Current Situation and Future Prospects of Japanese LNG Market

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Introduction

This study was conducted with the following objectives: 1) to observe Japan's natural gas (LNG) supply and demand structure, procurement contract and pricing schemes, and new market trends 2) to determine which approaches can help Japan improve its LNG trading system in terms of flexibility of trading terms and procurement costs. This research, which was assigned to The Institute of Energy Economics, Japan (IEEJ) by the Japan National Oil Corp. (JNOC), was part of the FY2000 Research Project conducted under the auspices of the Ministry of Economy, Trade and Industry (METI). Thanks to their kind cooperation we were able to publish our research results here. Acknowledgements are due for the kind understanding and cooperation of all those concerned at JNOC and METI.

1. Situation of Japan's Natural Gas Procurement Market

We compared five aspects of Japan's natural gas market, with those of U.S. and Europe; (1) demand structure (2) supply structure (3) competitive environment, (4) procurement contract and (5) procurement price. The results enabled us to identify the following points, which represent the principal characteristics of Japan's natural gas procurement.

1-1 Demand Structure

In Japan, about 70% of natural gas is used for electricity generation and the remaining 30% for town gas production. The share utilized by town gas production (residential, commercial and industrial) is far lower than other countries (Figure 1-1).

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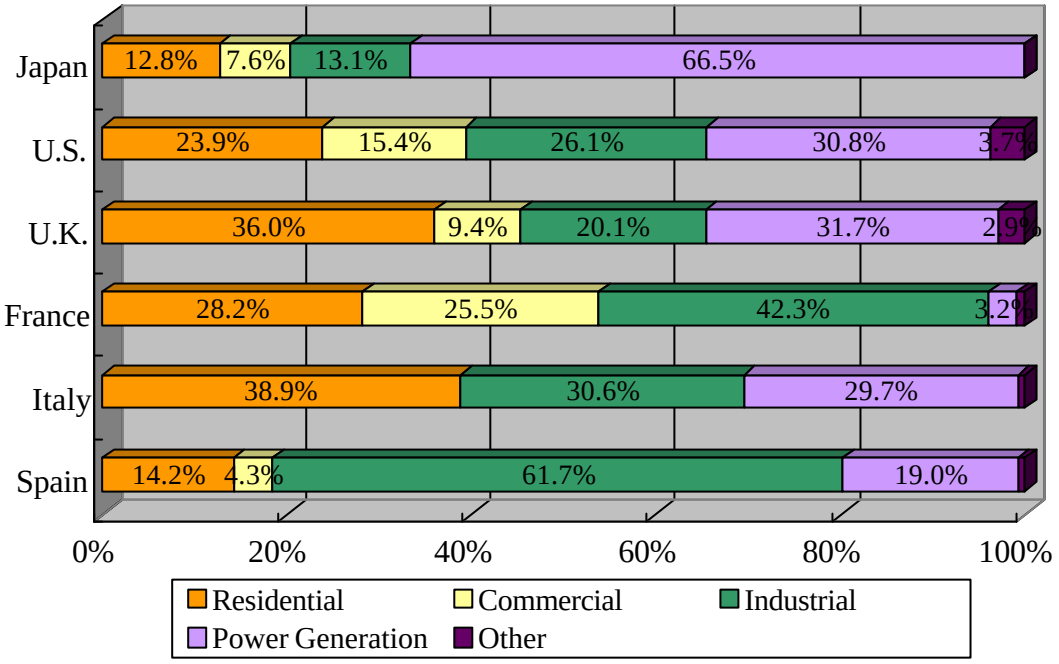
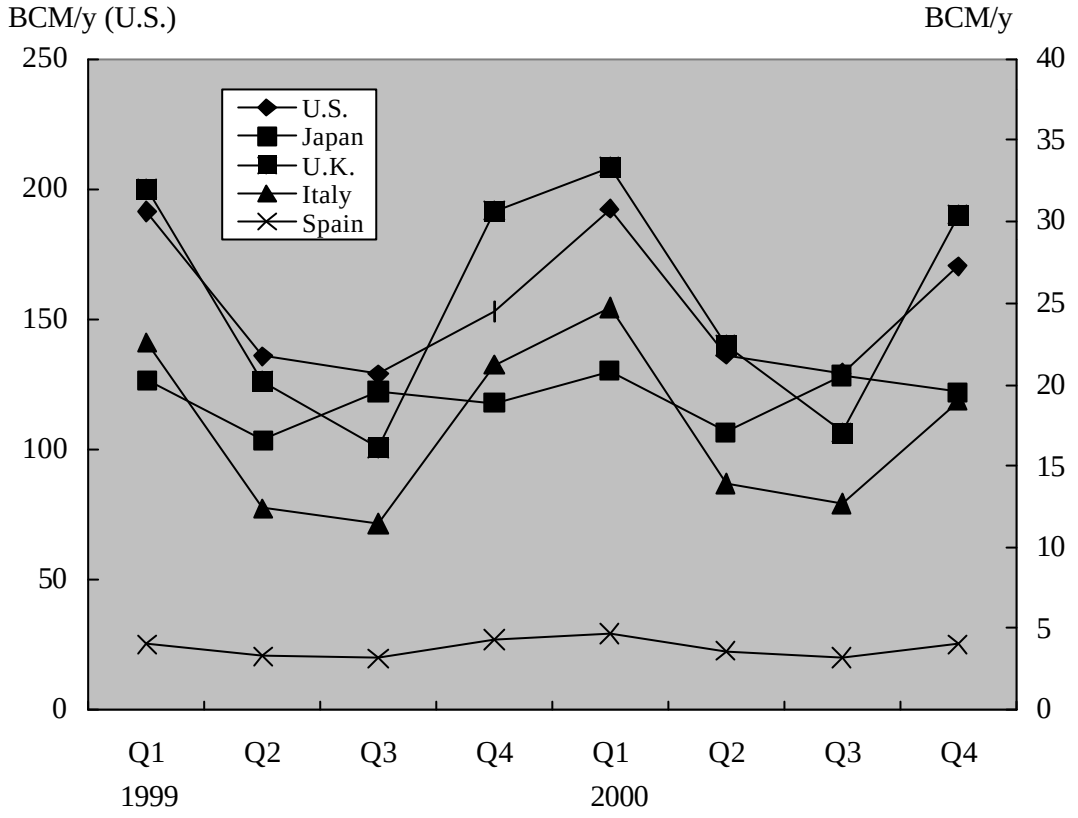
Figure 1-1. Natural Gas Consumption Shares by Sector



Source: IEA Energy Balances of OECD Countries 1998-1999

This characteristic reflects the fact that Japan's natural gas consumption for electricity generation exhibits both winter and summer peaks, and town gas production to a lesser extent, as shown in Figure 1-2.

