Study of Changes in Patterns of LNG Tanker Operation[1]

Koji Morita, General Manager, First Research Department
Takeharu Ueda, Researcher, Gas Group, First Research Department
Shin-ya Nagasaka, Researcher, Gas Group, First Research Department
(currently an employee of Shizuoka Gas Co., Ltd.)

Research Objective

Recent years have seen an increase in the number of newly ordered tankers for transport of liquefied natural gas (LNG). As of October 2002, a total of 133 LNG tankers were in operation, and an additional 60 had been ordered.

Some of the firms ordering LNG tankers reportedly did so without assurance of customers to charter them.

It was the objective of this study to shed light on the intentions of ship owners in their activity for a rapid buildup of their LNG carrying capacity in the recent past, as well as to view the changes in patterns of LNG tanker operation and their influence on LNG transactions.

The study encompasses not only the operation of LNG tankers but also the LNG supply and demand, corporate strategy for the LNG business, and other related matters. This was done in the judgment that LNG tanker operation is part of the LNG supply chain, and that its positioning and influence would become clearer if considered in the context of its relations with other parts and factors.

1. Rapid increase in orders for new LNG tankers

Generally speaking, LNG tankers are procured on the basis of long-term plans for LNG transport in LNG projects. They are ordered in the types and numbers thought to be optimal in light of the loading and unloading ports, sea routes, and related facilities.

In recent years, shipbuilding has been visited by an unprecedented boom ushered in by a number of factors. These include the projections of a big expansion of the LNG demand (LNG projects for supply to the European and North American markets are especially gathering momentum), the falling cost of LNG tanker construction, and the increase in ownership of tankers among LNG buyers and sellers themselves.

[1] This report summarizes the findings of the "Study of Changes in Patterns of LNG Tanker Operation," which was commissioned by the Ministry of Economy, Trade and Industry in fiscal 2002 to promote the development and utilization of natural gas. It has been published with the Ministry's permission. The authors hereby express their gratitude to the concerned Ministry personnel for their understanding and cooperation.

1-1 Orders for new LNG tankers

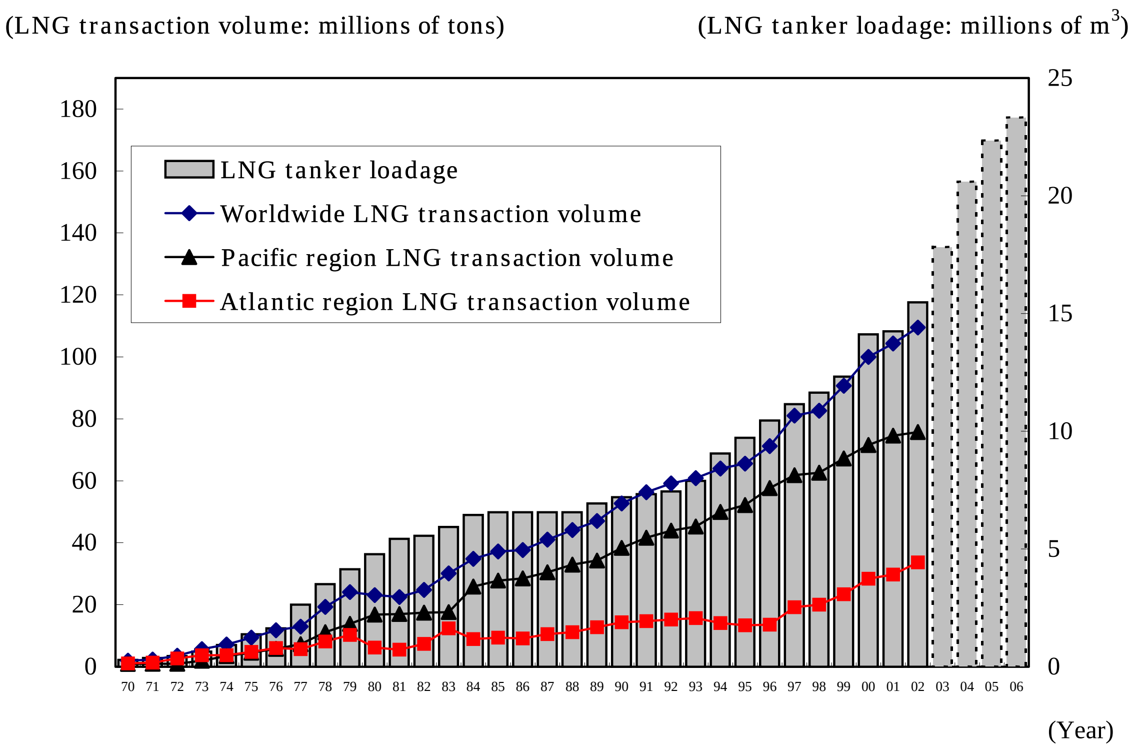
Table 1-1 shows the number and capacity of newly ordered LNG tankers. Coupled with the capacity already in operation, it can be seen that the total carrying capacity is going to rise rapidly (see Figure 1-1).

