# Natural Gas and LNG Supply/Demand Trends in Asia Pacific and Atlantic Markets* (FY2007)

Tetsuo Morikawa, Senior Researcher
Strategy and Industrial Research Unit – Oil & Gas Strategy Group

## Introduction

This paper discusses a portion of the outcome of a study undertaken by the Institute of Energy Economics, Japan (IEEJ) on commission from the Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry under the project title of "FY2007 Research for Promotion of Natural Gas Development and Utilization (Study of Natural Gas Supply and Demand Trends in Asia Pacific and Atlantic Markets)". The scope of the above study included a fixed-point observation survey on the on-going status of countries that are either exporting or importing LNG as well as trends in the LNG markets, which potentially may have an impact on Japan's natural gas supply and demand situation. In the following sections, an overview will be presented in sequence on the natural gas supply and demand situation, natural gas trading, the LNG chain, and LNG supply and demand balance.

## 1. Natural gas supply and demand situation

The world natural gas reserves at the beginning of 2007 stood at 183.1 Trillion Cubic Meters (Tcm), with the Middle East and the former Soviet Union respectively accounting for about 40% and 30% of the total. On the other hand, the reserves in Asia and Oceania were 16.3 Tcm, representing no more than 8.9% of the world total. The world natural gas production in 2006 was 2.89 Tcm, with North America and the former Soviet Union each making up 26.1% and 27.0%, respectively, while Asia and Oceania accounted for 13.1% of the total. In terms of consumption, large volumes are notable in North America and the former Soviet Union, both with vast production capacities, as well as in Europe with considerable natural gas trading activities based on regional supplies or those originating from Africa and the former Soviet Union as supported by well-developed pipeline networks. Natural gas consumption in Asia and Oceania was 426.7 Billion Cubic Meters (Bcm), accounting for 14.8% of the world total (see Chart 1 and Chart 2).

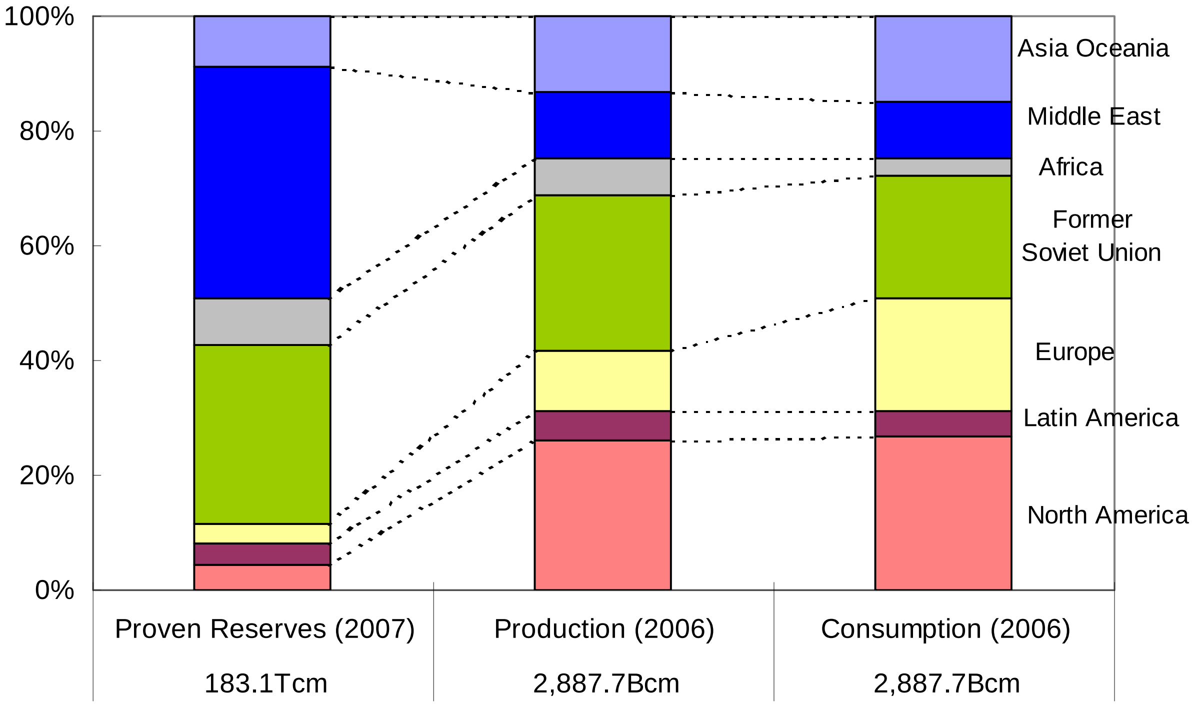
* This paper is an excerpt from a research work commissioned by the Ministry of Economy, Trade and Industry in FY2007, and has been released with the permission of the Ministry. We thank the related parties in the Ministry for their understanding and cooperation. We are also grateful to the Working Group members for their contribution to this research.

[Chart 1] World Natural Gas Reserves, Production and Consumption

| | Proven Reseraves (2007) | | Production (2006) | | Consumption (2006) | |
|---|---|---|---|---|---|---|
| | (Tcm) | Share(%) | (Bcm) | Share(%) | (Bcm) | Share(%) |
| North America | 8.0 | 4.4 | 753.2 | 26.1 | 769.9 | 26.7 |
| Latin America | 6.9 | 3.8 | 147.0 | 5.1 | 130.8 | 4.5 |
| Europe | 6.3 | 3.4 | 305.4 | 10.6 | 568.3 | 19.7 |
| Former Soviet Union | 57.2 | 31.2 | 778.7 | 27.0 | 616.4 | 21.3 |
| Africa | 14.5 | 7.9 | 191.7 | 6.6 | 88.5 | 3.1 |
| Middle East | 73.9 | 40.4 | 334.8 | 11.6 | 287.1 | 9.9 |
| Asia Oceania | 16.3 | 8.9 | 377.0 | 13.1 | 426.7 | 14.8 |
| Total | 183.1 | 100.0 | 2,887.7 | 100.0 | 2,887.7 | 100.0 |

(Source) *Natural Gas in the World*, Cedigaz

[Chart 2] World Natural Gas Reserves, Production, and Consumption by Region



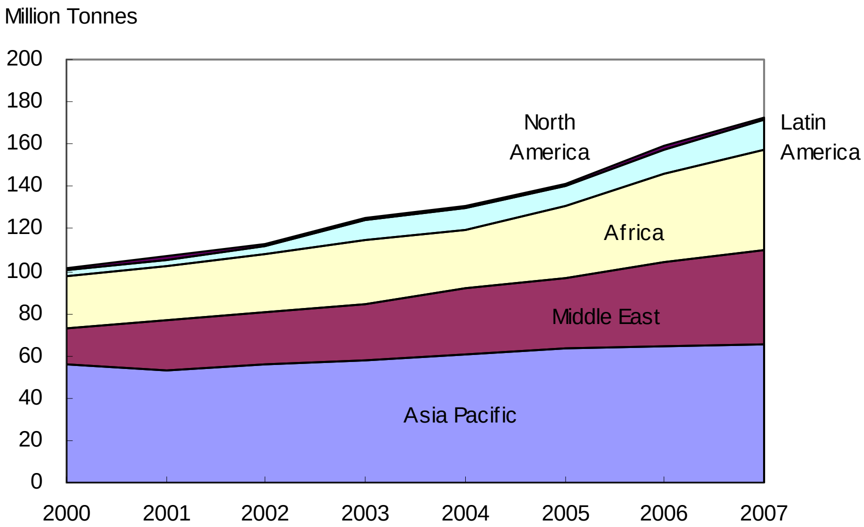

(Source) *Natural Gas in the World*, Cedigaz

2. LNG trading

2.1. LNG imports and exports:

The worldwide trading volume of natural gas in 2007 was 172.6 million tonnes (MT). The global LNG trade has expanded at an average annual rate of 8% between 2000 and 2007. During 2007, the total exports increased as much as 13.66 MT as the RasGas II Train 3 in Qatar (in March), the EG LNG plant in Equatorial Guinea (May), the Snohvit export terminal in Norway (September), and the NLNG Train 6 in Nigeria (December) started their respective operations. In terms of the 2007 export volumes by region, Asia Pacific accounted for 38% of the world total, while 28% was sourced from the Middle East, 27% from Africa, 8% from Central and Latin America, and 1% from North America (see Chart 3).

[Chart 3] LNG Exports by Region



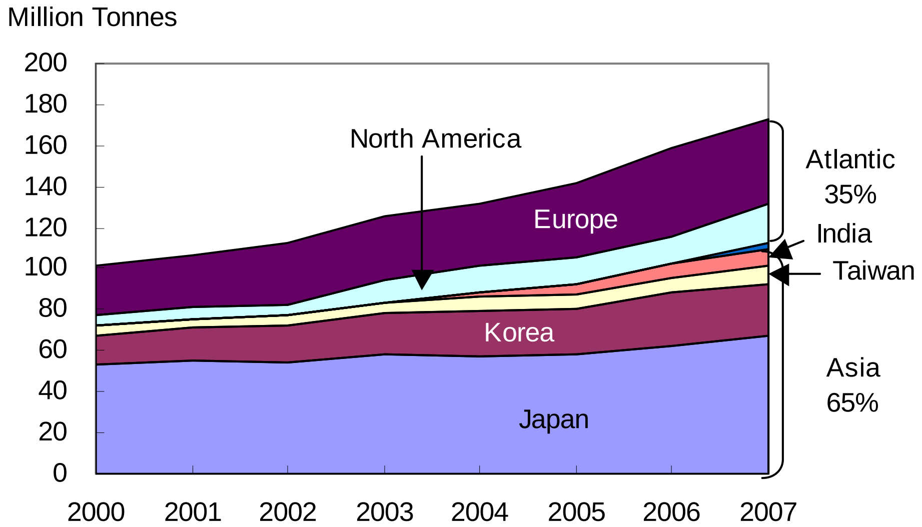

(Source) *Natural Gas in the World*, Cedigaz

Concerning imports by region, LNG demand in the Asia Pacific market[1] in 2007 was 112.5 MT, while the Atlantic market[2] had a demand of 60.1 MT. Over the period from 2000 to 2007, the average annual growth rate for the Asia Pacific market demand reached 7%, whereas the Atlantic market grew by an annual rate of 8% for the same period (see Chart 4). For 2007, the total imports grew by 9.64 MT from the previous year as the demand expanded substantially in Japan and India, and the LNG imports by China went into full swing.

[1] Consists of Japan, Korea, Taiwan, India and China as of 2007.

[2] Consists of the USA, Puerto Rico, Dominican Republic, Mexico, Belgium, France, Spain, Portugal, Italy, Greece, Turkey, and the UK as of 2007.