Figure 1-2. Quarterly Natural Gas Consumption

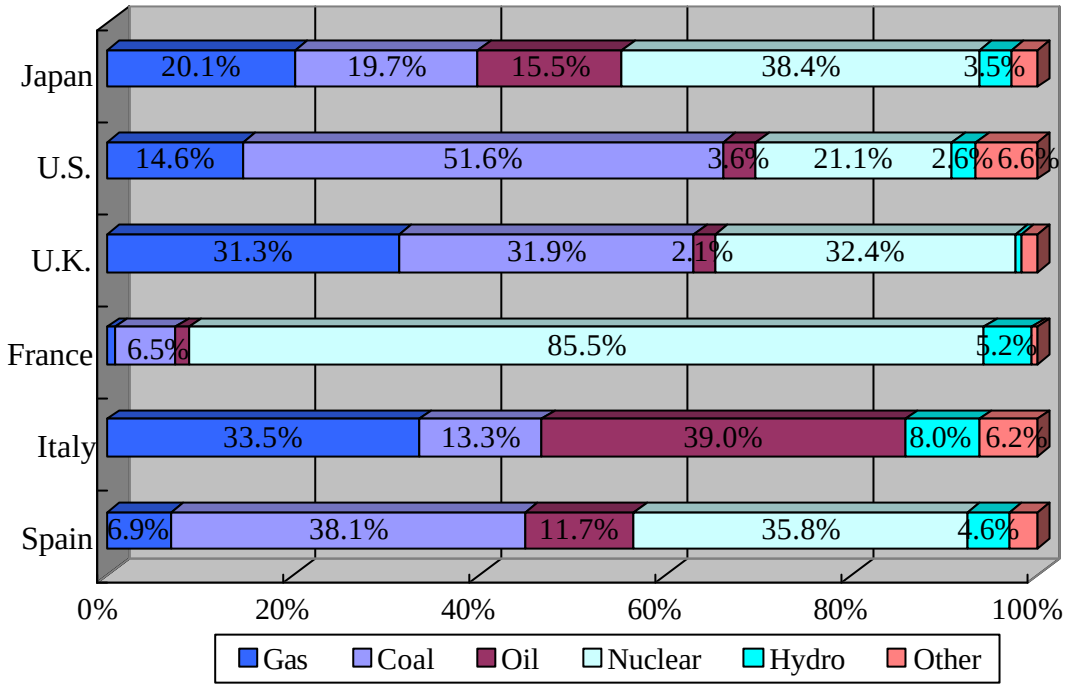


Source: Gasstrategies

Annual gas consumption per industrial customer varies as much as eight times between Japan and the U.S., with levels of 161,000m^3 and 1,286,000m^3, respectively. In Japan, 31.6% of industrial natural gas is utilized for combined heat and power (CHP), a much higher level than in the U.S. (9.1%).

As shown in Figure 1-3, the natural gas share (about 20%) of Japan's power generation is more or less similar to U.S. and European levels. However, when we look at new power source developments from the present to around 2005, natural gas accounts for over 80% in both the U.S. and Europe, compared with a mere 10% or so in Japan.

Figure 1-3. Comparison of Electricity Generation by Source in 1999

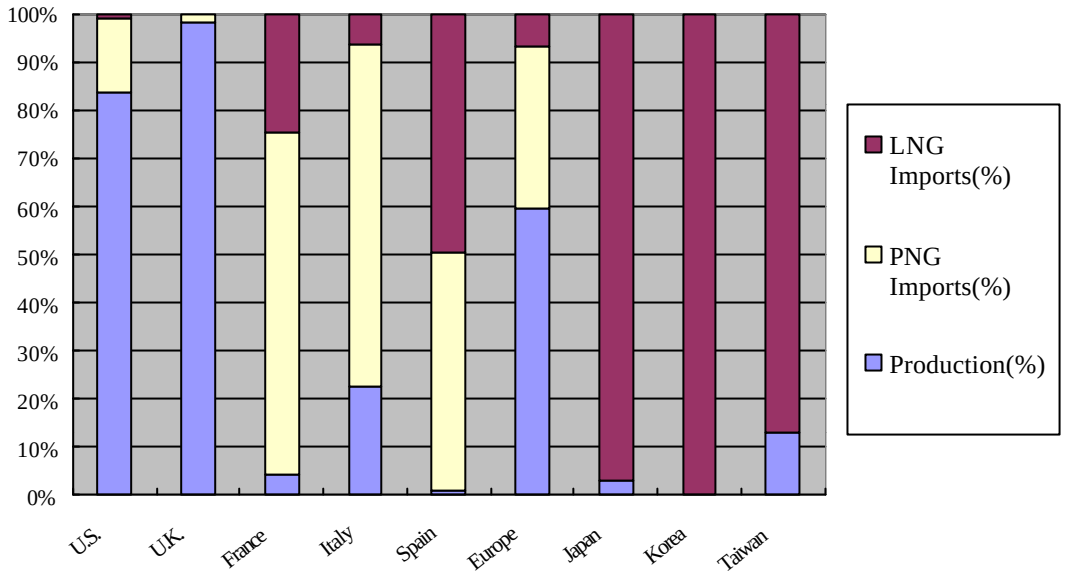


Source: IEA Energy Balances of OECD Countries 1998-1999

1-2 Supply Structure

Japan, with limited natural gas resources, depends heavily on LNG imports to meet the majority of its natural gas needs (Figure 1-4).

Figure 1-4. Natural Gas Production/Imports Shares for Selected Countries



Sources: BP Statistical Review of World Energy 2001,
IEA Natural Gas Information 2000 and Gas Industry Handbook 2000

The world's natural gas trade can be divided into 2 major trading regions: the Pacific, where LNG is the predominant commodity, and the Atlantic where pipeline gas and LNG are both traded. The majority of trade takes place within each region.

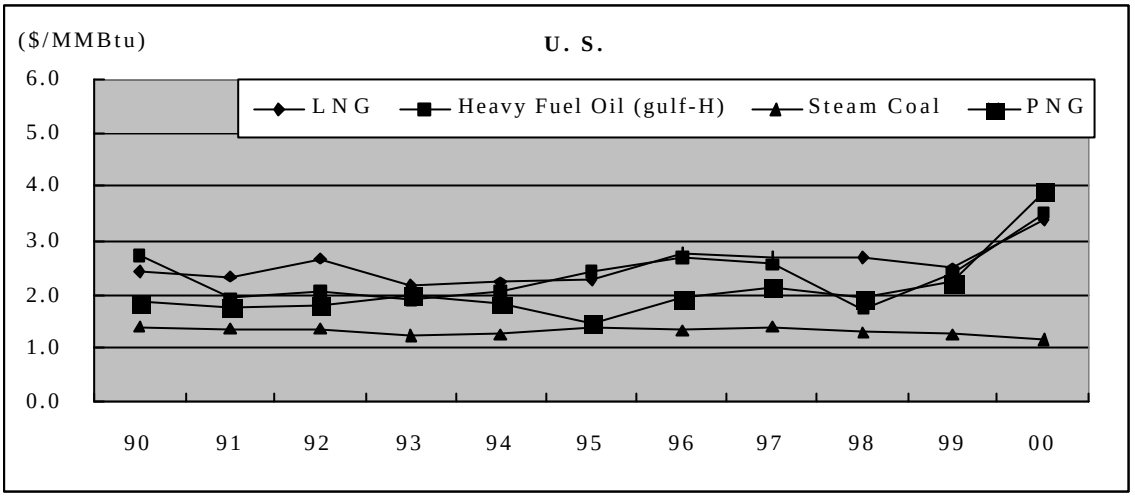
The U.S. and Europe, with well-developed pipeline networks, are not dependent on LNG stocks because they can procure natural gas easily through pipelines. In contrast, Japan, and typically gas companies, usually maintain one month LNG stocks.