Table 1-1 Number of newly ordered LNG tankers (as of October 2002)

Time of delivery	Number of tankers ordered	Bottoms (m^3)
2002 (Sep-Dec)	3	413,500
2003	17	2,343,700
2004	20	2,764,500
2005	13	1,751,200
2006	7	980,800
Total	60	8,253,700

Source: LNG Japan Corporation

Figure 1-1 Trend of LNG tanker loadage (capacity) and LNG transaction volume



Note: Figures for LNG tanker loadage are based on maximum levels for tankers in existence as of the end of 2000. They do not include tankers scrapped before that time.

Source: Data from the "BP Statistical Review of World Energy," the website of Mitsui O.S.K. Lines, Ltd., and LNG Japan Corporation

1-2 Regions for input of the increasing number of newly built LNG tankers

Europe and the United States are the largest prospective sites for input of the newly built LNG tankers; taken together, they account for 33. This situation is thought to reflect the burgeoning demand for LNG in the Atlantic region in recent years.

Table 1-2 Prospective sites for input of newly built LNG tankers

Input sites	Number of tankers ordered
Japan, Korea, India	15
Europe, U.S.A.	33
Undecided	12
Total	60

Source: estimates made on the basis of interview data

Table 1-3 List of LNG tankers on order (as of October 2002)