[Chart 4] LNG Imports by Region




(Source) *Natural Gas in the World*, Cedigaz

2.2. Mid/long-term contracts:

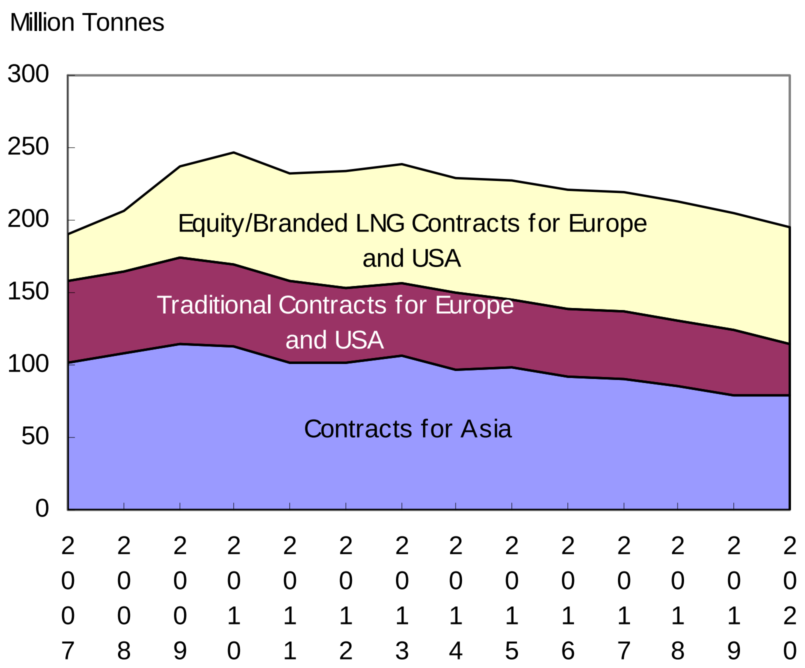
Most LNG trades are based on long term contracts extending over twenty years or longer, although volumes under mid-term contracts or spot deals have also increased in recent years. As of 2007, the total volume on mid/long-term LNG contracts amounted to 190.65 MT. As will be discussed later, a substantial increase in demand is anticipated in the European and the U.S. markets, which are reflected in the contracted volume through 2020 (see Chart 5). A noteworthy fact here is that a considerable portion of volumes in newly concluded contracts for the European/U.S. deliveries takes transaction forms known in the industry as an “Equity LNG”, where a contractual seller lifts the LNG for its own marketing, or a “Branded LNG”, in which a non-consuming buyer purchases LNG for marketing without specifying the supply sources.[3]

While the volume under the Equity/Branded LNG contracts for the European/U.S. deliveries did not even reach 10% of the world total in 2000, it accounted for 37% (about 33 MT) of the contract volume for the European/U.S. deliveries in 2007 and is expected to grow to as high as 64% by 2015. Since these types of contract often do not specify the cargo destination to one location, it is likely that a certain portion of the contract volume will be diverted in response to the intermarket supply-demand and price situations, within the allowance of individual contract terms. There also is a view expressed by an energy consultant that the increased trade volumes are contributing to balance the seasonal demand fluctuations.[4]

[3] These terms discussed in this paper follow the definitions provided in “LNG in 2007 – Strong growth but continuing uncertainty over supply”, by Andy Flower in *LNG Focus*, *February-March 2008*.

[4] “LNG in 2007 – Strong growth but continuing uncertainty over supply” by Andy Flower, *LNG Focus*, *February-March 2008*.

[Chart 5] Projected Mid/Long Term LNG Contract Volumes by Region




Notes:

1. The figures referred to in this chart are the total of volumes provided in Sale and Purchase Agreements (SPAs) and Heads of Agreements (HOAs), excluding those volumes expressed in Memorandums of Understanding (MOUs) or Letters of Intent (LOIs).
2. Where there is a range in the contractual volume, the lowest value is used for the projection and optional volumes are not included in the data.

Sources: GIIGNL, Press releases by respective project operators.

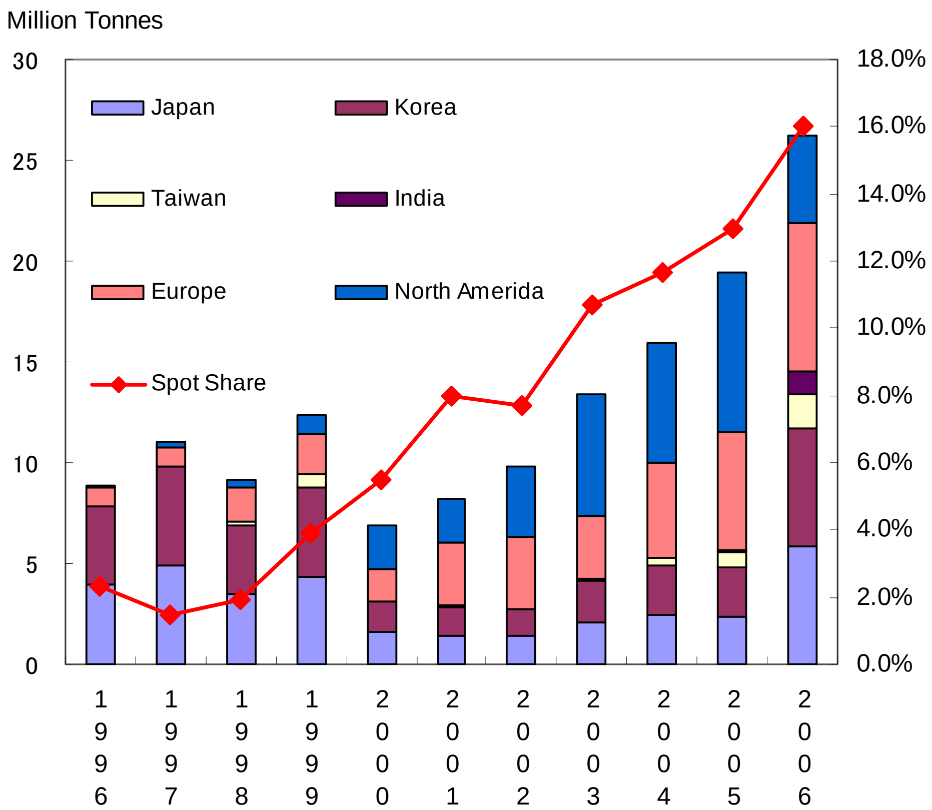
## 2.3. Spot/short-term trades:

The volume of LNG trades with spot or short-term contracts in 2006 was 25.47 MT worldwide, of which 4.29 MT was for deliveries into the U.S.A., 7.40 MT was for Europe, and 13.79 MT was for the Asian market. The above volume represents 16% of the global LNG trades, where a significant growth is notable after the late 1990s (see Chart 6). It should be noted that the spot or short-term trading discussed here refers to transactions made under contracts with terms of one year or less. It seems the cargo-by-cargo spot transactions remain to be limited in the case of LNG trade.[5] While the liqiodity in LNG trading is still low in comparison with crude oil or petroleum products trading, it is also a fact that the volume of spot or short-term trading is rapidly on the rise. In particular, the

[5] Although it is generally considered that spot transactions account for 30% or so in the crude oil trades, the percentage share refers to the ratio of cargo based transactions in the overall trade volume. Thus, the definition of “spot trade” differs between crude oil trades and those of LNG.

volumes transacted under the Equity/Branded LNG contracts mentioned above would likely be accounted for as spot or short-term transactions in statistical processing. As a consequence, the volumes on spot or short-term deals are envisaged to increase to a certain extent, augmenting the い liquidity in LNG trading.

[Chart 6] The Share of Spot Transactions of the World LNG Trades



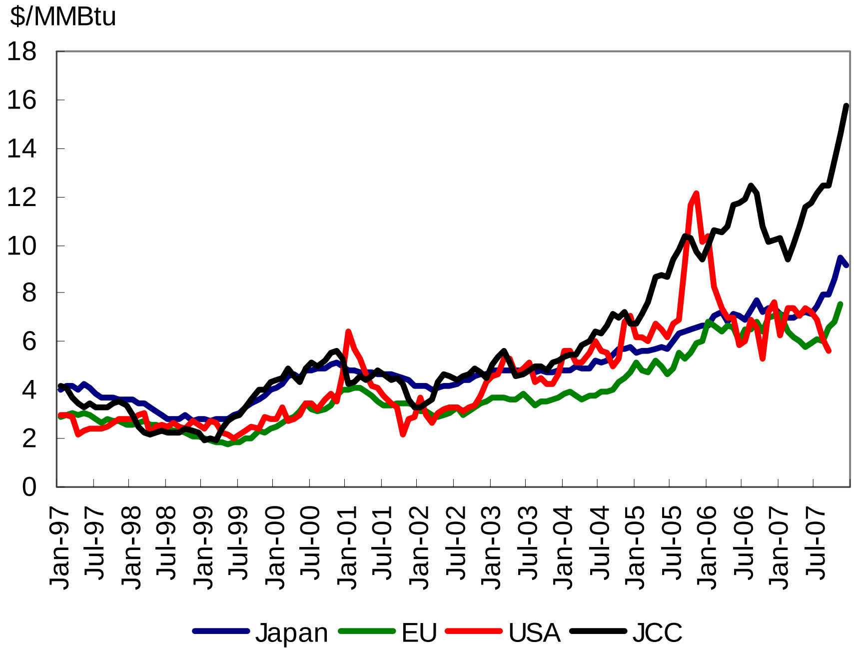

Sources: GIIGNL, Cedigaz

2.4. LNG pricing:

Pricing mechanisms for imported LNG vary from region to region. In Asia, LNG prices are generally linked to the so-called JCC (“Japan Crude Cocktail”), which is an average CIF price of crude oil imported into Japan, whereas in continental Europe they are linked to published indices for petroleum products or the Brent crude oil price. For the U.S.A or U.K. deliveries, LNG prices are determined by supply and demand situations at market places such as Henry Hub in the U.S.A or National Balancing Point (NBP) in the U.K.

Chart 7 shows the historical LNG import prices into Japan, the U.S.A. and the EU. Up until 2000 or so, LNG prices for Japan remained at relatively higher levels in comparison with the U.S.A. or the EU. While the LNG prices for delivery into Japan is on the rise in line with the increase in the JCC prices, the rate of increase has been restrained at a lower level than that of the JCC thanks to a moderating factor built into the pricing formula. Prices for delivery into the EU region show similar movements to those of Japan, since both prices are linked to crude oil or petroleum product prices. LNG prices into the U.S.A. have been on an upward trend since 1999 reflecting the escalated prices for domestic natural gas and are highly volatile as well.

[Chart 7] Historical LNG Import Prices




Source: *Energy Prices & Taxes*, IEA

As far as the LNG supply for Japan is concerned, it would appear unlikely to see a drastic change in the present oil-linked pricing system. It follows then that the main factors governing the long-term contract price trend for future deliveries to Japan should be the crude oil price levels and the extent to which the crude prices are linked in individual contracts. For the spot prices for Japan deliveries, factors such as gas price levels in the Atlantic markets like the U.S. or the U.K. as well as spot prices for Asian countries may have an impact in addition to the crude oil prices.

3. The LNG chain

3.1. Liquefaction plants:

The annual LNG production capacity currently available in the world stands at 198 MT at the end of 2007. On a regional basis, Asia Pacific has the largest capacity of 73.6 MT, followed by Africa and the Middle East at 58 MT and 46.1 MT respectively; with North and Central America having 16.1 MT (see Chart 8). LNG supplies for Asian countries are sourced mainly from Asia Pacific, North America and the Middle East, while LNG shipped to the U.S. and European destinations is primarily supplied from Africa and the Latin America.

Qatar, which overtook Indonesia as the world's largest LNG exporter in 2006, presently has a liquefaction capacity of 30.4 MT per year with additional large-scale expansion plans in progress. Although the export facilities at EG LNG in Equatorial Guinea and Snohvit in Norway had initial troubles in their liquefaction facilities after they were both brought on line in 2007, they are now back in normal operation.