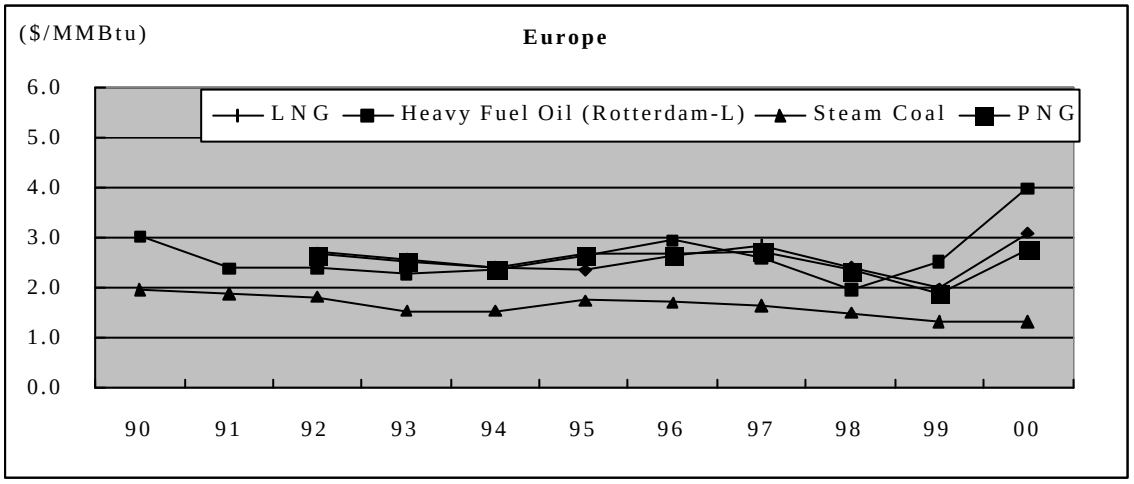
Japan imports most of its LNG under long-term contracts. Prior to deregulation, the U.S. and Europe also purchased most of their natural gas through long-term contracts. However, spot trading is increasingly becoming more common as a result of ongoing deregulation.

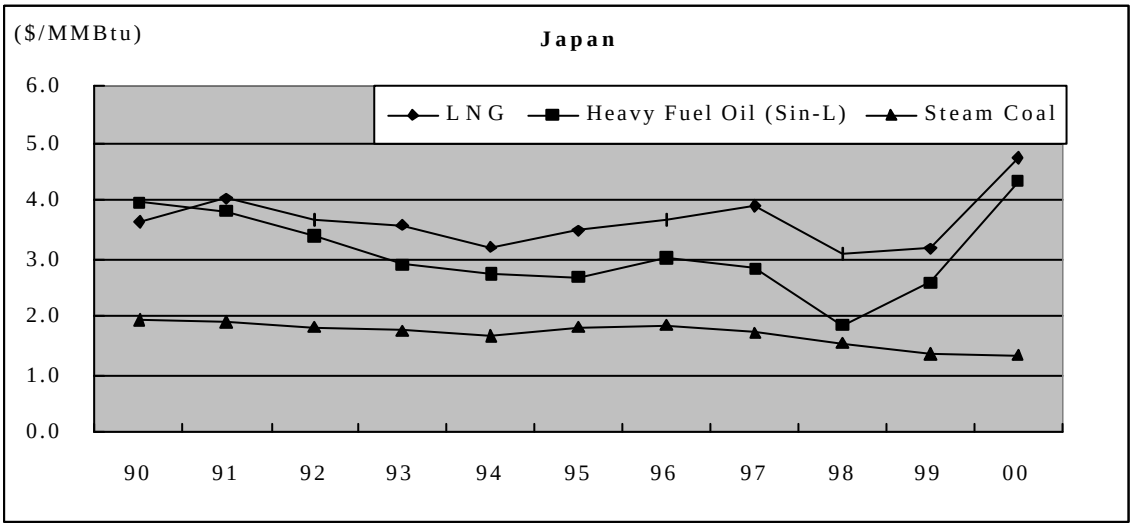
1-3 Competitive environment

Figure 1-5 gives a comparison of price levels at customs for the U.S., Europe and Japan. It shows that natural gas prices have stayed at virtually the same levels as heavy fuel oil prices in the U.S. and Europe, while in Japan, LNG prices have outrun heavy fuel oil prices. In terms of retail prices, Western industrial consumers also pay roughly the same price for natural gas and heavy fuel oil, while Japanese counterparts pay much more for natural gas than for coal, diesel and heavy fuel oil.

Figure 1-5. CIF Prices for Selected Fuels for U.S, Europe and Japan







Note 1: Steam coal price for Europe is weighted average for EU 15 countries.

Note 2: H: HSFO, 3.0% sulphur / L: LSFO, 1.0% sulphur

Source: IEA Energy Prices & Taxes 2000/2001

Natural gas, which accounts for some 30% of industrial energy consumption in the U.S. and Europe, only accounts for 6% or so in Japan.

Turning to the cost of power production for Japanese power plants, there are no significant differences in capital and maintenance costs compared to their Western counterparts. However, higher fuel prices make Japan's power production costs higher than those of the U.S. and Europe.

In the U.S., power plants specifically designed for burning only natural gas (gas-fired power plants) occupy a mere 8.6% of total installed capacity. Most gas-fired power plants are designed for dual fuels and are capable of burning coal or oil products as well. In Japan, about half the natural gas-fired power plants are equipped with dual fueling systems, but unlike their Western counterparts, few plants switch fuel to take advantage of fuel price trends.

1-4 Procurement contract

LNG sales contracts applicable to Japan generally involve state oil/gas companies, the majors as sellers, and a consortium consisting of Japanese power and gas companies as buyers.

In the case of Japan, long-term contracts over 20 years are very common, with a take-or-pay clause and elasticity of about 5–10% in the amount taken annually.

As for LNG delivery terms, about 80% of Japan's contracts are ex-ship contracts on a contract volume basis, with the remaining 20% or so are FOB contracts. Lately, a trend has been noted in which even Japanese buyers tend to conclude FOB contracts.

1-5 Procurement price

Most of the LNG imported by Japan is priced with a formula in which crude oil is the price indicator.