Owner	Builder	Time of delivery	Loadage(cm^3)	Tank type	Input route	Name
2002						
Stasco (Shell)	Mitsubishi Heavy Industries	2-Sep	135,000	Moss	Owntrade/Spot	Galea
Tapias	Daewoo Shipbuilding	2-Sep	140,500	GTT	Spain	Fernando Tapias
BP	Samsung Heavy Industries	2-Nov	138,000	GTT Mk. III	Owntrade	British Trader
Total no. ships 2002	3		413,500			
2003						
MISC	Mitsui Engineering & Shipbuilding	3-Jan	137,100	GTT	Malaysia-Japan	
Stasco (Shell)	Mitsubishi Heavy Industries	3-Jan	135,000	Moss	Owntrade	Gallina
Nigeria LNG	Hyundai Heavy Industries	3-Feb	137,500	Moss	Nigeria	LNG Bayelsa
Bergesen	Daewoo Shipbuilding	3-Mar	138,000	GTT	USA	Berge Boston
BP	Samsung Heavy Industries	3-Mar	138,000	GTT Mk. III	Owntrade	British Innovator
BP	Samsung Heavy Industries	3-Jun	138,000	GTT Mk. III	Owntrade	British Merchant
Bergesen	Daewoo Shipbuilding	3-Sep	138,000	GTT	USA	
I.S. Carriers S.A.	Samsung Heavy Industries	3-Sep	138,000	GTT Mk. III	Qatar-South Korea	
MISC	Mitsubishi Heavy Industries	3-Sep	137,100	GTT	Malaysia-Japan	
Naviera F. Tapias	Izar Sestao	3-Sep	138,000	GTT	Spain	Inigo Tapias
Tokyo Electric Power	Mitsubishi Heavy Industries	3-Sep	135,000	Moss	Japan	
Tokyo Gas	Kawasaki Shipbuilding	3-Oct	145,000	Moss	Japan	
Golar LNG	Hyundai Heavy Industries	3-Oct	137,000	Moss		
Golar LNG	Daewoo Shipbuilding	3-Nov	138,000	GTT	BG owntrade	
Stasco (Shell)	Daewoo Shipbuilding	3-Nov	138,000	GTT	Owntrade	Granatina
Empresa Nav. Elcano	Izar Puerto Real	3-Dec	138,000	GTT	Spain	
Petronet	Daewoo Shipbuilding	3-Dec	138,000	GTT	Qatar-India	Disha
Total no. ships 2003	17		2,343,700			
2004						
Exmar	Samsung Heavy Industries	4-Jan	138,000	GTT Mk. III	Qatar	
MISC	Mitsui Engineering & Shipbuilding	4-Jan	137,100	GTT	Malaysia-Japan	
AP Moller	Samsung Heavy Industries	4-Mar	138,000	GTT Mk. III	Ras Laffan	
Knutsen	Izar Sestao	4-Mar	138,000	GTT	Spain	
MOL/Oman	Kawasaki Shipbuilding	4-Mar	145,000	Moss	Oman	Muscat
NW Shelf	Daewoo Shipbuilding	4-Apr	138,000	GTT	Australia-Japan	
BG	Samsung Heavy Industries	4-May	138,000	GTT Mk. III	Trinidad & Tobago	
Stasco (Shell)	Mitsubishi Heavy Industries	4-May	135,000	Moss	Owntrade	Gemmata
Exmar	Daewoo Shipbuilding	4-Jun	138,000	GTT	USA	
Knutsen	Izar Puerto Real	4-Jun	138,000	GTT	Qatar-Spain	
Bergesen	Daewoo Shipbuilding	4-Jul	138,000	GTT	Algeria	
Golar LNG	Daewoo Shipbuilding	4-Jul	138,000	GTT		
Union Fenosa	Daewoo Shipbuilding	4-Jul	138,000	GTT	Spain	
Mitsui & Co	Mitsui Engineering & Shipbuilding	4-Aug	135,000	Moss	Qatar-Japan	
MISC	Mitsubishi Heavy Industries	4-Sep	137,100	GTT	Malaysia-Japan	
Exmar	Daewoo Shipbuilding	4-Oct	138,000	GTT	USA	Excel
Golar LNG	Hyundai Heavy Industries	4-Oct	137,000	GTT Mk. III		
Nigeria LNG	Hyundai Heavy Industries	4-Nov	137,300	Moss	Nigeria	
MOL/Itochu/Sonatrach	Kawasaki Shipbuilding	4-Dec	145,000	Moss	Algeria	
Petronet	Daewoo Shipbuilding	4-Dec	138,000	GTT	Qatar-India	
Total no. ships 2004	20		2,764,500			
2005						
Exmar	Daewoo Shipbuilding	5-Jan	138,000	GTT	USA	
Gaz de France	L'Atlantique	5-Jan	74,000	CS1	Algeria-France	
MISC	Mitsui Engineering & Shipbuilding	5-Jan	137,100	GTT	Malaysia-Japan	
Bergesen	Daewoo Shipbuilding	5-Feb	140,500	GTT	Nigeria-France	
Exmar	Daewoo Shipbuilding	5-Mar	138,000	GTT	USA	
Tokyo Gas	Kawasaki Shipbuilding	5-Mar	145,000	Moss	Japan	
Bergesen	Daewoo Shipbuilding	5-Jul	140,500	GTT	Nigeria-France	
Nigeria LNG	Hyundai Heavy Industries	5-Jul	137,300	Moss	Nigeria	
Exmar	Daewoo Shipbuilding	5-Sep	138,000	GTT	USA	
Leif Hoegh/MOL	Mitsubishi Heavy Industries	5-Oct	145,000	Moss	Norway-USA	
Bergesen	Daewoo Shipbuilding	5-Nov	140,500	GTT	Nigeria-France	
K-Line/Mitsui & Co	Kawasaki Shipbuilding	5-Nov	140,000	Moss	Norway-USA	
Nigeria LNG	Hyundai Heavy Industries	5-Nov	137,300	Moss	Nigeria	
Total no. ships 2005	13		1,751,200			
2006						
Leif Hoegh/MOL	Mitsubishi Heavy Industries	6-Jan	145,000	Moss	Norway	
Bergesen	Daewoo Shipbuilding	6-Mar	140,500	GTT	Nigeria-France	
Nigeria LNG	Hyundai Heavy Industries	6-Mar	137,300	Moss	Nigeria	
Tokyo Electric Power	Mitsubishi Heavy Industries	6-Mar	135,000	Moss	Japan	
K-Line/Mitsui & Co	Mitsui Engineering & Shipbuilding	6-Apr	140,000	Moss	Norway-USA	
Tapias	Izar Puerto Real	6-Jun	138,000	GTT	Spain	
Osaka Gas	Kawasaki Shipbuilding	6-Jun	145,000	Moss	Australia-Japan	
Total no. ships 2006+	7		980,800			