[Chart 8] Existing LNG Production Plants (at the end of 2007)

| Region | Country | Project (Train) | Capacity (MT/y) | Start Up | Investors | | Buyer (Quantity): Contract Duration |
|---|---|---|---|---|---|---|---|
| | | | | | Gas Field | Liquefaction Plant | |
| Africa | Algeria | Arzew GL4Z (Train 1-3) | 1.1 | 1964 | Sonatrach | | GdF(2.5): 1976-2019<br>GdF(3.7): 1982-2019<br>GdF(1.3): 1992-2019<br>Duke(3.2): 1989-2009<br>Botas(3.0): 1994-2014<br>ENI(1.4): 1997-2014<br>Enel(1.15): 1999-2022<br>DEPA(0.50): 2000-2021<br>Iberdrola(0.73): 2002-2021<br>Cepsa(0.45): 2002-<br>Endesa(0.75): 2005-2017 |
| | | Arzew GL1Z (Train 1-6) | 7.8 | 1978 | | | |
| | | Arzew GL2Z (Train 1-6) | 8.0 | 1980 | | | |
| | | Skikda GL1K Ⅱ (Train 4-6) | 3.0 | 1980 | | | |
| | Libya | Marsa el Brega (Train 1-2 ) | 0.6 | 1970 | Sirte Oil | | Gas Natural(1.15): 1981-2008 |
| | Nigeria | Nigeria LNG (Train 1, 2) | 6.4 | 1999 | NNPC, Shell, Total, ENI | NNPC(49), Shell(25.6), Total(15), ENI(10.4) | GdF(0.36): 1999-2021<br>Enel(2.5): 1999-2019<br>Gas Natural(1.17): 1999-2021<br>Gas Natural(1.99): 2002-2024<br>Endesa(0.75): 2005-2025<br>Iberdrola(0.36): 2005-2025<br>ENI(1.15): 2006-2028<br>Botas(0.9): 1999-2021<br>Transgas(1.42): 2002-2023<br>BG(2.5): 2004-2023<br>Shell(1.54): 1.54<br>Total(0.2): 2005-2026 |
| | | Nigeria LNG (Train 3) | 3.2 | 2002 | | | |
| | | Nigeria LNG (Train 4, 5) | 8.2 | 2006 | | | |
| | | NLNG (Train 6) | 4.1 | 2007 | NNPC, Shell, Total, ENI | NNPC(49), Shell(25.6), Total(15), ENI(10.4) | Shell(1.4): 2007-2027<br>Endesa(0.75): 2006-2016<br>Total(N.A.) |

[Chart 8] Existing LNG Production Plants (at the end of 2007) (continued)

<table>
<tr><th rowspan="2">Region</th><th rowspan="2">Country</th><th rowspan="2">Project (Train)</th><th rowspan="2">Capacity (MT/y)</th><th rowspan="2">Start Up</th><th colspan="2">Investors</th><th rowspan="2">Buyer (Quantity): Contract Duration</th></tr>
<tr><th>Gas Field</th><th>Liquefaction Plant</th></tr>
<tr><td rowspan="5">Africa</td><td rowspan="3">Egypt</td><td>Damietta LNG (Train 1)</td><td>5.0</td><td>2005</td><td>EGPC, EGAS, BP, BG, Petronas</td><td>Union Fenosa Gas(80), EGAS(10), EGPC(10)</td><td>Union Fenosa(3.3): 2005-2029<br>BP(1.2): 2005-2025<br>BG(1.7): 2005-2010</td></tr>
<tr><td>Egyptian LNG (Train 1)</td><td>3.6</td><td>2005</td><td rowspan="2">BG, Petronas</td><td>BG(35.5), Petronas(35.5), EGAS(12), EGPC(12), Gaz de France(5)</td><td>GdF(3.6): 2005-2025</td></tr>
<tr><td>Egyptian LNG (Train 2)</td><td>3.6</td><td>2005</td><td>BG(38), Petronas(38), EGAS(12), EGPC(12)</td><td>BG(3.6): 2006-2023</td></tr>
<tr><td>Equatorial Guinea</td><td>EG LNG (Train 1)</td><td>3.4</td><td>May 2007</td><td>Marathon, Sonagas</td><td>Marathon(60), Sonagas(25), Mitsui(8.5), Marubeni(6.5)</td><td>BG(3.4): 2007-</td></tr>
<tr><td colspan="2">Sub Total</td><td>58.0</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Europe</td><td>Norway</td><td>Snohvit LNG (Train 1)</td><td>4.2</td><td>October 2007</td><td colspan="2">Statoil 33.53%, Petoro 30%, Total 18.4%, Gaz de France 12%, Amerada Hess 3.26%, RWE 2.81%</td><td>Statoil(1.8): 2007-<br>Iberdrola(1.2): 2007-<br>GdF/Total(1.2): 2007-</td></tr>
<tr><td colspan="2">Sub Total</td><td>4.2</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="6">Americas</td><td>USA</td><td>Kenai (Train 1, 2)</td><td>1.3</td><td>1969</td><td colspan="2">ConocoPhilips(70), Marathon(30)</td><td>Tokyo Electric(0.92): 1989-2009<br>Tokyo Gas(0.31): 1989-2009</td></tr>
<tr><td rowspan="4">Trinidad and Tobago</td><td>Atlantic LNG (Train 1)</td><td>3.0</td><td>1999</td><td rowspan="4">BP, BG, Chevron, Petromin, ENI, PetroCanada</td><td>BP(34), BG(26), Repsol-YPF(20), NGC(10), Tractebel(10)</td><td rowspan="4">Gas Natural(1.06): 1999-2018<br>Gas Natural(0.65): 2002-2023<br>Repsol YPF(1.19): 2006-2023<br>Suez(1.63): 1999-2018<br>Suez(0.34): 2000-2020<br>BP(0.8): 2002-2021<br>BG(2.2): 2004-2020<br>Marathon(1.2): 2005-2010<br>BG(1.5): 2005-2026<br>NGC(0.58): 2006-2026</td></tr>
<tr><td>Atlantic LNG (Train 2)</td><td>3.3</td><td>2002</td><td rowspan="2">BP(42.5), BG(32.5), Repsol-YPF(25)</td></tr>
<tr><td>Atlantic LNG (Train 3)</td><td>3.3</td><td>2003</td></tr>
<tr><td>Atlantic LNG (Train 4)</td><td>5.2</td><td>2005</td><td>BP(37.78), BG(28.89), Repsol-YPF(22.22), NGC(11.11)</td></tr>
<tr><td colspan="2">Sub Total</td><td>16.1</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Middle East</td><td rowspan="2">Abu Dhabi</td><td>ADGAS (Train 1, 2)</td><td>3.1</td><td>1977</td><td rowspan="2">ADNOC(100)</td><td rowspan="2">ADNOC(70), Mitsui(15), BP(10), Total(5)</td><td rowspan="2">Tokyo Electric(4.3): 1994-2019</td></tr>
<tr><td>ADGAS (Train 3)</td><td>2.3</td><td>1994</td></tr>
<tr><td rowspan="2">Oman</td><td>Oman LNG (Train 1, 2)</td><td>6.6</td><td>2000</td><td rowspan="2">Oman Government(60), Shell(34), Total(4), Partex(2)</td><td>Oman Government(51), Shell(30), Total(5.54), Mitsubishi(2.77), Mitsui(2.77), Partex(2), Itochu(0.92), Korea LNG(5)</td><td>Osaka Gas(0.66): 2000-2024<br>KOGAS(4.06): 2000-2024<br>BP(0.77): 2004-2009<br>Itochu(0.7): 2006-2026</td></tr>
<tr><td>Qalhat LNG (Train 3)</td><td>3.7</td><td>2005</td><td>Oman Governmenet(47), Oman LNG(37), Union Fenosa(7), Mitsubishi(3), Itochu(3), Osaka Gas(3)</td><td>Mitsubishi(0.8): 2006-2020<br>Osaka Gas(0.8): 2006-2020<br>Union Fenosa Gas(1.6): 2006-2026</td></tr>
</table>

## [Chart 8] Existing LNG Production Plants (at the end of 2007) (continued)

| Region | Country | Project (Train) | Capacity (MT/y) | Start Up | Investors: Gas Field | Investors: Liquefaction Plant | Buyer (Quantity): Contract Duration |
|---|---|---|---|---|---|---|---|
| Middle East | Qatar | Qatargas (Train 1-3) | 9.7 | 1997 | QP(65), Total(20), ExxonMobil(10), Mitsui(2.5), Marubeni(2.5) | QP(65), Total(10), ExxonMobil(10), Mitsui(7.5), Marubeni(7.5) | Chubu Electric(4.0): 1997-2022<br>Tokyo Gas(0.35): 1998-2022<br>Osaka Gas(0.35): 1997-2021<br>Tohoku Electric(0.52): 1999-2022<br>Kansai Electric(0.29): 1999-2022<br>Chugoku Electric(0.12): 1999-2022<br>Tokyo Electric(0.2): 1999-2022<br>Toho Gas(0.17): 2000-2022<br>Gas Natural(0.66): 2001-2012<br>Gas Natural(0.66): 2002-2012<br>Gas Natural(0.75): 2005-2025<br>Gas Natural(0.75): 2006-2025<br>Iberdrola(0.88): 2003-2022 |
| | | RasGas (Train 1, 2) | 6.6 | 1999 | QP(63), ExxonMobil(25), KOGAS(5), Itochu(4), LNG Japan(3) | | KOGAS(4.92): 1999-2024<br>Petronet(7.5): 2004-2028<br>Endesa(0.8): 2005-2025<br>ENI(0.75): 2004-2023<br>Edison(4.7): 2007-2032<br>Distrigas(2.05): 2007-2027<br>CPC(3.0): 2008-2033 |
| | | RasGas II (Train 3) | 4.7 | 2004 | QP, ExxonMobil | QP(70), ExxonMobil(30) | |
| | | RasGas II (Train 4) | 4.7 | 2005 | QP, ExxonMobil | QP(70), ExxonMobil(30) | |
| | | RasGas II (Train 5) | 4.7 | March 2007 | N.A. | Qatar Petroleum(70), ExxonMobil(30) | |
| | Sub Total | | 46.1 | | | | |
| Asia Pacific | Brunei | Brunei LNG (Train 1-5) | 7.2 | 1972 -1974 | Brunei Government(50), Shell(50)<br>Total(37.5), Shell(35), Jasra(22.5), Pg Jaya(5) | Brunei Governmenet(50), Shell(25), Mitsubishi(25) | Tokyo Electric(4.03): 1973-2013<br>Tokyo Gas(1.24): 1973-2013<br>Osaka Gas(0.74): 1973-2013<br>KOGAS(0.70): 1997-2013 |
| | Indonesia | Bontang I (Train A, B) | 5.2 | 1977 | VICO, Total, INPEX, Chevron ① Offshore MahakamTotal(50) INPEX(50)②Attaka UnitChevron(50) INPEX(50)③ Makassar Chevron(90) Pertamina(10)④ Ganal Chevron(80) Eni-Ganal(20)⑤ Sanga SangaVICO(23.13)LASMO(26.25)BP(26.25)CPC(20)Universal Gas & Oil(4.37) | Pertamina(55), VICO(20), JILCO(15), Total(10) | Osaka Gas(1.27): 1994-2013<br>Tokyo Gas(0.92): 1994-2013<br>Toho Gas(0.12): 1994-2014<br>Hiroshima Gas(0.21): 1996-2015<br>Osaka Gas(0.1): 1996-2015<br>Nihon Gas(0.08): 1996-2015<br>Kansai Electric(2.57): 2000-2010<br>Chubu Electric(2.15): 2000-2010<br>Kyushu Electric(1.56): 2000-2010<br>Osaka Gas(1.30): 2000-2010<br>Nippon Steel(0.62): 2000-2010<br>Toho Gas(0.25): 2000-2010<br>Chubu Electric(1.65): 2003-2011<br>Kansai Electric(0.88): 2003-2011<br>Osaka Gas(0.44): 2004-2011<br>Toho Gas(0.55): 2003-2011<br>KOGAS(2.0): 1994-2014<br>KOGAS(1.0): 1998-2017<br>CPC(1.57): 1990-2010<br>CPC(1.84): 1998-2017<br>Tohoku Electric(0.85): 2005-2009<br>Tokyo Electric(0.13): 2005-2009<br>KOGAS(2.3): 1986-2007 |
| | | Bontang II (Train C, D) | 5.2 | 1983 | | | |
| | | Bontang III (Train E) | 2.8 | 1989 | | | |
| | | Bontang IV (Train F) | 2.8 | 1993 | | | |
| | | Bontang V (Train G) | 2.8 | 1997 | | | |
| | | Bontang VI (Train H) | 3.0 | 1999 | | | |
| | | Arun I (Train 1) | 1.5 | 1978 | ExxonMobil(100) | Pertamina(55),. ExxonMobil(30), JILCO(15) | |
| | | Arun II (Train 4, 5) | 3.0 | 1984 | | | |
| | | Arun III (Train 6) | 2.0 | 1986 | | | |

