	Growth %
1969	182	-	-	-	-	-	-	-	182	-
1970	977	-	-	-	-	-	-	-	977	436.8
1971	969	-	-	-	-	-	-	-	969	-0.8
1972	872	196	-	-	-	-	-	-	1068	10.2
1973	989	1375	-	-	-	-	-	-	2364	121.3
1974	933	2816	-	-	-	-	-	-	3748	58.5
1975	1017	3988	-	-	-	-	-	-	5005	33.5
1976	934	4969	-	-	-	-	-	-	5903	17.9
1977	1013	5262	706	1266	-	-	-	-	8247	39.7
1978	958	5297	1185	4245	-	-	-	-	11685	41.7

1979	958	5543	1462	6895	-	-	-	-	14858	27.2
1980	872	5418	2001	8674	-	-	-	-	16965	14.2
1981	1006	5157	2018	8817	-	-	-	-	16998	0.2
1982	1014	5197	2163	9210	109	-	-	-	17693	4.1
1983	1044	5280	1813	10657	1849	-	-	-	20642	16.7
1984	987	5212	2118	14643	3912	-	-	-	26872	30.2
1985	990	5188	2257	14825	4572	-	-	-	27831	3.6
1986	963	5195	2112	15030	5470	-	-	-	28770	3.4
1987	962	5230	2262	15392	5831	-	-	-	29678	3.2
1988	963	5445	2286	16433	6232	-	-	-	31348	5.7
1989	1014	5271	2409	16419	6312	1341	-	-	33041	5.4
1990	982	5254	2272	17609	6775	3185	-	-	36077	9.2
1991	1010	5284	2666	17878	7026	4087	-	-	37952	5.2
1992	1009	5277	2513	18414	7169	4595	-	-	38976	2.7
1993	1105	5545	2484	17931	7690	5321	-	-	40076	2.8
1994	1173	5481	3488	18498	7580	6155	-	-	42374	5.7
1995	1221	5507	4098	17476	8559	6827	-	-	43689	3.1
1996	1338	5511	4418	18120	9489	7276	293	-	46445	6.3
1997	1194	5444	4653	18206	9444	7025	2383	-	48349	4.1
1998	1304	5330	4523	17987	9789	7235	3310	-	49478	2.3
1999	1189	5582	4690	18232	10231	7247	4940	-	52112	5.3
2000	1260	5715	4802	18123	10923	7211	6000	123	54157	3.8
2001	1266	6004	4853	16444	11296	7489	6386	681	54421	0.6
2002	1253	6011	4633	17522	10881	7212	6640	867	55018	1.1
2003	1242	6367	5256	17490	12219	7644	6608	1656	58538	6.4
2004	1210	6357	5107	15545	13154	8612	6762	1104	58018	-0.9
2005	1250	6165	5251	13813	13136	10456	6396	1101	57797	-0.4
2006	1167	6502	5315	13988	12018	12159	7483	2372	62190	7.6
2007	893	6439	5572	13592	13274	12074	8172	3624	66186	7.4
2008	730	6177	5574	14130	13134	11983	8203	3192	69263	3.7
Shares (in Percent, %)										
1975	20.3	79.7	-	-	-	-	-	-	100	
1980	5.1	31.9	11.8	51.1	-	-	-	-	100	
1985	3.6	18.6	8.1	53.3	16.4	-	-	-	100	
1990	2.7	14.6	6.3	48.8	18.8	8.8	-	-	100	
1995	2.8	12.6	9.4	40.0	19.6	15.6	-	-	100	
2000	2.3	10.6	8.9	33.5	20.2	13.3	11.1	0.2	100	
2005	2.2	10.7	9.1	23.9	22.7	18.1	11.1	1.9	100	
2008	1.1	8.9	8.0	20.4	18.9	17.3	11.8	4.6	91*	

Sources: Energy Data and Modeling Center, *EDMC Handbook of Energy and Economic Statistics in Japan*, Tokyo: Energy Conservation Center, 15 February 2007 (Japanese version, p. 188). Data for 2006 to 2008 are taken from Japan Tariff Association, *Japan Exports and Imports: Commodity by Country*, December 2006, December 2007, and December 2008 editions.