Source: Data from interviews with LNG Japan Corporation and other parties

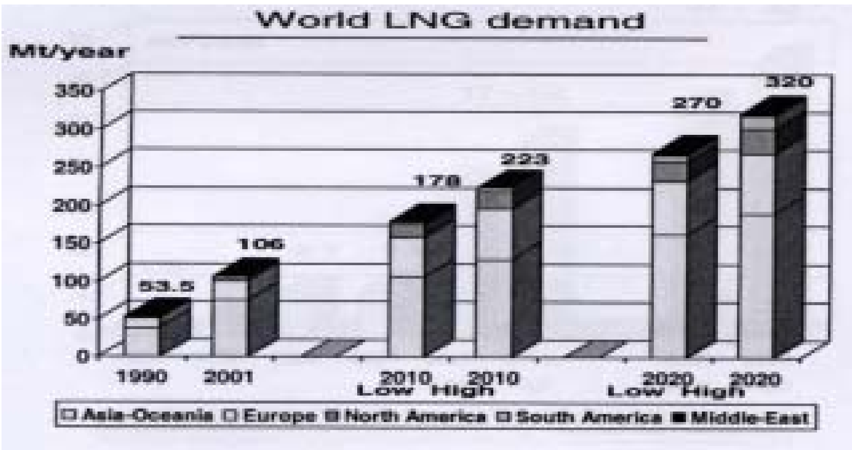
2. Factors behind the orders for newly built LNG tankers

2-1 Increase in demand for LNG

One of the chief factors behind the sharp increase in orders for new LNG tankers is the outlook for a substantial expansion of the demand for LNG.

Based on data from CEDIGAZ, Figure 2-1 shows actual figures for the LNG demand in 1990 and 2001, and forecast figures for the years to 2020. In both the high and low cases, the forecast envisions a sizable increase in the demand over the years 2001 - 2020. The rate of increase from 2001 to 2010 is forecast at an annual average of 5.9 percent in the low case and 8.6 percent in the high case. The corresponding rates from 2001 to 2020 are 5.0 and 6.0 percent, respectively.

Figure 2-1 LNG demand outlook



Source: CEDIGAZ, December 2002

This expectation of a steep increase in the LNG demand is hardly confined to CEDIGAZ; it is shared by most other observers. The following are the major factors behind this prospective increase in the demand.

a. Increase in the demand for natural gas led by the power sector

b. Rise in the share of the natural gas supply occupied by LNG (relative to pipeline gas)

- Decrease in LNG supply chain cost
- Decrease in the amount of production at nearby gas fields (in the case of the United Kingdom, the United States, etc.)
- Diversification of supply sources to improve energy security

- Internationalization of LNG business due to participation by oil majors, etc.

2-2 Changes in LNG transactions

The previous section explained the background to the brisk orders for new LNG tankers as viewed from the quantitative perspective of LNG demand.

This section considers the rising demand for LNG tankers from the qualitative aspect of changes in LNG transactions.

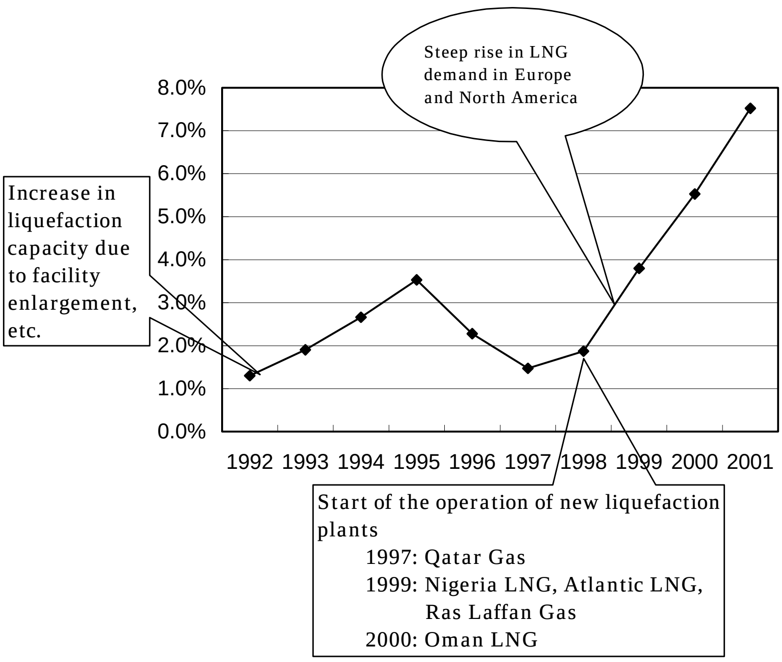
2-2-1 Increase in LNG spot transactions[2]

Figure 2-2 shows the trend of the share of all LNG transactions occupied by spot transactions and the major factors behind the change in this respect. This share has jumped over the last few years and now approaches 8 percent in terms of the total transaction volume.

The main factors in this jump are the increase in surplus production capacity outside the scope of long-term sales contracts due to the successive initiation of new liquefaction projects, and the steep rise in the LNG demand in Europe and North America since 1999.