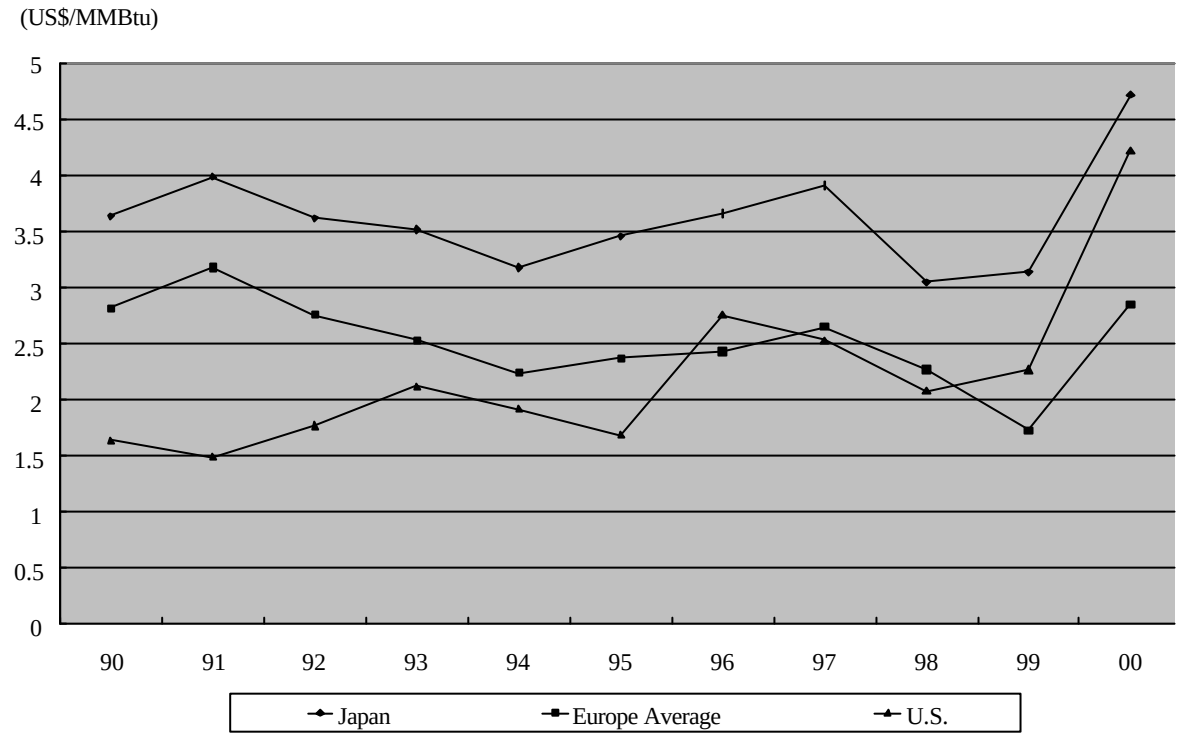
In the U.S., pipeline gas procurement contracts are divided into spot, mid-term and long-term contracts. The spot price depends on natural gas supply-demand conditions and other factors, and is fixed in the market, while the mid-term contracts often employ a price linked to spot and futures prices. Pricing under long-term contracts varies significantly. LNG is priced with reference to gas prices on spot and futures markets.

In the U.K., gas was conventionally priced according to a formula that employs price indicators such as diesel/heavy fuel oil prices and commodity price indexes. However, most of the new contracts these days are linked to spot and futures gas prices. In Continental Europe, many contracts still feature a pricing formula with price indicators based on diesel/heavy fuel oil prices and commodity indexes.

As shown in Figure 1-6, natural gas prices in Japan and Europe move in similar ways because they are both linked to the price of crude oil or petroleum products, even though Japan's price is approximately $1/MMBtu higher. In the U.S. natural gas prices move differently from those of Japan

and Europe because they are fixed every day according to market conditions, where the price is more volatile.

Figure 1-6. Natural Gas Prices for Japan, Europe and U.S.



Note: LNG imports prices (CIF), Henry Hub prices and pipeline imports prices are used for Japan, Europe Average and U.S respectively.
Source: BP Statistical Review of World Energy

Factors relevant to Japan's LNG pricing can be grouped into two categories: (1) those that are applicable to other energy sources and (2) inherent factors to LNG and the LNG market. Those that are applicable to other energy sources include long distance from producers and high priority given to stable supplies. Those specific to LNG include: firstly, the Asia/Pacific LNG market has been a seller's market for years, secondly, long-term (around 20-year) contracts are common, and finally non-competitive situations existed among buyers, whether they are power or gas companies, because of strict regulations.

2. LNG Market Trends throughout the World

2-1 LNG supply and demand trends

Of the LNG receiving terminal projects planned in North and Central America, 14 projects –

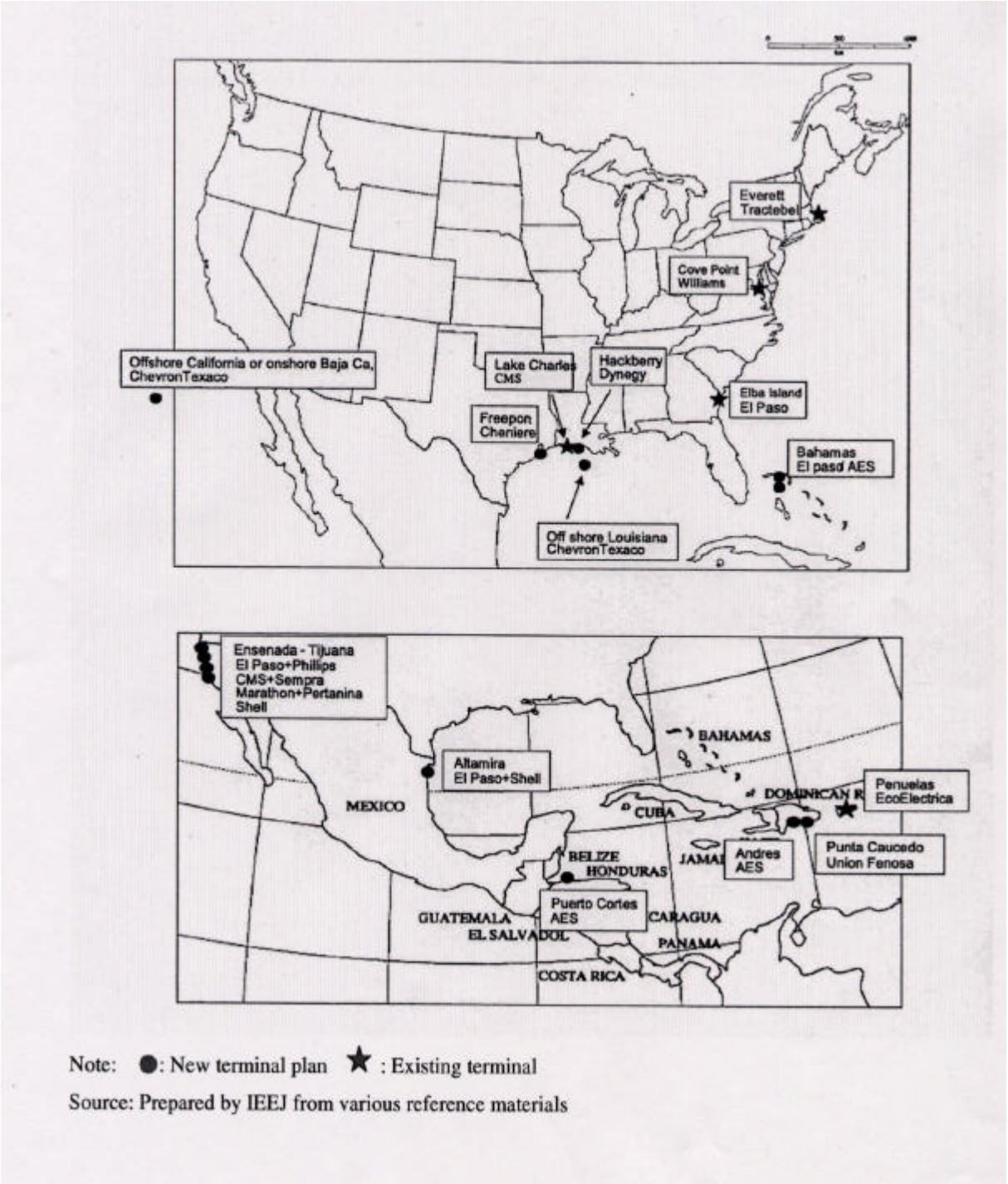
many in Central America - are expected to be completed in 2004 onward (Figure 2-1). If they are completed as scheduled, receiving capacities of existing, expanded and newly built LNG terminals in North and Central America should total some 91–96 million tons/year. Given that the terminals located on the West Coast will only contribute to 30% of the total, the East Coast and the Gulf of Mexico are likely to remain the centers for LNG trading.