[Chart 8] Existing LNG Production Plants (at the end of 2007) (continued)

| Region | Country | Project (Train) | Capacity (MT/y) | Start Up | Investors: Gas Field | Investors: Liquefaction Plant | Buyer (Quantity): Contract Duration |
|---|---|---|---|---|---|---|---|
| Asia Pacific | Malaysia | Malaysia LNG I (Satu) (Train 1-3) | 8.1 | 1983 | Shell(50), Carigali(50) | Petronas(90), Sarawak Government(5), Mitsubishi(5) | Tokyo Electric(4.8): 2003-2018<br>Tokyo Gas(2.6): 2003-2018<br>Saibu Gas(0.2): 1993-2013 |
| | | Malaysia LNG II (Dua) (Train 4-6) | 7.8 | 1995 | | Petronas(60), Shell(15), Mitsubishi(15), Sarawak Government(10), | Saibu Gas(0.16): 1993-2013<br>Tokyo Gas(0.8): 1995-2015<br>Osaka Gas(0.6): 1995-2015<br>Kansai Electric(0.42): 1995-2015<br>Toho Gas(0.28): 1995-2015<br>Tohoku Electric(0.5): 1996-2016<br>Shizuoka Gas(0.45): 1996-2016<br>Sendai City Gas(0.15): 1997-2017<br>KOGAS(2.0): 1995-2015<br>CPC(2.25): 1995-2015 |
| | | Malaysia LNG III (Tiga) (Train 7, 8) | 6.8 | 2003 | Shell(37.5), Nippon Oil(37.5), Carigali(25) | Petronas(60), Shell(15), Nippon Oil(10), Sarawak Government(10), Mitsubishi(5) | JAPEX(0.48): 2003-2023<br>Tokyo Gas(0.34): 2004-2024<br>Toho Gas(0.22): 2004-2024<br>Toho Gas (0.52): 2007-2027<br>Osaka Gas (0.12) : 2006-2024<br>Hiroshima Gas (0.008-0.016): 2005-2012<br>Tohoku Electric(0.5): 2005-2025<br>Toho Gas(0.52): 2007-2027<br>KOGAS(1.5): 2003-2010<br>KOGAS(1.5): 2008-2028<br>CNOOC(3.03): 2009-2034 |
| | | Malaysia LNG (Project Unspecified) | | | | | Osaka Gas(0.92): 2009-2025<br>Shikoku Electric(0.42): 2010-2025<br>Chubu Electric(0.54): 2011-2031<br>Saibu Gas(0.39) :2013-2028 |
| | Australia | NWS (Train 1-4) | 11.9 | 1989-2004 | Woodside(16.7), Shell(16.7), Chevron(16.7), BHP Billiton(16.7), BP(16.7), MIMI(16.7), CNOOC | Woodside(16.7), Shell(16.7), Chevron(16.7), BHP Billiton(16.7), BP(16.7), MIMI(16.7) | Tokyo Gas(0.79→0.53): 1989-2009→2017<br>Tokyo Electric(1.18→0.3): 1989-2009→2016<br>Toho Gas(0.23→0.76): 1989-2009→2019<br>Osaka Gas(0.79→0.5): 1989-2009→2015<br>Kyushu Electric(1.05→0.7): 1989-2009→2017<br>Kansai Electric(1.13→0.4): 1989-2009→2017<br>Chubu Electric(1.05→0.5): 1989-2009→2016<br>Chugoku Electric(1.11→1.43): 1989-2009→2021<br>Kansai Electric(0.50→0.925): 2009-2014→2023<br>KOGAS(0.50): 2003-2007→2016<br>Tokyo Gas(1.07): 2004-2028<br>Toho Gas(0.3): 2004-2028<br>Osaka Gas(1.0): 2004-2034<br>Kyushu Electric(0.5): 2004-2026 |
| | | Darwin LNG | 3.5 | 2006 | ConocoPhillips(56.72), Eni(12.04), Santos(10.63), Inpex(10.53), Tokyo Electric(6.72), Tokyo Gas(3.36) | | Tokyo Electric(2.0): 2006-2023<br>Tokyo Gas(1.0): 2006-2023 |
| | Sub Total | | 73.6 | | | | |
| Total | | | 198.0 | | | | |

Source: Prepared by IEEJ based on respective corporate websites, etc.

In addition to the existing capacities described in the above, there are a number of new projects and expansion programs on existing plants. Such new LNG production capacities that are either under construction or with signed SPAs (Sale and Purchase Agreement) or HOAs (Heads of Agreement) total to 117.4 MT at the end of 2007 and are expected to come on line by 2015. In terms of regional distribution, Africa is slated for a total expansion of 18.1 MT, whereas 53.5 MT is planned in the Middle East, 44.0 MT in Latin America, and 4.2 MT in Asia Pacific. (see Chart 9).

[Chart 9] LNG Production Plants with Signed SPAs/HOAs

| Region | Country | Project (Train) | Capacity (MT/y) | Start Up | Investors: Gas Field | Investors: Liquefaction Plant | Buyer (Quantity): Contract Duration |
|---|---|---|---|---|---|---|---|
| Africa | Algerica | Skikda | 4.5 | 2011 | Sonatrach | | Sonatrach |
| | Nigeria | NLNG<br>(Train 7) | 8.4 | 2012 | NNPC, Shell, Total, ENI | NNPC(49),<br>Shell(25.6),<br>Total(15),<br>ENI(10.4) | BG(2.25): 2012-<br>Total(1.38): 2012-<br>ENI(1.38): 2012- |
| | Angola | Angola LNG<br>(Train 1) | 5.2 | 2012 | Sonagas(22.8%),<br>Chevron(36.4%),<br>Eni(13.6%),Total(13.6%),<br>BP(13.6%) | | Chevron(1.9): 2012-<br>Sonangol(1.2): 2012-<br>Total(0.7): 2012-<br>BP(0.7): 2012-<br>ENI(0.7): 2012- |
| | Sub Total | | 18.1 | | | | |
| Middle East | Qatar | RasGas 3<br>(Train 6) | 7.8 | End 2008 | N.A. | Qatar Petroleum (70),<br>ExxonMobil(30) | ExxonMobil(7.8): 2008- |
| | | RasGas 3<br>(Train 7) | 7.8 | End 2009 | N.A. | Qatar Petroleum(70),<br>ExxonMobil(30) | ExxonMobil(7.8): 2009- |
| | | Qatargas II<br>(Train 1) | 7.8 | 2008 | N.A. | Qatar Petroleum(70),<br>ExxonMobil(30) | ExxonMobil(10.4): 2007-2032<br>Total(5.2): 2009-2034 |
| | | Qatargas II<br>(Train 2) | 7.8 | 2009 | N.A. | Qatar Petroleum(65),<br>ExxonMobil(18.3),<br>Total(16.7) | |
| | | Qatargas 3 | 7.8 | 2009 | N.A. | Qatar Petroleum(68.5),<br>ConocoPhillips(30),<br>Mitsui(1.5) | ConocoPhillips(7.8): 2009- |
| | | Qatargas 4 | 7.8 | End 2009 | N.A. | Qatar Petroleum (70),<br>Shell (30) | Shell(4.8): 2009-<br>PetroChina(3.0): 2009- |
| | Yemen | Yemen LNG<br>(Train 1, 2) | 6.7 | 2009 Q4 | Hunt Oil(38.5),<br>ExxonMobil(37),<br>SK(24.5) | Total(42.9),<br>Yemen Gas(23.1),<br>Hunt Oil(18),<br>SK(10),<br>Hyundai(6) | KOGAS(1.3): 2008-2028<br>Suez(2.5): 2009-2029<br>Total(1.5): 2009-2029 |
| | Sub Total | | 53.5 | | | | |
| Americas | Peru | Peru LNG | 4.4 | 2010 Q2 | Hunt Oil(50), SK(20),<br>Repsol YPF(20), Marubeni(10) | | Repsol YPF(3.6): 2010- |
| | Sub Total | | 4.4 | | | | |

[Chart 9] LNG Production Plants with Signed SPAs/HOAs (continued)

| Region | Country | Project (Train) | Capacity (MT/y) | Start Up | Investors | | Buyer (Quantity): Contract Duration |
|---|---|---|---|---|---|---|---|
| | | | | | Gas Field | Liquefaction Plant | |
| Asia Pacific | Australia | NWS (Train 5) | 4.4 | 2008 Q4 | Woodside, BHP Billiton, BP, Chevron, Shell, MIMI (1/6 each), CNOOC | Woodside, BHP Billiton, BP, Chevron, Shell, MIMI (1/6 each) | Partially same as the NWS Train 1–4 buyers |
| | | Gorgon (Train 1, 2) | 15.0 | 2014–2015? | Chevron(50), Shell(25), ExxonMobil(25) | | Tokyo Gas(1.2): 2010–2035<br>Chubu Electric(1.5): 2010–2035<br>Osaka Gas(1.5): 2010–2035<br>Shell(2.5): 2010–<br>PetroChina(1.0): |
| | | Pluto (Train 1) | 4.8 | End 2010 | Woodside(90)、Tokyo Gas(5)、Kansai Electric (5) | | Tokyo Gas(1.5–1.75): 2010–2025<br>Kansai Electric(1.75–2.0): 2010–2025 |
| | Indonesia | Tangguh (Train 1, 2) | 7.6 | 2008–2009 | BP(37.16), MI Berau BV(16.3), CNOOC(16.96), Nippon Oil(12.23) , KG Berau・KG Wiriagar(10), LNG Japan(7.35) | | POSCO(0.55): 2005–2025<br>CNOOC(2.6): 2007–2032<br>Sempra(3.7): 2008–2028<br>Tohoku Electric(0.12): 2010–2025 |
| | Russia | Sakhalin II (Train 1, 2) | 9.6 | 2008 | Gazprom(50), Shell(27.5), Mitsui(12.5), Mitsubishi(10) | | Tokyo Gas(1.1): 2007–2031<br>Tokyo Electric(1.5): 2007–2029<br>Hiroshima Gas(0.21): 2008–2028<br>Kyushu Electric(0.5): 2009–2031<br>Toho Gas(0.5): 2009–2033<br>Tohoku Electric(0.42): 2010–2030<br>Saibu Gas(0.0085): 2010–2028<br>Chubu Electric(0.5): 2011–2025<br>Osaka Gas(0.2): 2008–2028<br>KOGAS (1.5) : 2008–2028<br>Shell (1.6) : 2008–2028 |
| | Sub Total | | 41.4 | | | | |
| Total | | | 117.4 | | | | |

Source: Prepared by IEEJ based on respective corporate websites, etc.