Although short-term transactions would ordinarily not motivate the placement of orders for new LNG tankers, the spread of spot and other such transactions would increase the range of options for efficient tanker operation. For example, while transactions grounded in long-term sales contracts would remain the chief object, empty capacity could be put to use for short-term transactions.

Figure 2-2 Share of all LNG transactions occupied by spot transactions (worldwide)



Source: Prepared by the Institute of Energy Economics, Japan based on data from the "BP Statistical Review of World Energy" and PETROSTRATEGIES.

2-2-2 Changes in the LNG supply chain in the Atlantic region

Conventionally, the division of roles among the players in each sector of the LNG supply chain has basically been fixed. However, the oil majors and other international energy concerns are now beginning to move into new sectors. They are particularly eager to build, or get rights to, receiving terminals in the downstream sector.

Besides the progress of deregulation in Europe and North America, this trend reflects desires among international energy concerns, which are endowed with enormous financial and marketing power, to stimulate demand by moving into the downstream sector and contributing to the launch of new liquefaction projects or effective use of surplus liquefaction capacity.

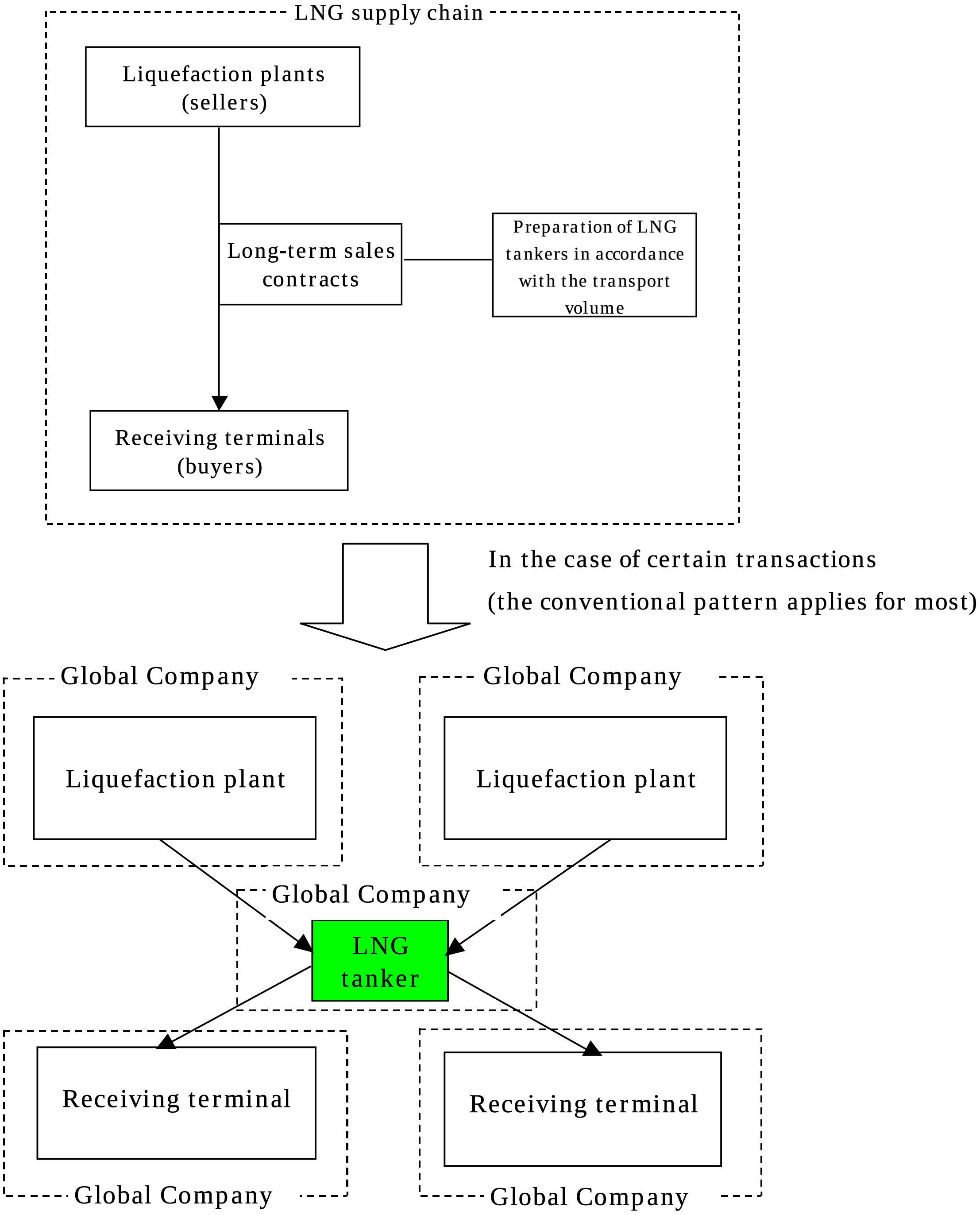
There is also a trend toward consideration of investment in each sector (upstream, middle range, and downstream) of the LNG supply chain separately. In the upstream sector, some liquefaction projects have been launched even though contracts have not been concluded for the entire liquefaction capacity. In the downstream sector, it is becoming customary first to decide upon the construction of receiving terminals and then to select suppliers offering the best terms.