Note: Total imports are not equal sum of components for the years 1989, 2003, 2004, 2005, 2006, 2007 and 2008. The differences are imports from "other" countries (Algeria, Nigeria, Trinidad & Tobago, Egypt, Equatorial Guinea and Norway.

The electric and gas utilities are key LNG consumers in Japan. There are no state-owned enterprises in the energy and utilities sector; private regional monopolies characterize the electricity and gas (piped) sectors. Japan has 10 private electric power utilities, of which six electric utilities (Tokyo Electric Power Company, Chubu Electric Power, Kansai Electric Power, Tohoku Electric Power, Kyushu Electric Power, and Chugoku Electric Power) use LNG as their feedstock for power generation. In the near future, Shikoku Electric Power and Okinawa Electric Power will start burning LNG [Hosoe, 2007].

The four utilities (Tokyo Electric Power Company, Kansai Electric, Chubu Electric, and Tohoku Electric) accounted for more than 90 percent of LNG consumption in the power sector in 2006. Generally speaking, TEPCO (largest electric power utility in Japan) remains the dominant LNG consumer, although demand by Chubu Electric has been growing robustly in recent years. TEPCO alone consumed 16.3 tons (45%) of the total consumption in the power industry (36.2 tons), and consumption of Chubu Electric rose to 9.8 tons, up 8.8 percent from 9 tons in 2005. Demand in the Chubu area has been growing significantly, given the many large-scale, energy-intensive manufacturing industries in the region, such as Toyota Motor and its affiliated manufacturers [Hosoe, 2007].

Japan has 212 city gas utilities, of which the "Big Four" gas utilities accounted for 77 percent of the total LNG consumption in the gas sector in 2006. Tokyo Gas Company accounted for 37 percent of the total 25.2 tons, followed by Osaka Gas Company (27%), Toho Gas (11%), Saibu Gas (2%), and others (23%). The recent growth in demand by industrial sector has been considerable, as industrial customers continue to switch to natural gas from fuel oil, supported by attractive gas prices relative to oil prices and government subsidiary programs. All of the "Big Four" utilities increased their sales volumes to their industrial customers in 2006, with their yearly demand growth rates as follows: Tokyo Gas (8%), Osaka Gas (8%), Toho Gas (20%), and Saibu Gas (17%) [Hosoe, 2007].

Japanese regulations permit individual utilities and natural gas distribution companies to sign LNG supply contracts with foreign sources, in addition to directly importing spot cargoes [Energy Information Administration, 2008]. The largest LNG supply agreements are held by Tokyo Gas Company, Osaka Gas Company, Toho Gas Company, Chubu Electric and Tokyo Electric Power Company, primarily with countries in Southeast Asia and the Middle East. Most Japanese LNG imports takes place under long-term contracts between buyers and sellers. Some LNG imports also takes place under short-term or spot contracts. Around 5 percent of LNG imports into Japan are based on spot purchases [Sandu and Copeland, 2009]. The existing long-term LNG supply contract of Japan with Brunei includes 6.01 million ton per year. This contract is expiring in 2013. It is expected that the contract will be renewed for LNG supply to Japan.

Japan has currently 27 operating LNG import terminals. Most LNG terminals are located around main population centers of Tokyo, Osaka, and Nagoya. Table 10 and Figure 2 show LNG import terminals in Japan. Collectively, the 27 terminals have the capacity to import 238.09 billion cubic meters (equivalent to 176.19 million tons) a year. This is significantly higher than current annual imports. In addition, seven LNG receiving terminals are currently under planning.