Furthermore, there are a number of new projects being considered for further commercialization. As shown in Chart 10, the known new LNG production capacities currently under review for commercialization total to 194.4 MT. However, there are significant differences among these projects with respect to the possibility of their realization, depending on factors such as LNG demand trends, political stability and environmental restrictions at project sites, and development strategies adopted by investors. Accordingly, there is no guarantee that all of these projects will be implemented, and, even if they are, they may not necessarily start operations at the indicated timing.

[Chart 10] LNG Production Plants Under Planning

| Region | Country | Project (Train) | Capacity (MT/y) | Start Up | Investors | Destinations |
|---|---|---|---|---|---|---|
| Africa | Algeria | Gassi Touil (Arzew) | 4.0 | N.A. | Sonatrach | Atlantic |
| | Nigeria | Olokola LNG (Train1-4) | 22.0 | 2009-2010 | NNPC(49.5), Chevron(18.5), Shell(18.5), BG(13.5) | USA |
| | | Brass River LNG (Train 1, 2) | 10.0 | 2013 | NNPC(49), Total(17), ConocoPhillips(17), ENI(17) | North America |
| | | Flex LNG | 1.0 | 2011 | Flex LNG, Peak Petroleum | N.A. |
| | Angola | Angola LNG (Train 2) | 6.0 | N.A. | Sonangol, ENI, Gas Natural, Galp, Exem | Atlantic |
| | Egypt | Damietta (Train 2) | 5.0 | N.A. | ENI, BP, EGAS, SEGAS | N.A. |
| | | Egyptian LNG (Train 3) | N.A. | N.A. | BG, RWE | N.A. |
| | | West Damietta | 4.0 | N.A. | Shell, EGPC | N.A. |
| | Libya | Marsa el Brega Refurbishment (Train 1-2 ) | 2.5 | N.A. | NOC, Shell | N.A. |
| | Equatorial Guinea | EG LNG (Train 2) | 4.4 | N.A. | Marathon(60), Sonagas(25), Mitsui(8.5), Marubeni(6.5) | N.A. |
| | Sub Total | | 58.9 | | | |
| Europe | Russia | Shtokman LNG | 7.0 | 2014 | Gazprom | Atlantic |
| | Norway | Snohvit LNG (Train 2) | 4.2 | 2012 | Petro, Statoil, Total, Gaz de France, Amerada Hess, RWE | Atlantic |
| | Sub Total | | 11.2 | | | |
| Middle East | Iran | Pars LNG (Train 1, 2) | 10.0 | 2013 | NIOC(50), Total(40), Petronas(10) | Asia, Europe |
| | | Persian LNG (Train 1, 2) | 16.2 | 2013 | NIOC(50), Shell(25), Repsol(25) | Asia, Europe |
| | | North Pars LNG | 15.0 | 2013 | CNOOC | Chna |
| | | Iran LNG | 10.0 | N.A. | NIOC | Asia |
| | | Qeshm | 1.2 | 2010 | LNG Ltd. | N.A. |
| | Sub Total | | 52.4 | | | |
| Americas | USA | North Slope | 9.0 | N.A. | Yukon Pacific | USA |
| | Venezuela | Mariscal Sucre (Train 1) | 4.7 | 2013 | PDVSA, Shell, Mitsubishi | USA |
| | | Delta Caribe | 4.5 | 2015 | Chevron | Atlantic |
| | Trinidad and Tobago | Atlantic LNG (Train 5) | N.A. | N.A. | N.A. | N.A. |
| | Sub Total | | 18.2 | | | |

[Chart 10] LNG Production Plants Under Planning (Continued)

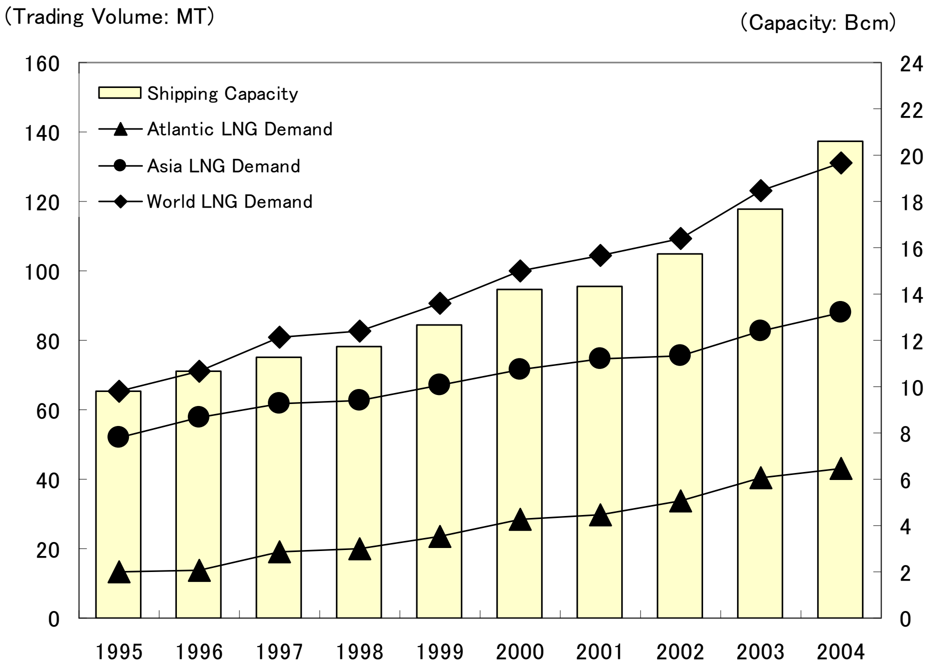
| Region | Country | Project (Train) | Capacity (MT/y) | Start Up | Investors | Destinations |
|---|---|---|---|---|---|---|
| Asia Pacific | Australia | Browse | 7.0 | 2013-2015 | Woodside, Chevron, BP, BHP Billiton, Shell | Asia Pacific |
| | | Greater Sunrise | 7.0 | 2013 | Woodside(33.44), ConocoPhillips(30), Shell(26.56), Osaka Gas(10) | Asia Pacific |
| | | Timor Sea LNG (Tassie Shoal) | 3.6 | N.A. | Methanol Australia | Aisa |
| | | Pilbara | 6.0 | N.A. | BHP Billiton, ExxonMobil | USA |
| | | Pluto (Train 2) | N.A. | 2012 | Woodside | Asia Pacific |
| | | Ichthys | 6.0 | 2012 | INPEX(76), Total(24) | Asia Pacific |
| | | Gladstone | 3.0 | 2014 | Santos | Asia Pacific |
| | | Project Sun | 0.5 | 2012 | Sojitz, Sunshine Gas | N.A. |
| | | Gladstone LNG (Train 1) | 1.3 | 2011 | LNG Ltd. | N.A. |
| | | Gladstone LNG (Train 2) | 1.3 | 2013 | LNG Ltd. | N.A. |
| | | N.A. | 3.0 | 2013 | BG, Queenland Gas | N.A. |
| | Indonesia | Tangguh (Train 3) | N.A. | N.A. | BP, MI Berau, CNOOC, Nippon Oil, KG Berau Wiriagar, LNG JAPAN | Asia Pacific |
| | Indonesia | Natuna | N.A. | N.A. | ExxonMobil, Pertamina | Asia Pacific |
| | | Donggi Senoro LNG | 2.0 | 2010 | Mitsubishi(51), Pertamina(29), Medco(20) | Asia Pacific |
| | | Abadi | 3.0 | 2015 | INPEX | Asia Pacific |
| | Papua New Guinea | N.A. | 5.0 | 2012 | ExxonMobil(42.5), Oil Search(36.6), Santos(13.8), Nippon Oil(2.7)、AGL(3.3)、MRDC(1.1) | Asia Pacific |
| | | PNG LNG | 4.0 | 2012 | InterOil, Merrill Lynch, Clarion Finaz AG | Asia Pacific |
| | | N.A. | 1.0 | 2010 | LNG Ltd. | Asia Pacific |
| | Sub Total | | 53.7 | | | |
| Total | | | 194.4 | | | |

Source: Prepared by IEEJ based on various corporate websites, etc.

3.2. LNG tankers:

As of the 2007 year-end, the number of tankers in the world LNG fleet in operation was 254 with an aggregated loading capacity of 32 Bcm. In the face of growing LNG demand, the number of LNG tankers being built has also been on a steep rise in recent years, and the resultant expansion in the shipping capacity has outstripped the growth in LNG demand (see Chart 11). As a result, recently there are LNG tankers having only spot or short-term charters, or some of them not even having any charter contract.

[Chart 11] LNG Shipping Capacity Trends




Sources: LNG Japan, IEEJ

3.3. Receiving terminals:

As of the 2007 year-end, LNG receiving terminals existed at 58 locations throughout the world, with an aggregated annual storage capacity of 2.6 million Kl, with the total send out capability of 519.18 Bcm per year. In terms of regional distribution, Japan has by far the largest number with 27 terminals, followed by Spain with six terminals, the U.S.A. with five, and South Korea with four (see Chart 12).

[Chart 12] Existing LNG Receiving Terminals (2007 Year-end)

| Region | Country | Name | Investor(s) | Storage (1,000kl) | Send Out Capacity （Bcm/y） | Start-up |
|---|---|---|---|---|---|---|
| アジア | Japan | Sendai | Sendai City Gas | 8.0 | 0.38 | 1997 |
| | | Higashi Niigata | Nihonkai LNG | 72.0 | 11.60 | 1984 |
| | | Futtsu | Tokyo Electric | 111.0 | 26.00 | 1985 |
| | | Sodegaura | Tokyo Electric, Tokyo Gas | 266.0 | 37.80 | 1973 |
| | | Higashi Ogishima | Tokyo Electric | 54.0 | 20.00 | 1984 |
| | | Ogishima | Tokyo Gas | 60.0 | 7.70 | 1998 |
| | | Negishi | Tokyo Electric, Tokyo Gas | 118.0 | 15.60 | 1969 |
| | | Sodeshi | Shimizu LNG | 17.7 | 1.10 | 1996 |
| | | Chita Kyodo | Chubu Electric, Toho Gas | 30.0 | 10.40 | 1977 |
| | | Chita | Chita LNG | 64.0 | 15.70 | 1983 |
| | | Chita Midorihama | Toho Gas | 20.0 | 6.90 | 2001 |
| | | Yokkaichi LNG Center | Chubu Electric | 32.0 | 9.20 | 1987 |
| | | Yokkaichi | Toho Gas | 16.0 | 0.90 | 1991 |
| | | Kawagoe | Chubu Electric | 48.0 | 7.10 | 1997 |
| | | Senboku 1 | Osaka Gas | 18.0 | 3.20 | 1972 |
| | | Senboku 2 | Osaka Gas | 158.5 | 16.60 | 1977 |
| | | Sakai | Sakai LNG | 42.0 | 8.70 | 2006 |
| | | Himeji | Osaka Gas | 74.0 | 6.40 | 1984 |
| | | Himeji LNG | Kansai Electric | 52.0 | 11.00 | 1979 |
| | | Mizushima | Chugoku Electric, Nippon O | 16.0 | 1.30 | 2006 |
| | | Hatsukaichi | Hiroshima Gas | 17.0 | 0.74 | 1996 |
| | | Yanai | Chugoku Electric | 48.0 | 3.10 | 1990 |
| | | Oita | Oita LNG | 46.0 | 6.27 | 1990 |
| | | Tobata | Kitakyushu LNG | 48.0 | 8.80 | 1977 |
| | | Fukuoka | Saibu Gas | 7.0 | 1.10 | 1993 |
| | | Nagasaki | Saibu Gas | 3.5 | 0.20 | 2003 |
| | | Kagoshima | Nihon Gas | 8.6 | 0.30 | 1996 |
| | | Japan Total | | 1,455.3 | 238.09 | |
| | Korea | Pyeong Taek | KOGAS | 100.0 | 27.70 | 1986 |
| | | Inchon | KOGAS | 248.0 | 35.90 | 1996 |
| | | Tong Young | KOGAS | 70.0 | 14.50 | 2002 |
| | | Gwangyang | POSCO | 30.0 | 2.30 | 2005 |
| | | Korea Total | | 448.0 | 80.40 | |
| | Taiwan | Yung An | CPC | 69.0 | 23.00 | 1990 |
| | India | Dahej | Petronet | 32.0 | 7.00 | 2004 |
| | | Hazira | Shell, Total | 32.0 | 3.30 | 2005 |
| | China | Dapeng | CNOOC, BP他 | 32.0 | 4.90 | 2006 |
| | Subtotal | | | 2,041.2 | 356.69 | |