If the upstream and downstream sectors lose the degree of coherence that has characterized them thus far, the LNG tankers positioned in the middle will have to become capable of more versatile and flexible operation. As suggested by the fact that both sellers and buyers actively want to have tankers of their own, the transportation link of the LNG supply chain is expected to acquire increasing importance over the coming years.

---

[2] Transactions based on LNG sales contracts with a term of less than one year.

Figure 2-3 Changes in the LNG supply chain (Atlantic region)



-- Trend toward launch in each sector
-- Focus on versatility and flexibility in LNG tanker operation

Source: Prepared by the Institute of Energy Economics, Japan based on various data

2-2-3 Changes in the LNG chain in the Pacific region

Major changes in the configuration of the LNG chain like those under way in the Atlantic region have not appeared in the Pacific region. Nevertheless, there have been signs of certain change, in the form of plans for construction of receiving terminals on the U.S. West Coast and ownership of tankers by buyers.

3. Changes in the pattern of LNG tanker operation

The preceding sections have described the situation and background of the surge in orders for new LNG tankers; this section is concerned with the changes in the patterns of actual LNG tanker operation.

3-1 Europe and North America

3-1-1 Changes in the patterns of tanker operation

Table 3-1 lists LNG tankers selected for the purpose of comparing LNG tanker operation over the years 1997 - 1999 with that in 2002.[3] They exemplify five categories of operation, as follows.

1) Tankers 1 - 6: operation mainly in the Mediterranean
2) Tankers 7 - 9: operation mainly for transactions in the Atlantic region
3) Tankers 10 - 11: transport to the United States
4) Tankers 12 - 14: transport of Nigerian LNG
5) Tankers 15 - 20: operation for short-term transactions

[3] The number of voyages in 2002 contains some discrepancy due to factors such as the method of counting voyages that span two different years.

Table 3-1 List of LNG tankers for comparison of changes in patterns of operation

NO.	Tanker name	Capacity(m3)	Year of construction	Owner	Charterer
1	HASSI R'MEL	40,109	1971	SNTM-HYPROC	GdF
2	TELLIER	40,081	1973	Messigaz	GdF
3	EDOUARD L.D.	129,440	1977	Dreyfus/GdF	GdF
4	RAMDANE ABANE	126,000	1981	SNTM-HYPROC	GdF
5	ISABELLA	31,700	1975	Chemikalien Seetrans	Enagas
6	LNG PORTVENERE	65,000	1996	Snam	Snam
7	METHANE ARCTIC	71,500	1969	British Gas(BG)	Enagas
8	METHANE POLAR	71,500	1969	British Gas(BG)	Enagas
9	NORMAN LADY	87,600	1973	Leif Hoegh/MOL	Enagas
10	MATTHEW	126,540	1979	Tractebel North America	Atlantic LNG
11	MOSTEFA BEN BOULAID	125,260	1976	SNTM-HYPROC	Distrigas
12	LNG LAGOS	122,250	1976	Bonny Gas Transport	Nigeria LNG
13	LNG ABUJA	126,530	1980	Bonny Gas Transport	Nigeria LNG
14	LNG FINIMA	133,000	1984	Bonny Gas Transport	Nigeria LNG
15	HAVFRU	29,388	1973	Bergesen	BP
16	HOEGH GALLEON	87,600	1974	Leif Hoegh	Tractebel
17	HILLI	126,227	1975	Golar LNG	BG
18	GIMI	126,277	1976	Golar LNG	BP
19	LNG AQUARIUS	126,300	1977	MOL/LNG Japan	Hyundai Shipping
20	GOLAR FREEZE	125,858	1977	Golar LNG	BG

Source: prepared by the Institute of Energy Economics, Japan based on various data

Category 1 Operation mainly in the Mediterranean

Formerly, LNG tankers operating in the Mediterranean generally went back and forth between Algeria and a single receiving country. As shown in Figure 3-1, however, along with the diversification of exporting and importing countries, some LNG tankers have begun to take in LNG at more than one liquefaction plant and carry it to more than one receiving terminal.