In Europe as well, new LNG receiving terminals are being planned in ten locations.

It is believed that the Atlantic region is LNG-deficient and the Pacific region is LNG-glutted. All the projects under way in the Atlantic reportedly already have buyers, while those in the Pacific do not seem to have found enough buyers to fill their capacities.

LNG balance of supply and demand in the Asia/Pacific region may change when the U.S. West Coast, and new markets, such as China and India start importing LNG. Furthermore, if LNG supply and demand begins to tighten in Europe and/or the U.S. East Coast, the supplies for the Pacific might shift to the U.S. and Europe.

Figure 2-1. LNG Receiving Terminal Plans in North and Central America

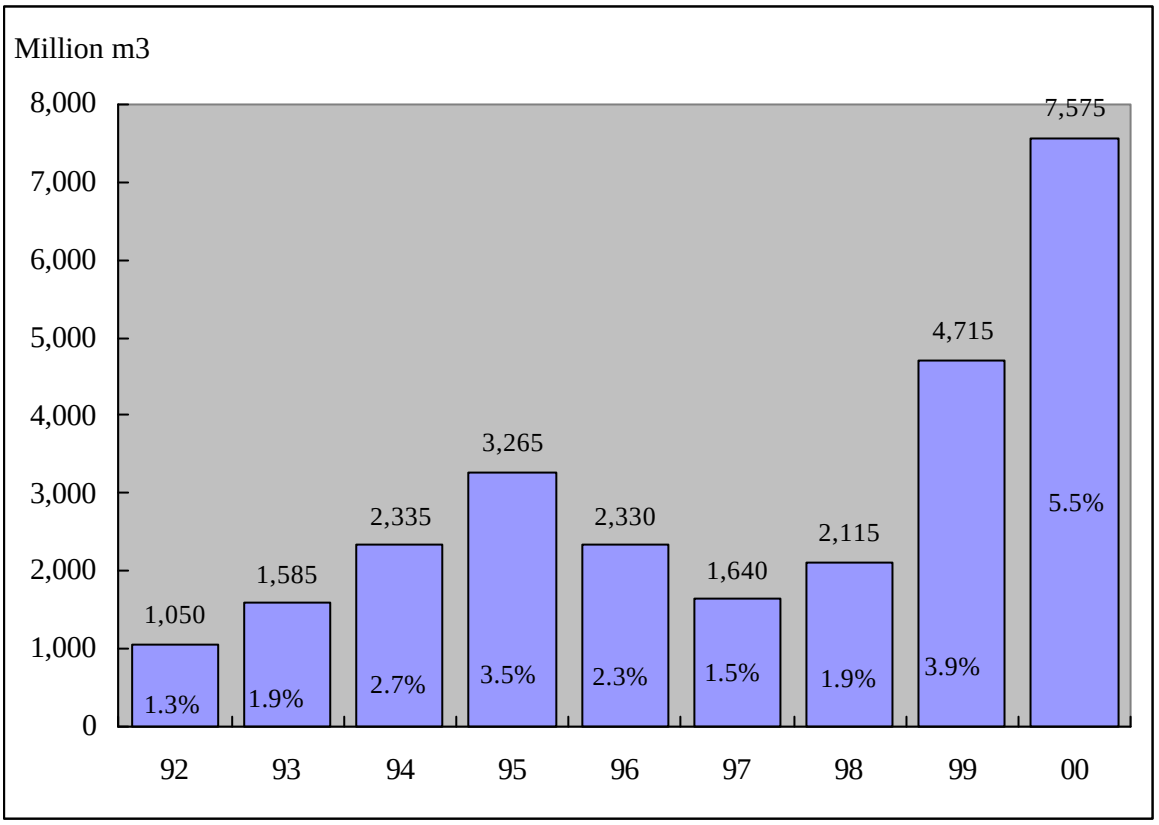


Note: ●: New terminal plan ★ : Existing terminal

Source: Prepared by IEEJ from various reference materials

As shown in Figure 2-2 and 2-3, in recent years LNG spot trading has been burgeoning in volume. The Atlantic region accounts for more than half of such trading. However, spot trading is quite likely to grow in the Asia/Pacific region due to surplus supply capacity in the Pacific and LNG imports being initiated by new markets.