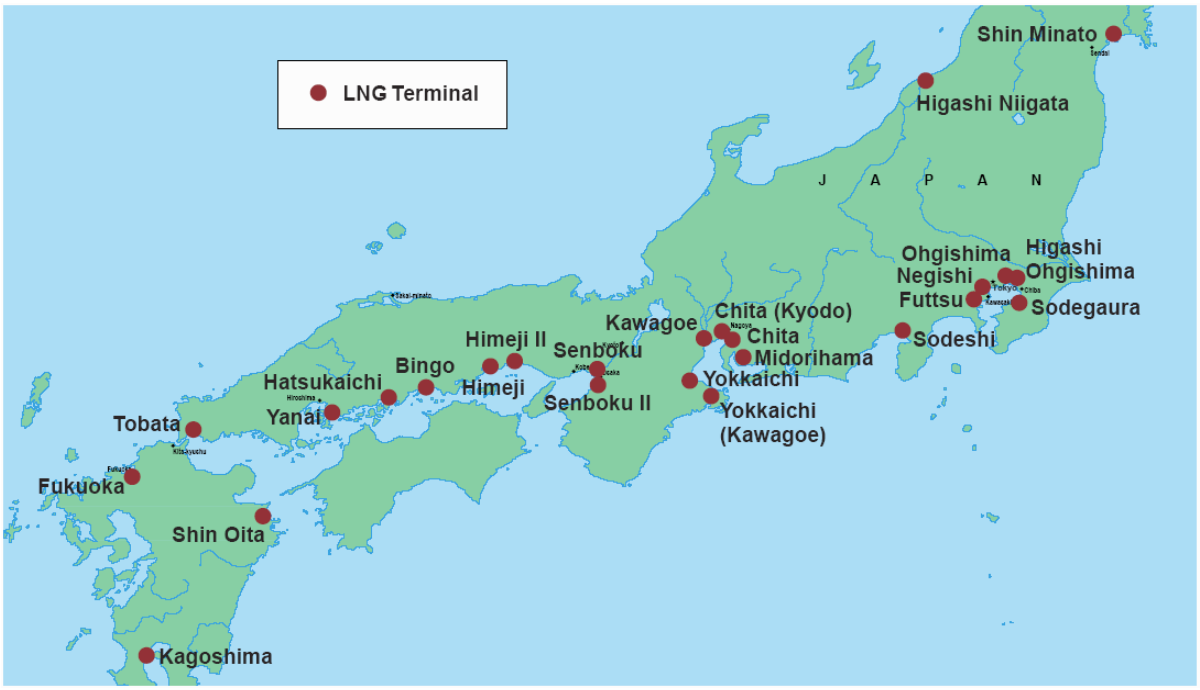
Table 10: LNG Receiving Terminals in Japan, 2007 (year-end)

Terminals	Operator	Start up	Capacity Bcm/year
Existing (2007 year-end)			
Negishi	Tokyo Gas	1969	15.60
Senboku 1	Osaka Gas	1972	3.20
Sodegaura	Tokyo Gas	1973	37.80
Senboku 2	Osaka Gas	1977	16.60
Chita Kyodo	Toho Gas	1977	10.40
Tabata	Kitakyushu LNG	1977	8.80
Himeji LNG	Kansai Electric	1979	11.00
Chita	Chita LNG	1983	15.70
Himeji	Osaka Gas	1984	6.40
Higashi-Niigata	Nihonkai LNG	1984	11.60
Higashi Ogishima	Tokyo Electric	1984	20.00
Futtsu	Tokyo Electric	1985	26.00
Yokkaichi LNG Center	Chubu Electric	1987	9.20
Oita	Oita LNG	1990	6.27
Yanai	Chugoku Electric	1990	3.10
Yokkaichi	Toho Gas	1991	0.90
Fukuoka	Saibu Gas	1993	1.10
Hatsukaichi	Hiroshima Gas	1996	0.74
Sodeshi	Shimizu LNG	1996	1.10
Kagoshima	Nihon Gas	1996	0.30
Kawagoe	Chubu Electric	1997	7.10
Sendai	Sendai City Gas	1997	0.38
Ogishima	Tokyo Gas	1998	7.70
Chita-Midorihama	Toho Gas	2001	6.90
Nagasaki	Saibu Gas	2003	0.20
Mizushima	Chugoku Electric	2006	1.30
Sakai	Sakai LNG	2006	8.70
Total			238.09
Under Planning			

Wakayama	Kansai Electric	N.A	N.A
Joetsu	Chubu Electric	N.A	N.A
Omaezaki	Chubu Gas	2010	N.A
Sakaide	Shikoku Electric	2010	0.55
Kumamoto	Saibu Gas	N.A	N.A
Nakagusuku	Okinawa Electric	2010	0.97
Naoetsu	INPEX	2013	N.A

Source: Tetsuo Morikawa, "Natural Gas and LNG Supply/Demand Trends in Asia Pacific and Atlantic Markets (FY2007)", Institute of Energy Economics, Japan, July 2008 (http://eneken.iiej.or.jp/en/data/pdf/447.pdf).