Nevertheless, transport over a single route remains the dominant mode of operation.

In other words, although there has been an increase in the patterns of operation for LNG tankers operating mainly in the Mediterranean, there has been no change as regards the commitment to long-term contracts and limited frequency of voyages for spot transactions.

It should also be noted that all of the tankers listed in Table 3-1 were operated on the free-on-board (FOB) basis. Those loading on LNG at more than one liquefaction plant were owned either by buyers or shipping companies; in no case did tankers owned by the seller, i.e., the state enterprise in Algeria, make voyages to Nigeria or Trinidad.

Figure 3-1 Changes in the pattern of operation in Category 1

1.HASSI R'MEL

1997

Route	Number of voyages
Algeria - France	11
Algeria - Spain	1
Total	12

2002

Route	Number of voyages
Algeria - Spain	32
Algeria - France	13
Algeria - Italy	5
Total	50

2.TELLIER

1998

Route	Number of voyages
Algeria - France	67

2002

Route	Number of voyages
Algeria - France	64
Algeria - Italy	2
Total	66

3.EDOUARD LD

1998

Route	Number of voyages
Algeria - France	33

2002

Route	Number of voyages
Algeria - France	25
Nigeria - France	3
Trinidad - Spain	1
Algeria - USA	1
Total	30

4.RAMADANE ABANE

1998

Route	Number of voyages
Algeria - France	38

2002

Route	Number of voyages
Algeria - France	16
Algeria - Turkey	9
Total	25

5.ISABELLA

1998

Route	Number of voyages
Algeria - Spain	48

2002

Route	Number of voyages
Algeria - Spain	35
Libya - Spain	7
Trinidad - USA	1
Total	43

6.LNG PORTVENERE

1998

Route	Number of voyages
Algeria - Italy	14
UAE - Italy	8
Total	22

2002

Route	Number of voyages
Algeria - Italy	19
Qatar - Italy	5
Total	24

Source: LNG One World, Sigtto LNG log26

Category 2 Operation mainly for transactions in the Atlantic region

As shown in Figure 3-2, some LNG tankers are operating to both Spain and the United States. Owned by British Gas and chartered by Enagas (Spanish company), Methane Arctic and Methane Polar carry LNG from Algeria and Trinidad to Spain and the United States while monitoring the situation as regards demand and price.

Owing to considerations of transportation distance, it is becoming common for them to carry Algerian LNG to Spain and Trinidad LNG to the United States.

Figure 3-2 Changes in the pattern of operation in Category 2

7.METHANE ARCTIC

1998

Route	Number of voyages
Algeria - Spain	40
UAE - Spain	1
Total	41

2002

Route	Number of voyages
Trinidad - USA	8
Algeria - Spain	7
Trinidad - Spain	2
Total	17

8.METHANE POLAR

1998

Route	Number of voyages
Qatar - Spain	12

2002

Route	Number of voyages
Algeria - Spain	39
Trinidad - USA	5
Algeria - USA	2
Total	46

9.NORMAN LADY

1998

Route	Number of voyages
UAE - Spain	12
Total	12

2002

Route	Number of voyages
Trinidad - USA	9
Trinidad - Puerto Rico	1
Trinidad - Spain	5
Total	15

Source: LNG One World, Sigtto LNG log26

Category 3 Transport to the United States

Tankers carrying LNG to the United States fall into two categories in respect of LNG source: the conventional Algerian and the emerging Trinidad. Algerian tankers make up most of the former, and high-frequency operation has been made more difficult due to the long-term slump in the LNG demand in the United States and the low level of transport volumes based on long-term contracts. Since the start of LNG export by Trinidad, LNG export from Algeria to the United States has gone into decline, and Algerian tankers accustomed to making runs there are increasingly carrying LNG to Turkey.

Figure 3-3 Changes in the pattern of operation in Category 3

10.MATTHEW

1999

Route	Number of voyages
Trinidad - USA	10
Algeria - USA	4
Total	14

↓

2002

Route	Number of voyages
Trinidad - USA	14
Trinidad - Puerto Rico	2
Total	16

11.MOSTEFA BEN BOULAID

1998

Route	Number of voyages
Algeria - USA	6

↓

2002

Route	Number of voyages
Algeria - Turkey	6
Algeria - Spain	1
Algeria - USA	1
Total	8

Source: LNG One World, Sigtto LNG log26

Category 4 Tankers used by Nigeria LNG

Beginning in 1990, Bonny Gas Transport, the subsidiary of Nigeria LNG, actively purchased LNG tankers that had been idle and placed them into operation again. Of the nine tankers used by Nigeria LNG, seven were built between the years 1976 and 1984 and saw almost no operation in the succeeding years, when they were basically moored.