[Chart 12] Existing LNG Receiving Terminals (2007 Year-end) (continued)

| Region | Country | Name | Investor(s) | Storage (1,000kl) | Send Out Capacity (Bcm/y) | Start-up |
|---|---|---|---|---|---|---|
| Americas | USA | Everett | Tractebel LNG | 15.5 | 6.90 | 1971 |
| | | Lake Charles | Trunkline LNG | 28.5 | 18.60 | 1982 |
| | | Cove Point | Dominion | 38.0 | 10.74 | 1978 |
| | | Elba Island | Southern LNG (El Paso) | 19.1 | 8.33 | 1978 |
| | | Gulf Stream, (Off-shore), GOM | Excelerate Energy | N.A. | 4.60 | 2005 |
| | Puerto Rico | Penuelas | EcoElectrica | 16.0 | 3.75 | 2000 |
| | Dominica | Andres | AES | 16.0 | 2.32 | 2003 |
| | Mexico | Altamira | Shell, Total, Mitsui | 30.0 | 5.30 | 2006 |
| | Subtotal | | | 163.1 | 60.54 | |
| Europe | Belgium | Zeebrugge | Fluxys | 26.1 | 5.26 | 1987 |
| | France | Fos-sur-Mer | Gaz de France | 15.0 | 7.00 | 1972 |
| | | Montoir-de-Bretagne | Gaz de France | 36.0 | 10.00 | 1980 |
| | Italy | Panigaglia | Snam | 10.0 | 3.32 | 1971 |
| | Spain | Barcelona | Enagas | 54.0 | 14.45 | 1969 |
| | | Cartagena | Enagas | 28.7 | 10.51 | 1989 |
| | | Huelva | Enagas | 46.0 | 10.51 | 1988 |
| | | Bilbao | BP, Respol, Iberdola, EVE | 30.0 | 7.00 | 2003 |
| | | Sagunto | Union Fenosa, Iberdrola, Endesa | 30.0 | 7.00 | 2006 |
| | | Reganosa | Endesa, Union Fenosa, Tojeiro Group, Caixa Galicia, Xunta de Galicia, Caixanova, | 30.0 | 3.60 | 2007 |
| | Portugal | Sines | Transgas | 12.0 | 5.20 | 2003 |
| | UK | Isle of Grain | National Grid | 20.0 | 4.60 | 2005 |
| | | Teesside GasPort | Excelerate Energy | 4.0 | N.A | 2007 |
| | Greece | Revithoussa | DEPA | 13.0 | 1.30 | 2000 |
| | Turkey | Marmara Ereglisi | Botas | 25.5 | 6.20 | 1994 |
| | | Aliaga/Izmir | Eregaz | 28.0 | 6.00 | 2006 |
| | Subtotal | | | 408.3 | 101.95 | |
| Total | | | | 2,612.6 | 519.18 | |

Source: Prepared by IEEJ based on respective corporate websites, etc.

In addition to existing terminals, a number of new projects are currently being considered for commercial operations (see Chart 13). Such projects are especially numerous in North America and China, where demand for LNG is expected to grow rapidly. However, with regard to the prospect of realization, these projects vary significantly subject to factors such as project economics, environmental and social constraints, respective countries' policies on infrastructure development,.

[Chart 13] LNG Receiving Terminals Under Planning

| Region | Country | Name | Investors | Capacity (MT/y) | Start Up |
|---|---|---|---|---|---|
| North America | USA | Hackberry, LA | Sempra Energy | 20.3 | 2008 |
| | | Freeport, TX | Freeport LNG Development | 30.7 | 2008 |
| | | Sabine, LA | Cheniere Energy | 19.9 | 2008 |
| | | Corpus Christi, TX | Cheniere Energy | 19.9 | 2010 |
| | | Corpus Christi, TX | ExxonMobil | 8.4 | 2008-2009 |
| | | Fall River, MA | Hess LNG | 6.1 | 2010 |
| | | Sabine, TX | ExxonMobil, Qatar Petroleum, ConocoPhillips | 15.3 | 2009 |
| | | Corpus Christi, TX | Occidental Energy | 7.7 | 2008 |
| | | Logan Township, NJ | BP | 9.2 | N.A. |
| | | Port Arthur, TX | Sempra Energy | 12.3 | 2010 |
| | | Cameron, LA | Cheniere Energy | 25.3 | 2011 |
| | | Pascagoula, MS | Gulf LNG | 11.5 | 2009 |
| | | Pascagoula, MS | Chevron | 10.0 | N.A. |
| | | Port Lavaca, TX | Gulf Coast LNG Partners | 7.7 | 2009-2010 |
| | | Port Pelican, LA | Chevron | 12.3 | N.A. |
| | | (Offshore), LA | McMoran | 7.7 | N.A. |
| | | Boston(Offshore), MA | Suez | 3.1 | 2009 |
| | | Boston(Offshore), MA | Excelerate Energy | 6.1 | N.A. |
| | | Long Island Sound, NY | TransCanada, Shell | 7.7 | 2010 |
| | | Pleasant Point, ME | Quoddy Bay | 15.3 | N.A. |
| | | Robbinston, ME | Kestrel Energy | 3.8 | N.A. |
| | | (Offshore), NY | ASIC | 15.3 | N.A. |
| | | Baltimore, MD | AES | 11.5 | N.A. |
| | | (Offshore), GOM | TORP | 10.7 | N.A. |
| | | (Offshore), FL | Suez | 14.6 | N.A. |
| | | （Offshore）, FL | Port Dolphin Energy | 9.2 | N.A. |
| | | Long Beach, CA | Sound Energy Solutions | 5.4 | N.A. |
| | | Bradwood, OR | Northern Star | 7.7 | N.A. |
| | | Coos Bay, OR | Jordan Cove Energy Project | 7.7 | N.A. |
| | | (Offshore), CA | BHP Billiton | 11.5 | N.A. |
| | | (Offshore), CA | Northern Star | 3.8 | N.A. |
| | | (Offshore), CA | Woodside | 9.2 | N.A. |
| | | (Off-shore), CA | Chevron | 5.8 | N.A. |
| | | St. Helens, OR | Port Westward LNG | 5.4 | N.A. |
| | | Philladelphia, PA | PGW | 4.6 | N.A. |
| | | Calais, ME | BP Consulting | N.A. | N.A. |
| | | (Offshore), CA | Excelerate Energy | 4.6 | N.A. |
| | | (Offshore), CA | Tidelands | N.A. | N.A. |

[Chart 13] LNG Receiving Terminals Under Planning (continued)

| Region | Country | Name | Investors | Capacity (MT/y) | Start Up |
|---|---|---|---|---|---|
| North America | Canada | St. John, NB | Canaport LNG | 7.7 | 2008 |
| | | Point Tupper, NS | Venture Energy | 7.7 | 2008 |
| | | Quebec City, QC | Enbridge, Gaz Met, Gaz de France | 3.8 | 2010 |
| | | Riviere-du-Loup, QC | TransCanada, PetroCanada | 3.8 | 2010 |
| | | Kitimat, BC | Galveston LNG | 7.7 | 2010 |
| | | Prince Rupert, BC | WestPac LNG | 3.8 | 2011 |
| | | Goldboro, NS | Keltin Petrochemichals, Petroplus | 7.7 | 2010 |
| | | Energie Grande-Anse | N.A. | 8 | N.A. |
| | Mexico | Costa Azul, Baja California | Shell, Sempra | 7.7 | 2008 |
| | | GNL Mar Adentro, Baja California | Chevron | 10.7 | 2008 |
| | | Lazaro Cardenas | Tractebel, Repsol-YPF | 3.8 | 2008 |
| | | Puerto Libertad, Sonora | DKRW Energy | 10.0 | 2011 |
| | | Gulf of Mexico(Offshore) | Tidelands | 7.7 | 2008 |
| | | Manzanillo | CFE, PEMEX, Mitsui, KOGAS | 3.8 | 2011 |
| | | Topolobampo | TransCanada | 3.8 | N.A. |
| | Bahama | Bahamas | Suez, El Paso | 6.4 | N.A. |
| | | Bahamas | AES Ocean Express | 6.4 | N.A. |
| Latin America | Brazil | Pecem | Petrobras | 1.6 | 2008-2009 |
| | | Guanabara Bay | Petrobras | 3.7 | 2008 |
| | Chile | Quintero Bay | BG, ENAP, Endesa, Metrogas | 2.5 | 2009 |
| | | GNL Meijillones | Suez, Codelco | 2.5 | 2009 |
| | Uruguay | Montevideo | N.A. | 2.6 | 2012 |
| Europe | France | Fos-Cavaou | Gaz de France, Total | 6.0 | 2008 |
| | | Fos-Cavaou | ExxonMobil | N.A. | 2009 |
| | | Bordeaux | 4Gas | N.A. | 2011 |
| | | Le Havre | N.A. | N.A. | N.A. |
| | | Dunkirk | Electricite de France | 4.4 | 2011 |
| | Italy | Isola di Porto Levante | ExxonMobil, Qatar Petroleum, Edison | 5.8 | 2008 |
| | | Brindisi | BG | 5.8 | N.A. |
| | | Livorno | Endesa, Amga, CrossGas | 2.9 | N.A. |
| | | Syracuse | Shell, ERG | 5.8 | N.A. |
| | | Rosignano | Edison, Solvay, BP | 5.8 | N.A. |
| | | Gioia Tauro | CrossGas | 8.8 | N.A. |
| | | Trieste | Gas Natural | 5.8 | N.A. |
| | | Taranto | Gas Natural | 5.8 | N.A. |
| | | (Offshore), Trieste | Endesa | 5.8 | N.A. |
| | | Porto Empedocle | Nouve Energie | 8.8 | N.A. |
| | | Rada di Augusta | ERG, Shell | 5.8 | N.A. |
| | | Sicily | Enel | 5.8 | N.A. |
| | | Ravvena | Enel | 5.8 | N.A. |
| | Spain | Gran Canaria | Endesa | N.A. | 2008 |
| | | El Musel | Enagas | 5.1 | 2012 |