Figure 2: LNG Import Terminals in Japan



Source: Energy Information Administration, *The Global Liquefied Natural Gas Market: Status and Outlook*, U.S. Department of Energy, Washington DC, December 2003, p. 19 (http://www.eia.doe.gov/oiaf/analysispaper/ global/pdf/eia_0637.pdf).

7. EXPECTED INCREASE IN LNG IMPORTS TO JAPAN

LNG sales on the Japanese market rose sharply to 92.13 billion cubic meters in 2008. The shutdown of some of the largest nuclear plants in the country (especially Kashiwasaki-Kariwa operated by Tokyo Electric Power Company) is responsible for the sharp rise in LNG imports to Japan. Under long-term contracts and "spot" cargo purchases, nearly all LNG producers now participate in supplying Japanese buyers. This section reviews potential demand for natural gas in Japan over the period to 2015. The analysis of projected LNG

imports to Japan is based on Global Trade and Environment Model (GTEM) developed by the Australian Bureau of Agricultural and Resource Economics (ABARE, 2004). To meet future Japanese natural gas demand, prospects for potential expansion in LNG exports from Brunei is discussed in section 8.

Economic activity is a key driver of demand for gas in Japan. With the economy assumed to contract by 2.5 per cent in 2009, this is expected to result in lower gas consumption, which in turn could result in lower imports of LNG. LNG imports into Japan are projected to grow steadily after 2009, supported by government policies aimed at increasing the share of gas in energy mix for Japan. The Japanese Government has encouraged increased natural gas consumption in the electricity generation sector because it is cost effective compared with oil, has lower greenhouse gas emissions than coal and is more reliable than nuclear power. Over the past five years nuclear generation utilisation has not met planned output levels. A number of maintenance and safety issues have resulted in the shutdown of some reactors. For example, for a large part of 2008, nuclear generation sector in Japan operated at a utilisation rate of less than 50 per cent [Sandu and Copeland, 2009, p 142].

A large proportion of increased LNG imports to Japan will be consumed in new gas-fired power stations. In 2008, four new gas-fired power stations were brought into operation with a combined capacity of 2600 megawatts. These power stations could consume the equivalent of 7 million tonnes of LNG if they were to operate at full capacity. In the period between 2009 and 2013 an additional four gas-fired power stations are scheduled to enter operation at a capacity of 5200 megawatts. New capacity includes Futtsu (1000 megawatts, 2009) and Kawasaki (500 megawatts, 2013) of Tokyo Electric Power Company, 1785 megawatts Joetsu plant (2013) of Chubu Electric, and 750 megawatts Sakai-ko power plant (2010) of Kansai Electric [Sandu and Copeland, 2009, p 142].

With this growing demand for natural gas in Japan, LNG imports are expected to increase in the next few years. ABARE (2004) forecasts that LNG imports to Japan will reach 61.4 million tons a year by 2015. Assuming annual domestic production of natural gas at 1.8 million tons a year to 2015, the remainder of gas consumption in Japan is expected to be met by imports. It is also expected that all of gas imports to Japan out to 2015 will continue to be met by LNG.

Based on known long term contracts, contracted supply of LNG in Japan at 2010 will be 57.6 million tons. This leaves Japan with uncontracted LNG demand of 1.7 million tons in that year [ABARE 2004, p. 48]. With the expiry of further LNG contracts and growth in gas demand, the shortfall between demand and currently contracted supply is expected to rise strongly between 2010 and 2015, to 24 million tons a year in 2015. Within the same timeframe, further shortfalls are predicted for Korea (20 million tons a year), Taiwan (5 million tons a year), India (6 million tons a year), and China (12 million tons a year). Table 11 shows ABARE (2004) forecast for LNG supply shortfalls in Japan and other Asian importers over the period to 2015.