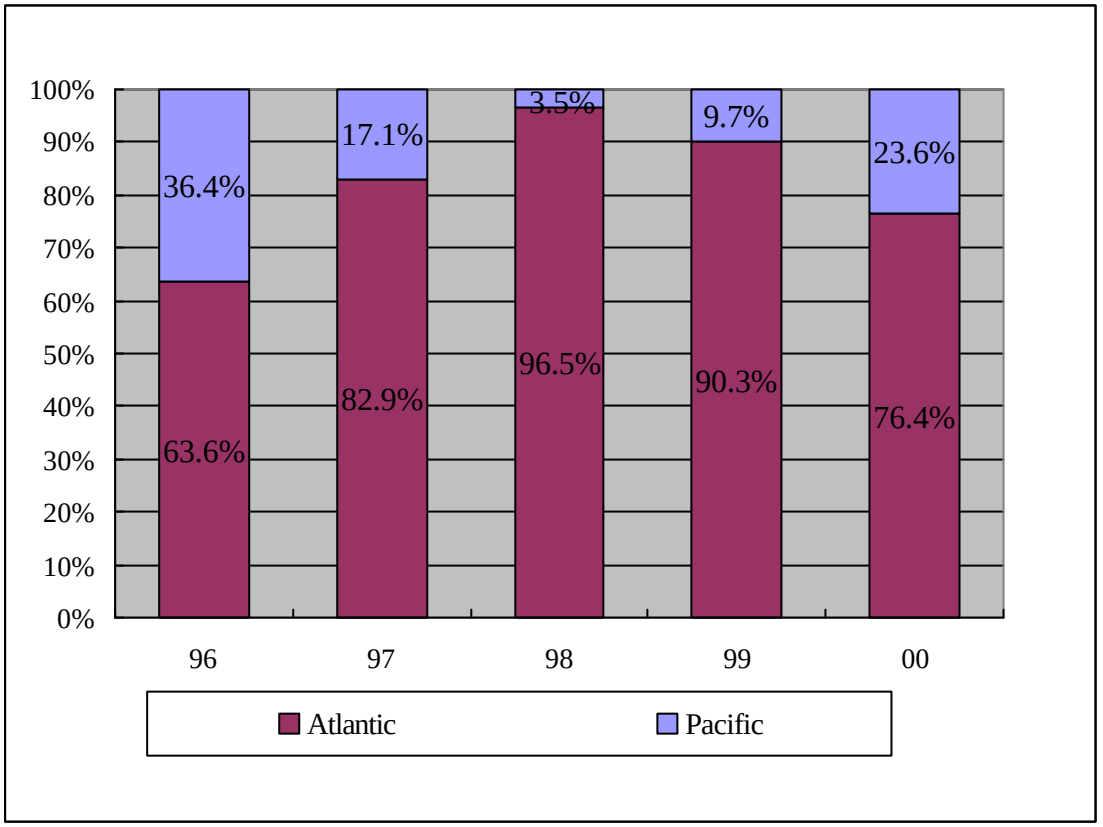
Figure 2-2. LNG Spot Trading Volume Worldwide



Note: Percentage indicates shares accounted for by spot trading in all LNG transactions

Source: Petrostrategies

Figure 2-3. LNG spot trading shares for Pacific and Atlantic regions



Note: Spot LNG imports base

Source: Petrostrategies

The cost of LNG projects has declined recently. According to El Paso, costs have fallen by approximately $0.7/MMBtu since the 1970s. Breaking down the cost decrease, some 70% ($0.5/MMBtu) was trimmed in the liquefaction process, and the remaining 30% ($0.2/MMBtu) in transportation and the re-gasification process. The fall in cost of liquefaction stands out. In 1998 Merlin Associates analyzed the decrease in the cost of liquefaction and found that 45% of it could be attributed to terminal design (differences in specifications, etc), 39% to competitive bidding by EPC contractors, and 16% to reduction in terminal size.

2-2 Changing contract forms and players' roles in world LNG markets

2-2-1 Changing LNG contract terms

In recent years, LNG buyers have become to request more flexibility in the delivery and amount of LNG for them to take. For example, Japanese buyers are trying to increase the flexibility of their contract volume for LNG from Malaysia III and West Australian expanded projects.

In the context of such moves to spot and shorter-term contracts, the restrictions concerning gas origins and destinations are being softened. BP is introducing a new approach called “branded LNG” by signing with AES (U.S) a long-term contract in which neither gas supply sources nor transport capacities are specified.

Meanwhile, the Competition Commission of the European Union (EU) began an investigation of the destination clause on the grounds that this clause in a natural gas long-term contract for Europe allegedly violated the EU’s rules of competition.

2-2-2 Changing roles of players

The natural gas market in North America enables it to absorb LNG whenever excess production exists making LNG trade more flexible. For this reason, European firms began to secure the capacities of existing receiving terminals or construct new LNG terminals in North America (Figure 2-4).

Along with the growing trend toward liberalization of electricity and gas businesses, we can observe new entrants into the European market from North America and other regions, and Europeans advancing into the global market. Business diversification through vertical integration is also noted.

In the Asia/Pacific market, new LNG terminals such as those in Sakai and Mizushima tend to involve new players. Many utilities, including Tokyo Gas, Osaka Gas and KOGAS, are now launching LNG upstream sectors and/or moving into the international market.

Figure 2-4 Trends among Players in World LNG Markets

(1)	Firms initiating active LNG trading in the Atlantic market: BP, Shell, El Paso, Sempra, Tractebel LNG, Repsol, BG, GdF
(2)	Firms trying to enter the upstream sector (gas development, liquefaction plants): Union Fenosa, Edison, Repsol, CNOOC, Tokyo Gas, Osaka Gas
(3)	Firms with equity investment in receiving terminals: BP, Sonatrach, BG, Union Fenosa, Shell, ExxonMobil
(4)	Firms entering the LNG transport sector: BG, Bergesen, BP, Shell, Union Fenosa, TEPCO, Tokyo Gas, Osaka Gas, Chinese enterprises, Indian enterprises
(5)	Business alliance: GdF/Sonatrach

Source: Prepared by IEEJ from various materials including Gasstrategies

2-3 LNG transport market trends

There are 127 LNG tankers currently (as of June 2001) in service around the world. About one-third of these were built over the past five years, which indicates a sharp growth in the number of LNG tankers recently. As of October 2001, new orders had been placed to construct 48 LNG tankers, with an additional 31 tankers waiting for options to be exercised, as shown in Figure 2-5. Both BP and Exmar also ordered LNG tankers without having any charter contracts signed. These new tankers, once they are put into service, are likely to ease the current tanker capacity shortage.