[Chart 13] LNG Receiving Terminals Under Planning (continued)

| Region | Country | Name | Investors | Capacity (MT/y) | Start Up |
|---|---|---|---|---|---|
| Europe | UK | South Hook | ExxonMobil, Qatar Petroleum | 14.0 | 2008 |
| | | Canvey | Caor Gas, LNG Japan, Osaka Gas | 4.0 | 2012 |
| | | Teesside | ConocoPhillips | N.A. | N.A. |
| | | Gateway | Stag Energy | N.A. | N.A. |
| | Ireland | Shannon LNG | Hess LNG | N.A. | 2011 |
| | Netherlands | Rotterdam | Gasunie/Vopak | 4.4 | 2010 |
| | | Eemshaven | ConocoPhillips | 7.3 | 2010 |
| | Germany | Wilhelmshaven | E.On Ruhrgas | 4.4-7.3 | 2010 |
| | Turkey | Ceyhan | N.A. | N.A. | N.A. |
| | Cyprus | Vasilikos | State Electricity Authority | 0.7 | 2010 |
| | Poland | Swinoujscie | PGNiG | 2.2-3.7 | 2010 |
| | Croatia | Krk | E.ON, Total, OMV, RWE, Geoplin | 7.3 | 2012 |
| | Latvia | Baltic Coast | Itera Latvija | 0.4 | N.A. |
| Middle East | Kuwait | | KPC | 1.3-1.7 | 2009 |
| Asia Oceania | China | Putian, Fujian | CNOOC, Fujian Investment and Development | 2.6 | 2008 |
| | | Qingdao, Shangdong | SINOPEC | 3.0 | 2008 |
| | | Shanghai | Shanghai LNG (CNOOC、Shenergy) | 3.0 | 2009 |
| | | Ningbo, Zhejiang | CNOOC, Zhejiang Energy Group, Ningbo Electric | 3.0 | 2008 |
| | | Rudong, Jiangsu | PetroChina | 3.0 | 2008 |
| | | Darlian, Liaoning | PetroChina | 2.0 | 2011 |
| | | Tangshan, Hebei | PetroChina, Beijing Enterprises Group, Hebei Construction Investment | 6.0 | 2010 |
| | | Tiangjing | CNOOC | 2.5 | 2010 |
| | | Haikou, Hainan | CNOOC, Hainan Government | 2.0 | 2009 |
| | | Swatou, Guangdong | CNOOC | 2.5 | 2010 |
| | | Zhuhai, Guangdong | CNOOC | 3.0 | 2010 |
| | | Guangxi | PetroChina | 3.0 | 2010 |
| | | Hong Kong | CLP | 3.0 | 2011 |
| | | Yingkou, Liaoning | CNOOC | 3.0 | N.A. |
| | | Binghai, Jiangsu | CNOOC | 3.0 | N.A. |
| | | Wenzhou, Zhejiang | CNOOC, Yancheng Government | N.A. | N.A. |
| | India | Kochi | Petronet | 2.5 | 2011 |
| | | Dabhol | Petronet, NTPC, Gail | 5.0 | 2008 |
| | | Ennore | IOC, Petronas | 5.0 | N.A. |
| | | Mangalore | HPCL, Petronet, MRPL | 2.5 | 2012 |
| | Pakistan | Karachi | SSGC | 2.5 | 2009 |

[Chart 13] LNG Receiving Terminals Under Planning (continued)

| Region | Country | Name | Investors | Capacity (MT/y) | Start Up |
|---|---|---|---|---|---|
| Asia Oceania | Japan | Wakayama | Kansai Electric | N.A. | N.A. |
| | | Joetsu | Chubu Electric | N.A. | N.A. |
| | | Omaezaki | Chubu Gas, Tokai Gas, Suzuyo | N.A. | 2010 |
| | | Sakaide | Shikoku Electric | 0.4 | 2010 |
| | | Kumamoto | Saibu Gas | N.A. | N.A. |
| | | Nakagusuku | Okinawa Electric | 0.7 | 2010 |
| | | Naoetsu | INPEX | N.A. | 2013 |
| | Korea | Gunsan | GS Caltex | 1.5 | N.A. |
| | | Samcheok | KOGAS | N.A. | N.A. |
| | Taiwan | Taichung | CPC | 1.7 | 2008 |
| | Phillipines | Bataan | GN Power | N.A. | N.A. |
| | Indonesia | Cilegon | PLN, Pertamina | 3.0 | N.A. |
| | Singapore | Singapore | Gas Supply Pte, PowerGas | N.A. | N.A. |
| | Thailand | Map Ta Phut | PTT、EGAT、EGCO | 5.0 | 2011 |
| | New Zealand | N.A. | Contact Energy, Genesis Energy | 0.9-1.08 | 2011 |

Source: Prepared by IEEJ based on respective corporate websites, etc.

4. LNG supply demand balance

4.1. LNG demand forecasts:

Summarized in Chart 14 is the world LNG demand forecast by IEEJ. This has been produced by an econometric model using certain assumptions factored into parameters such as the rate of economic growth, demographic trends. The assumptions used for the demand forecast were established in reference to a study made by IEEJ entitled "Asia/World Energy Outlook 2007."[6] It should be noted here that a number of uncertainties exist over factors such as the projected economic growth rate and inter-fuel substitution.

According to the model case computation results exhibited below, the global LNG demand is projected to grow from the actual result of 176.2 MT in 2007 at an annual rate between 4.1 and 4.9% to reach a level between 435 MT and 517 MT by 2030. In terms of regional pictures, the Asian demand would expand from 112.58 MT in 2007 at an annual rate between 2.1 and 3.0% to a level between 182 MT and 223 MT by 2030.

The LNG demands in Europe and the Americas are projected to grow much faster than the Asian market to surpass Asia by the mid 2010s. In particular, the projected growth in the U.S. demand is so brisk that the country is expected to become the world's largest LNG importer by 2030.

[6] "Asia/World Energy Outlook 2007 – Focusing on China and India", by K. Ito, Y. Morita, Z.Y. Shen, A. Yanagisawa, S. Suehiro, IEEJ, October 2007, http://eneken.ieej.or.jp/en/data/pdf/405.pdf

[Chart 14] World LNG Demand Forecasts

(Million Tonnes)

| | | 2007 | 2010 | 2020 | 2030 |
|---|---|---|---|---|---|
| Asia Oceania | Japan | 66.87 | 66.0 －70.0 | 68.0 －74.0 | 70.0 －78.0 |
| | Korea | 26.05 | 31.0 －33.0 | 38.0 －41.0 | 42.0 －45.0 |
| | Taiwan | 8.22 | 9.5 －11.5 | 14.0 －17.0 | 17.0 －22.0 |
| | India | 8.42 | 9.0 －11.0 | 10.0 －12.0 | 13.0 －20.0 |
| | China | 3.02 | 8.0 －10.0 | 20.0 －25.0 | 25.0 －36.0 |
| | Others | － | － | 12.0 －17.0 | 15.0 －22.0 |
| | Subtotal | 112.58 | 123.5 －135.5 | 162.0 －186.0 | 182.0 －223.0 |
| Europe | France | 9.74 | 12.0 －14.0 | 17.0 －20.0 | 21.0 －24.0 |
| | Italy | 2.13 | 6.0 －8.0 | 13.0 －16.0 | 17.0 －20.0 |
| | Spain | 18.91 | 20.0 －22.0 | 23.0 －28.0 | 25.0 －32.0 |
| | UK | 1.13 | 7.0 －9.0 | 17.0 －19.0 | 28.0 －31.0 |
| | Others | 9.15 | 14.0 －16.0 | 17.0 －22.0 | 26.0 －31.0 |
| | Subtotal | 41.06 | 59.0 －69.0 | 87.0 －105.0 | 117.0 －138.0 |
| Americas | USA | 15.84 | 22.0 －28.0 | 65.0 －73.0 | 102.0 －111.0 |
| | Canada | － | 0.0 －1.0 | 4.0 －6.0 | 7.0 －12.0 |
| | Mexico | 1.99 | 4.0 －6.0 | 8.0 －10.0 | 16.0 －19.0 |
| | Others | 1.15 | 1.0 －2.0 | 6.0 －8.0 | 11.0 －14.0 |
| | Subtotal | 18.98 | 27.0 －37.0 | 83.0 －97.0 | 136.0 －156.0 |
| Total | | 172.62 | 209.5 －241.5 | 332.0 －388.0 | 435.0 －517.0 |

Source: IEEJ

4.2. LNG supply potentials:

As presented in Chart 8 earlier, the global LNG production capacity existing at the end of 2007 was 198.0 MT. Of that figure the production capacity existing in Asia Pacific, North America, and the Middle East for an aggregated total of 121.0 MT was directed mainly toward the Asian market, although some 6 MT was diverted to the Atlantic market in 2007.[7] Adjusting the production capacity of 4.7 MT at the RasGas II Train 5[8] and regarding the actual export volume of 20.9 MT as the capacity for Indonesia, which is suffering from a substantial decline in production rate, it can be estimated that a production capacity of 104.4 MT was available for the Asian market in 2007.

As for the future outlook, new liquefaction capacities with signed SPAs or HOAs are expected to become operational in succession to bring the production capacity available for the Asian market to a total of 135.5 MT by 2015 (see Chart 15). For the period after 2011, some of the other projects indicated in Chart 10 as currently under planning are anticipated to come on stream as well.

[7] Calculated based on the data shown in *LNG Focus February – March 2008.* Total exported volume of 111.0 MT from Asia-Oceania and the Middle Eastern producers plus 7.7 MT diverted to Asia from African and Latin American exporters minus the demand in the Asian markets at 112.7 MT equals to 6.0 MT.

[8] This train started production in March 2007. For this study, we regarded that this train operated for 9 months (April to December) in 2007 and that produced 3.53 MT of LNG.

Additionally, there is a high probability that some new projects that are presently unknown will add to the capacity listed in Chart 15. As far as this study could identify, a supply capacity up to some 98 MT out of such projects as discussed above could become available for supplying the Asian market by 2020. Thus the potential supply availability for Asia in 2020 is estimated at 233.5 MT. Further, as discussed earlier, those volumes under the Equity/Branded LNG contracts intended for European or U.S. deliveries are expected to play an important role of adjusting the Asian demand.

It should be kept in mind that the numeric data here referred to as the supply capacity for Asia is nothing but a total of liquefaction capacity for which a degree of uncertainty exists as to whether production of natural gas could be secured in sufficient quantity from a long-term supply perspective, and also that, as discussed above, some new projects for which final business decisions are not confirmed yet are likely to come into operation in addition to the capacity listed in Chart 15.