Table 11: Projected Natural Gas Demand and Supply in Japan and Other Asian Importers for 2015 (in million tons)

	Japan	S.Korea	Taiwan	India	China	Total
Projected natural gas demand	63.2	33.3	12.6	51.2	56.2	216.5
Projected domestic supply	1.8	0.4	0.5	40.0	37.9	80.6
Projected LNG imports	61.4	32.9	12.1	11.2	18.3	135.9
Existing LNG supply contracts	37.3	13.0	7.1	5.0	5.9	68.3
Projected uncontracted gas demand	24.0	19.9	5.0	6.2	12.4	67.5

Source: ABARE, *The Asia Pacific LNG Market: Issues and Outlook*, ABARE Research Report 04.1, Australian Bureau of Agricultural and Resource Economics, Canberra, November 2004, Tables 13, 21, 29, 36 and 43. (This report was prepared by Allison Ball, Karen Schneider, Lindsay Fairhead and Christopher Short).

The shortfall in currently contracted gas supply in Japan will need to be met by additional LNG imports. This will provide opportunities for LNG suppliers for selling gas to Japanese customers in the coming years to 2015. Competition for supply of LNG to Japanese customers will be keen, but Brunei can play a significant role towards filling the predicted LNG requirements in Japan.

Some of the uncontracted LNG demand stated above will be met by the renewal of existing long term contracts. However, ABARE [2004, p. 174] suggest that some proportion of potentially renewable contractual volumes could be genuinely contestable.

8. EXPANSION OF LNG EXPORTS FROM BRUNEI

For any expansion in gas exports from Brunei, the rate of potential growth in LNG imports to Japan will be dominant factor. This section looks at the prospects for further expansion in LNG exports from Brunei under the consideration of LNG supply shortfall problem in Japan over the medium term period to 2015.

The original capacity of Brunei LNG (BLNG) plant was 5 million tons per annum, but this has been increased to 7.5 million tons. Despite the expansion, there is room to further develop the plant in its current location. Any expansion could be made in conjunction with the existing facilities and would need much less capital input, a major consideration at a time of inflating costs. Until recently, a new LNG plant cost US$200 million per 1 million tons of capacity. In order to create competition for resources, materials and people as the global LNG industry goes for massive expansion, the cost has increased to US$1 billion per 1 million ton capacity [Oxford Business Group, 2007, p. 78].

There is one proposed LNG project in Brunei over the period to 2015, which is an extension to the existing BLNG facility. A sixth train is planned, which would increase annual LNG supply capacity of BLNG by 4.0 million tons to 11.2 million tons (Table 12). The company is delaying its plans pending new supplies of gas from either existing sources or new finds. Brunei Shell Petroleum Company (BSP), a venture between Brunei government and Shell, found gas in the Bubut area in 2007 [Oxford Business Group 2008, p. 51]. The Bubut platform is located in shallow water 7 kilometer offshore and 15 kilometers (9 miles) from the Brunei LNG plant. However, details on reserves and output from the new field are not available. The Bubut discovery is not adequate to support a new production line (sixth train), but it may supplement gas production from Ampa and Champion areas. In May 2008, Total E&P Borneo announced that it had made a significant discovery of gas in Block B, around 50 kilometers off the coast and in some 62 meters of water. According to Mohammad Jaafar, Chief Executive Officer of Petroleum BRUNEI "...if the discoveries are big then we can talk about ... a sixth train for the liquid natural gas" [Oxford Business Group, 2008, p. 54][5].

[5] PetroleumBRUNEI (also known as Brunei National Petroleum Corporation) is the national oil company established by the Government in 2002. It is responsible for managing the assets of Brunei in its joint oil gas ventures and for regulating the petroleum industry in Brunei.

Table 12: Potential LNG Supply Capacity, Asia Pacific and Middle East (in Millions Tons)

	2004	2010	2015
Indonesia	29.4	39.6	39.6
Malaysia	22.2	22.2	22.2
Australia	11.7	43.2	53.2
Brunei	7.2	11.2	11.2
Qatar	19.6	19.6	19.6
Oman	6.6	8.3	8.3
Abu Dhabi	5.7	5.7	5.7
Total	102.4	149.8	159.8

Source: ABARE, *The Asia Pacific LNG Market: Issues and Outlook*, ABARE Research Report 04.1, Australian Bureau of Agricultural and Resource Economics, Canberra, November 2004, Table 99. (This report was prepared by Allison Ball, Karen Schneider, Lindsay Fairhead and Christopher Short).