Figure 2-5. LNG tanker orders for selected shipbuilders and option contracts

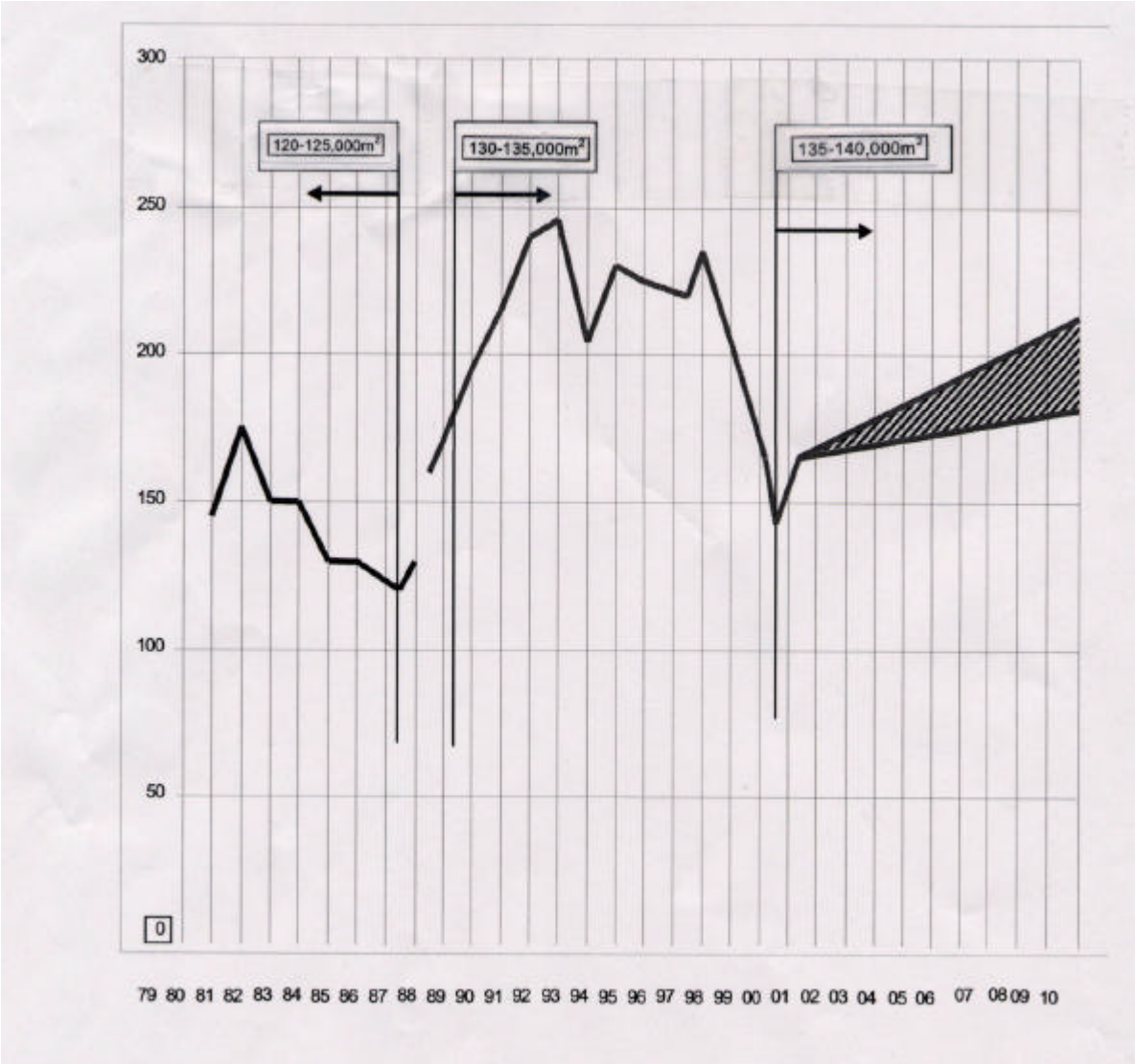
Ship Builder	Ordered by	Number of Orders	Number of Options	Price	Remarks
Daewoo	Exmar	5	3	$150-168M	El Paso (4 ships)
	Bergesen	3	2	$160M	Tractabel (2 ships)
	Golar LNG	2	1	$162-170M	
	Petronet	2	0		Ras Raphan, Qatar ←→ Dahej, India/Petronet LNG
	NW Shelf	1	2		NWS expansion project
	Shell	1	1	$165-170M	
	Naviera F Tapias	1	0		Repsol and Enagas
	Union Fenosa	1	0		
Samsung	BP	3	2	$170M	
	BG	2	6		138,000m^{3} X 2. Options to be exercised 2005/2006 onward (2 ships to be hired by Atlantic LNG)
	AP Moller	1	1		
	Exmar	1	1		
	Golar LNG	0	2		
	Leif Hoegh	0	1		
	I.S.Carriers S.A	1	0		KOGAS
Hyundai	Nigeria LNG	3	4		
	Golar LNG	2	1	$165.6-170M	
Izar Sestao	Tanker Pacific	1	0		
	Tapias	1	0		Repsol and Enagas
	Elcano	1	0		Repsol and Enagas
	Knutsen	1	0		Repsol and Enagas
	Union Fenosa	1	0		Egypt ←→ Spain (140,000m^{3} class)
Kawasaki	Tokyo LNG Tanker	1	1		100% subsidiary of Tokyo Gas
Mitsubishi	MISC	3	0		Malaysia LNG III
	Shell	3	2	$165-170M	Cove Point LNG terminal (Plan)
	Brunei LNG	1	0		Brunei ←→ Japan
	Enron/MOL	1	0		Dabhol project (Plan)
	TEPCO	1	0		
Mitsui	Qtargas	1	1		Contracted on July 3, 2001/Jointly owned by Qatar Liquified Gas Company Ltd.
	MISC	3	0		
Total		48	31		

Source: Prepared by IEEJ from various materials including Gasstrategies and LNG Observer(As of October 2001)

Over the last few years, LNG tanker construction costs have been decreasing from some $250 million in 1992 to $150 million in 1999 (Figure 2-6) due to competition among shipbuilders and other factors.

Figure 2-6. LNG tanker cost in the past and forecast

$1 million



Source: Gasstrategies

One significant trend of LNG transportation to Japan is that Japanese buyers increasingly sign FOB contracts to lower the LNG price and make their contract more flexible. Meanwhile in other markets, swap trading is under way between ENEL and Gaz de France and between China

Petroleum Corporation (CPC) and Chubu Electric Power. PERTAMINA, Indonesia's state oil and gas company, and Korea Gas Corporation (KOGAS) have reportedly proposed a back-haul of LNG transportation to an LNG receiving terminal under construction in Ennore, Tamil Nadhu Province on the east coast of India.

3. Direction of Japan's LNG Trade – Forecast for the Next Ten Years

3-1 Changing LNG procurement needs and future directions

In the past Japanese power and gas companies formed consortiums to bargain with sellers. However, since the mid 1990s, their needs for contract terms have changed drastically due to slower growth of electricity/gas demand largely due to the Asian financial crisis and growing uncertainties about future demand because of ongoing deregulation. As a result, terms such as procurement timing began to vary significantly among contracts.

In the days when demand was steadily growing and new LNG sources were limited, priority was given to security of supply with emphasis on starting up new LNG projects, rather than questioning the economics of projects. However, since the mid-1990s, in response to supply gluts, growing priority has been given to prices and increasing trading flexibility.

Today it is very difficult for Japanese power companies to make decisions regarding new power sources. Thus, power companies are virtually unable to commit to new LNG projects in quantitative terms, and tend to postpone their decisions on new LNG projects. Meanwhile, although facing increasing uncertainties about future gas demand, Japanese gas companies can take a more positive stance towards new LNG sources, because they have little choice but to absorb all risks of demand volatility with LNG.