[Chart 15] LNG Supply Potential for Asian Market

（Million Tonnes）

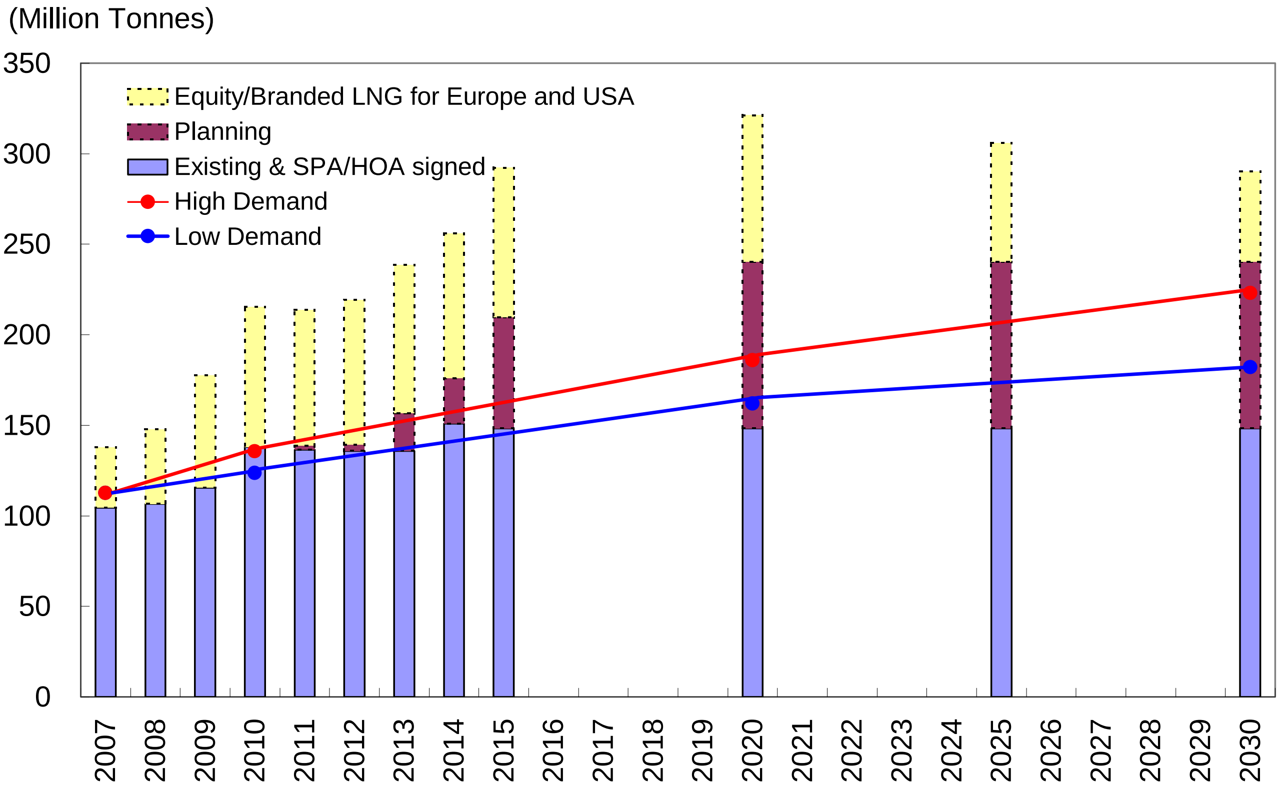
| | Existing & HOA/SPA signed | Planning | Supply Potential for Asia | Equity/Branded LNG for Europe and USA |
|---|---|---|---|---|
| 2007 | 104.4 | | 104.4 | 33.4 |
| 2008 | 106.6 | | 106.6 | 41.2 |
| 2009 | 111.5 | | 111.5 | 62.2 |
| 2010 | 126.2 | | 126.2 | 77.4 |
| 2011 | 123.7 | 5.5 | 129.2 | 75.0 |
| 2012 | 123.0 | 12.9 | 135.9 | 80.0 |
| 2013 | 123.0 | 58.4 | 181.4 | 81.7 |
| 2014 | 138.0 | 61.4 | 199.4 | 80.0 |
| 2015 | 135.5 | 61.4 | 196.9 | 82.5 |
| 2020 | 135.5 | 98.0 | 233.5 | 80.9 |
| 2025 | 135.5 | 98.0 | 233.5 | 65.7 |
| 2030 | 135.5 | 98.0 | 233.5 | 49.8 |

Source: Prepared by IEEJ based on respective corporate websites, etc.

4.3. LNG supply demand balance for Asia:

Based on the LNG demand forecast and supply potentials discussed in the foregoing, the outlook of LNG supply demand balance for Asia can be summarized as in Chart 16. The line graphs in the chart represent the projected demand for Asia as given in Chart 14, and the bar graphs refer to the supply potentials discussed in Chart 15. Again, as mentioned earlier, some of those new projects that are currently unknown could be added. Therefore, the demand up to 2030 could be covered if those projects currently under consideration are smoothly brought to operation. For the period after 2030, a similar scenario would apply where the demand could be satisfied with the smooth realization of those projects currently under planning. As discussed before, 7.7 MT of LNG flowed from Africa and Latin America into Asia in 2007, a substantial portion of which could be attributed to have come from the Equity/Branded LNG contracts originally intended for European or U.S. deliveries. Thus, the supply availability originally for Europe or the U.S.A. is already built in the supply portfolio for Asia. This trend is likely to last for the medium-term unless future projects targeted at Asian markets are brought into commercial operation quicker than expected.

[Chart 16] LNG Supply Demand Outlook for Asia




Source: IEEJ

In the same study conducted last year[9], the author pointed out that the following seven factors were considered as key issues in examining the future LNG supply and demand situation for Asia: namely, energy consumption trends linked to the economic growth; weather and heating/cooling degree days; operating conditions of nuclear power plants; developments on renewal negotiations for Indonesian LNG supply agreements; cost inflation of LNG projects; demand growth in the North American markets; and Qatar's LNG supply strategy. While the importance of factors mentioned above would not change substantially, in view of the developments in the current year, the following points seem to require close watch:

First, stemming originally from the subprime mortgage and credit crisis in the U.S., economic slow-down is becoming a real possibility especially in Europe and the U.S. Although the economy in

9 "Natural Gas and LNG Supply/Demand Trends in Asia Pacific and Atlantic Markets (for FY2006)" by Tetsuo Morikawa, IEEJ, http://eneken.ieej.or.jp/en/data/pdf/401.pdf

the OECD member countries that include main LNG importers has expanded steadily in the last three to four years, these countries are now making downward revisions one after another to their real GDP growth projection for the short-term. Even though the LNG demand is largely subject to infrastructure-related or contractual constraints, the impact of the economic slow down on the natural gas consumption in these countries should be closely monitored.

Secondly, in relation to the first point above, attention should be paid to the price levels in the U.S. market, where almost all supplies are based on Equity or Branded LNG contracts, and their impact on the expansion of rapidly increasing reselling volume intended for Asian deliveries. Although the Henry Hub natural gas price tends to be more volatile than the LNG prices for Japan, it can be mentioned that Henry Hub price has been relatively stable throughout 2007 up until the first quarter 2008. Owing to the soaring prices since 2000, natural gas development in the U.S. has been in brisk progress especially for non-conventional gas reserves, and the annual production in recent years has stayed roughly at about 19 Tcf. On the other hand, since the demand growth has been sluggish, the LNG demand outlook published by EIA[10] was continuously revised downward for the last several years[11]. How the Henry Hub price will behave in the 2008 - 2010 period, when various LNG projects aimed at the U.S. market will start operations, should be important as it is one of the key elements determining the LNG supply potential for Asian deliveries.

Thirdly, there is the issue of the Kashiwazaki-Kariwa Nuclear Power Station and its timing of service restoration from the current shutdown due to the July 2007 earthquake in Niigata Prefecture. According to estimates by IEEJ[12], an additional LNG demand of between 3.37 MT and 3.84 MT per year would be generated as a result of this unplanned shutdown. While resuming plant operation would largely depend on the ruling by the local autonomous body, its timing will substantially impact the short-term LNG demand of Japan.

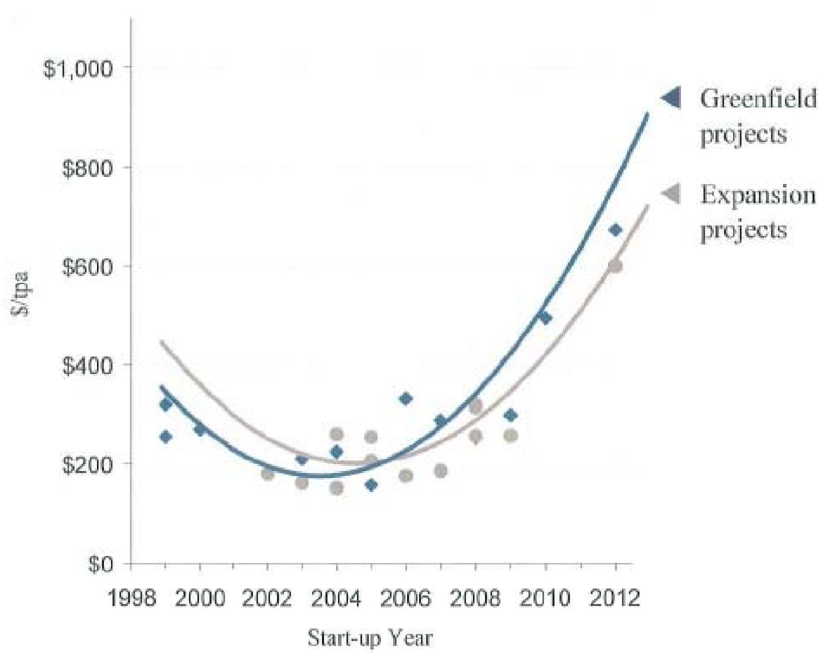
The fourth element to watch is concerned with a deteriorating investment climate for LNG projects. Behind this trend are cost inflation of LNG projects and the rise of resource nationalism. As illustrated in Chart 17, the EPC (i.e. engineering, procurement and construction) cost for an LNG project used to be about $200 per tonne during 2003 - 2004, but in the case of projects planned for start-ups around 2012 it is said to increase sharply to $700 - $900 per tonne.

[10] Energy Information Administration, the U.S. Department of Energy

[11] In the *Annual Energy Outlook 2005* by IEA, the LNG demand for 2010 was projected at 2.5 Tcf (52.5 MT), whereas the *Annual Energy Outlook 2007* puts it at 1.81 Tcf (38.0 MT).

[12] "Impacts on International Energy Market of Unplanned Shutdown of the Kashiwazaki-Kariwa Nuclear Power Station", by T. Murakami, M. Watanabe, S. Sato, K. Shida, April 2008, http://eneken.ieej.or.jp/en/data/pdf/434.pdf

[Chart 17] Development in EPC Cost for LNG Projects




Source: Poten & Partners

Furthermore, gas-producing countries are strengthening control over their domestic resource bases to create a risk element for investment into LNG projects. The speculated creation of a gas cartel did not materialize in the GECF[13] meeting in Doha in April 2007. Differences between oil and gas businesses with respect to the market structure or transaction, and the difficulty to form a unified decision among the member countries seem to present a high hurdle for organizing an effective gas cartel. However, if gas producing countries like Russia, Iran or Algeria would start to either take coordinated actions or hold regular meetings on investment for future development or pricing policy, international oil companies or LNG buyers might be pressured from such moves at least psychologically, which could prevent timely investment decisions from being taken. The EU is heavily dependent on natural gas from Russia or Algeria and therefore is taking the situation quite seriously. Since Japan also is preparing for importing LNG from Russia in the near future, it would be necessary to pay sufficient attention on the so-called "Gas-OPEC" idea.

The fifth factor of note is that non-conventional LNG projects are being brought to realization. In the area of gas field development, a number of new gas projects based on coal-seam gas reserves are announced one after another in Queensland, Australia. In particular, the project currently pursued by LNG Ltd. of Australia is said to employ a unique liquefaction technology and, despite its

[13] Gas Exporting Countries Forum. Established in 2001, the forum did not have a fixed membership structure in the past six meetings; however Algeria, Bolivia, Brunei, Egypt, Equatorial Guinea, Indonesia, Iran, Malaysia, Nigeria, Qatar, Russia, Trinidad & Tobago, the UAE and Venezuela could be identified as current members.

small scale, have cost competitiveness approaching a commercial level. Meanwhile, Flex LNG of the U.K. is planning an LNG project in Nigeria based on a floating liquefaction plant. Elsewhere, continued efforts are paid to developing off-shore liquefaction technologies as well. Although these non-conventional projects appear to face numerous obstacles in terms of technology or economics, they also demonstrate that technological advancement is being achieved in the face of rapidly expanding LNG demand. It is therefore believed that the speed of technological innovation will become one of the factors strongly influencing the LNG supplies on a medium-term basis.

Contact: report@tky.ieej.or.jp