Another reason for delaying the addition of a sixth train is the territorial dispute between Brunei and Malaysia that has stalled exploration of promising offshore J and K blocks of Brunei [Brunei Government, 2008b, p. 80]. Block J covers an area of 5020 square kilometers. Its southern boundary is located about 100 kilometers north-west of Brunei, at depths between 800 and 2800 meters below sea level. Block J is in 200-nautical-mile exclusion zone of Brunei. There is hope that the dispute over Block J will reach a satisfactory conclusion soon, releasing more reserves onto the market. New gas finds in those two disputed blocks could set Brunei on the path to major expansion of its LNG industry.

Expansion in LNG exports from Brunei (in terms of the addition of a sixth train) would also depend on consumption of natural gas in a methanol export facility in Brunei. The methanol plant, which is capable of producing 850,000 metric tons of methanol per year, is the first gas-based petrochemicals plant in Brunei. The Brunei Methanol Company is developing the plant through a joint venture between Petroleum Brunei and two leading Japanese companies, Mitsubishi Gas Chemical Co Inc and Itochu Corporation. The construction of the plant is expected to be completed soon, and its commercial operation is scheduled to begin in early 2010. Because of strategic location of Brunei, Brunei Methanol Company targets to serve the growing demands in the regional

markets, such as Japan, South Korea, Taiwan, Singapore, Thailand and potentially the west coast of the United States.

But the plan for implementing the sixth train may meet stiff competition from already established rival centers in the region such as Malaysia, Indonesia and Australia.

In 2013, Brunei also has plans to modernize its existing LNG plant to maintain production capacity and extend its operating life for another 20 years to 2033 [ABARE 2004, p. 129]. With the renewal of the contracts on the horizon, Brunei LNG plant was faced with a decision as to whether it should rejuvenate its existing five LNG trains or replace them with two new liquefaction trains with comparable capacity. Considering that it did not want to lose production, not to mention the prohibitive rising costs of building new plants, Brunei LNG plant opted to rejuvenate its current LNG trains. As such, it has developed a B$500 million (US$330.5 million) asset reference plan to ensure that the plant is in the right condition to be able to operate another 20 years and will be able to retain its position in top 25 percent of global LNG plants in terms of reliability.

9. CONCLUDING REMARKS

We have analyzed the current status and future prospects of LNG exports from Brunei. Expansion of LNG exports from Brunei is analyzed with respect to expected LNG demand in Japan over the medium term to 2015. The analysis of projected LNG demand in Japan is based on global trade and environment model (GTEM) developed by the Australian Bureau of Agricultural and Resource Economics [ABARE, 2004].

LNG is a commodity very important to Japan and Brunei. With limited domestic gas resources and no pipeline imports of natural gas, LNG imports have been essential to fueling gas demand in Japan. Similarly, Brunei is lacking domestic uses for natural gas, the only alternative means of exploiting it was to export it as LNG. In addition, LNG is the leading source of foreign exchange for the country which is critical to its national development and economic well being.

LNG currently accounts for 98 percent of gas consumption in Japan. LNG demand in Japan is expected to continue to expand, supported by economic growth, ongoing security concerns and to address environmental issues. The projected expansion in LNG consumption in Japan will provide opportunities for LNG suppliers. Japan is biggest buyer of LNG in the world, followed by South Korea. According to the Australian Bureau of Agricultural and Resource Economics (ABARE), Japan could face a gap in supply of natural gas of 24 million tons by 2015. Indonesia, Malaysia, Brunei, Australia and Qatar, which have been supplying up to 80 percent of natural gas supply to Japan, may need to expand their LNG export facilities to meet future shortfalls in Japan.

Brunei is one of the potential suppliers to meet future LNG requirements in Japan, with a proposed project over the medium term to 2015. The proposed project in Brunei is to expand its existing plant that could potentially expand current export capacity by 4 million tons a year to 11.2 million tons.

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