For each of the existing power and gas companies, we examined what would change in power and gas markets in the years leading up to 2010, and then considered the possibilities and directions of the impacts of such changes on LNG procurement. Important factors behind the expected changes are:

(From the existing power companies' perspectives)

(1) Slower demand growth
(2) Penetration of distributed power sources and promotion of newcomers
(3) Reform of the market system,
(4) Changing demand load patterns
(5) Response to greenhouse gases
(6) Delays in construction of new nuclear power plants

(From the existing gas companies' perspectives)

(1) Slower demand growth
(2) Ongoing deregulation
(3) New demand development
(4) Changing demand load patterns

3-2 Factors reducing cost of LNG procurement and improving flexibility

3-2-1 Cost reduction and flexibility improvement in transport sector

(1) Use of FOB contracts

Employing FOB contracts has become more common recently as a result of falling LNG tanker costs. Figures 3-1 summarizes FOB contracts have both advantages and disadvantages. It is essential for buyers to examine the viability of introducing LNG tankers and to decide how to use them in relation to their own situation and criteria.

Figure 3-1 Potential Advantages/Disadvantages of FOB Contracts

Advantages	Disadvantages
a. Lower transportation cost b. Effective use of spot/short-term contracts c. Arbitrage by reselling LNG to overseas buyers d. Surplus capacities capable of serving as a backup when troubles occur in other projects. e. Strengthening of potential preparedness for any changes in electricity/gas markets due to deregulation, etc. f. Launches into LNG transportation business	a. Responses to LNG tanker accidents, etc. b. Risks of decreasing LNG amounts in the event of LNG tankers being out of service c. Rising unit price of transportation if the operating rate of LNG tankers is not as high as expected.

Source: Prepared by IEEJ from various reference materials.

(2) Larger LNG tankers

With the tanker price assumed as a given condition, the unit price of LNG transportation depends substantially on the amount of LNG that a tanker can transport each year (distance from liquefaction terminal to receiving terminal plus size of the LNG tanker).

In the future, companies are likely to select appropriate tanker sizes in accordance with the effect on transportation cost cuts, the cost incurred in retrofitting receiving-related equipment (e.g.

berths) and prevailing trends among other terminals. From the standpoint of economics, they are expected to introduce larger LNG tankers that can contribute to reducing the transportation cost.

(3) Utilization of new transportation schemes

a. Swap trading to shorten transport distance

Under the present conditions, where there are significant differences in transport distances between LNG exporters and importers, the Asia/Pacific LNG market has no reason to establish LNG swap trading to shorten the transport distance. In the coming years, however, swap trading such as the following may take place.

- Once Sakhalin II is introduced, swap trades may occur between Japan and Taiwan, China and others.
- Once India starts LNG imports, swap trades may occur in which Japan's Middle Eastern LNG would go to India, and India's Southeast Asian LNG to Japan.
- Once new terminals are built on the North American West Coast, LNG swaps may take place between Japan, with Alaskan LNG to be swapped with Sakhalin II LNG.

b. Back-hauling

Various possibilities of back-hauling in the Asia/Pacific market in the future are summarized in Figure 3-2.

Figure 3-2 Possibilities of Back-haul in Asia/Pacific market

Direction	LNG exporter	Transport routes/possibilities of back-haul
East	USA (Alaska)	● Absence of additional importing/supplying countries around the transport route makes back-haul improbable.
South	Brunei Malaysia Indonesia Australia Others	● Efficient back-haul is hardly viable since exporters (Brunei, Malaysia and Indonesia) are close to each other and no importer exists between them. ● The only viable assumption would be that an empty LNG tanker from Japan stops in Brunei to load LNG and then proceeds back to the Philippines or any other places to unload the cargo before returning to the original supplying country.
West	UAE Qatar Oman Others	● Long transport distance, presence of other exporters and importers along the return route make back-haul highly viable. ● A possibility for back-haul would be that having an empty LNG tanker load Southeast Asian LNG, unload the cargo in India, and then return to the Middle East.
North	Russia	● Short transport distance and the absence of additional importers and exporters along the transport route make back-haul improbable.

Source: Prepared by IEEJ from various reference materials.

3-2-2 Bidding systems

Bidding systems, if partly introduced into newly signed long-term contracts or spot/short-term contracts in Japan in the future, could have the following advantages:

(1) Widening buyers' options in selecting sellers and thus increasing direct competition among sellers.

(2) Enabling buyers to take the bargaining initiative.

(3) Improved transparency expected in the process of supplier selection.

However, following points should be considered:

a) It is not desirable that only a few suppliers would participate in the bidding unless a necessary amount of LNG demand could be guaranteed in the long run for their starting up an LNG project.

b). It is not likely that new players would (with no stake in the existing projects) be able to participate currently planned LNG projects in the Asia/Pacific market even if those projects are realized.

3-3 Directions of LNG pricing

3-3-1 Globalization of LNG prices

For the reasons outlined below, LNG prices across the world are unlikely to show synchronous movements within certain links (differentials) in the next ten years, which means that the globalization of LNG prices will not likely be a reality during the next decade.

(1) Over the next ten years, LNG seems to remain a complement to pipeline gas in the U.S./European markets. This means that the LNG prices will reflect the prices of their pipeline gas markets and will not depend on the prevailing prices in other regions.

(2) To advance globalization of LNG prices requires higher liquidity of physical LNG trading. However, because LNG trading involves issues such as boil-off-gas (BOG) and low calorific values, even new receiving terminals cannot always allow unconditional LNG imports in terms of gas composition etc.

(3) The world's LNG supplies are now controlled by a handful of players, notably state oil companies and the majors. Given their vested interests, these players are unlikely to discard the current pricing systems under their control or respond positively to globalization of LNG prices unless there are logical reasons for them to do so.

3-3-2 LNG pricing in Asia/Pacific region and alliances among buyers

In the future, we expect the Asia/Pacific region to establish region-wide communication networks and encourage LNG trade to be more liquid in order to accomplish the following:

(1) Formation of spot/short-term markets that will allow effective responses to demand volatility, crisis management, etc.

(2) Accumulating demand to start up new LNG projects.

(3) Alliances of LNG transportation to achieve cost reduction.

3-3-3 LNG pricing options in the future

LNG pricing options that can correspond to long-term LNG trading over the next ten years are described below:

(1) Although crude oil price will remain the price indicator, the share of fixed elements will increase while the portion linked to the crude oil price will be curtailed in pursuit of further price stability.

(2) In regards to LNG for electricity generation, viable candidates for its price indicator include the price of coal, which is a rival fuel of LNG and features superior stability in terms of both price and supply security, a package price of fuels such as coal, heavy fuel oil and crude oil,

and the retail price of electricity. As for LNG used for town gas production, the price of petroleum products such as heavy fuel oil and kerosene are viable price indicators.

(3) The price of natural gas futures contract (Henry Hub price) at the New York Mercantile Exchange (NYMEX) can be a price indicator. In this case, heading LNG price risk at NYMEX would be a premise. However, it is necessary for Japanese players to consider whether or not prices that do not take Japanese energy markets into consideration be appropriate.

New pricing in the Asia/Pacific LNG market is likely to be heavily influenced by market changes. These changes include privatization of state oil companies, the entry of new suppliers, the introduction of non-conventional LNG pricing formulas employed by India and China, the Sakhalin II project might seem to supply even North American LNG receiving terminals, and a different pricing system that would be created when the Sakhalin I pipeline project is actually put on stream.

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