Before they were renovated and put back into operation by Nigeria LNG, these tankers had been chartered for short-term, spot operation, mainly in the Asian region. Upon the resumption of operations by Nigeria LNG in 1999, however, they were dedicated to contracts with a long term of at least 20 years for transport to the European market.

Given its location, Nigeria would also be in a position to export to the United States, and has opportunities for business in connection with transatlantic transactions.

Although FOB contracts have been dominant thus far in Europe, the course of the Nigeria LNG projects based on ex-ship contracts holds importance as an indicator of the direction for future LNG transport.

Figure 3-4 Changes in the pattern of operation in Category 4

12.LNG LAGOS

1999

Route	Number of voyages
Nigeria - France	1
Nigeria - Turkey	1
Total	2

2002

Route	Number of voyages
Nigeria - France	7
Nigeria - Turkey	2
Nigeria - USA	1
Total	10

13.LNG ABUJA

1999

Route	Number of voyages
Algeria - USA	5
Trinidad - USA	2
Trinidad - Spain	1
Total	8

2002

Route	Number of voyages
Nigeria - France	5
Nigeria - Spain	3
Nigeria - Turkey	3
Total	11

14.LNG FINIMA

1999

Route	Number of voyages
Qatar - Spain	8
Nigeria - Spain	1
Qatar - USA	1
Total	10

2002

Route	Number of voyages
Nigeria - France	7
Nigeria - Spain	3
Nigeria - Turkey	3
Total	13

Source: LNG One World, Sigtto LNG log26

Category 5 Operation for short-term transactions

As shown in Figure 3-5, LNG tankers operated for short-term transactions make voyages between a plural number of liquefaction plants and a plural number of receiving terminals in a single year. They are not committed to long-term contracts, and the transactions in question exhibit a regional diversity including transatlantic runs, transport from the Middle East to Europe or North America, and intra-Asian voyages. This category is also marked by the presence of many independent shipping companies in the circle of parties owning LNG tankers for short-term transactions.

Figure 3-5 Changes in the pattern of operation in Category 5

15.HAVFRU

1995

Route	Number of voyages
Libya - Spain	29
Algeria - Spain	4
Total	33

2002

Route	Number of voyages
Trinidad - USA	5
Algeria - Spain	4
UAE - Spain	4
Qatar - Italy	1
Qatar - Spain	1
Total	15

16.HOEGH GALLEON

2002

Route	Number of voyages
Algeria - Spain	4
Algeria - USA	4
Qatar - Spain	3
Qatar - Puerto Rico	1
Qatar - Belgium	1
Trinidad - USA	1
Total	14

17.HILLI

1998

Route	Number of voyages
Indonesia - Korea	10
Malaysia - Korea	5
Total	15

2002

Route	Number of voyages
Trinidad - USA	5
Qatar - USA	3
Qatar - Korea	2
Total	10

18.GIMI

1998

Route	Number of voyages
Qatar - Turkey	7

2002

Route	Number of voyages
UAE - Spain	4
Oman - Spain	3
Qatar - USA	1
Total	8

19.LNG AQUARIUS

1998

Route	Number of voyages
Indonesia - Japan	19

2002

Route	Number of voyages
Indonesia - Korea	11
Qatar - USA	2
Qatar - Korea	1
Total	14

20.GOLAR FREEZE

1999

Route	Number of voyages
Indonesia - Korea	10
Malaysia - Korea	5
Total	15

2002

Route	Number of voyages
Qatar - USA	4
Qatar - Korea	3
Total	7

Note: For the Hoegh Galleon, data enabling comparison with the 1990s are not available because ownership changed in the interim.

Source: LNG One World, Sigtto LNG log26

3-1-2 Trends among LNG tankers used for spot transport (2001)

Figure 3-6 lists the LNG tankers used for spot transport (at least twice) in 2001. Here, the term "spot transport" refers to transport other than that based on commitments to long-term contracts. The tanker used most often for spot transport was Hassi R'mel, owned by SNTM-HYPROC, the state-run Algerian shipping company. Of the 30 voyages it made in 2001, 20 were for spot transport. The Hassi R'mel operated mainly between Algeria and France until 1997, but subsequently made fewer voyages; in 1999, it made only three.

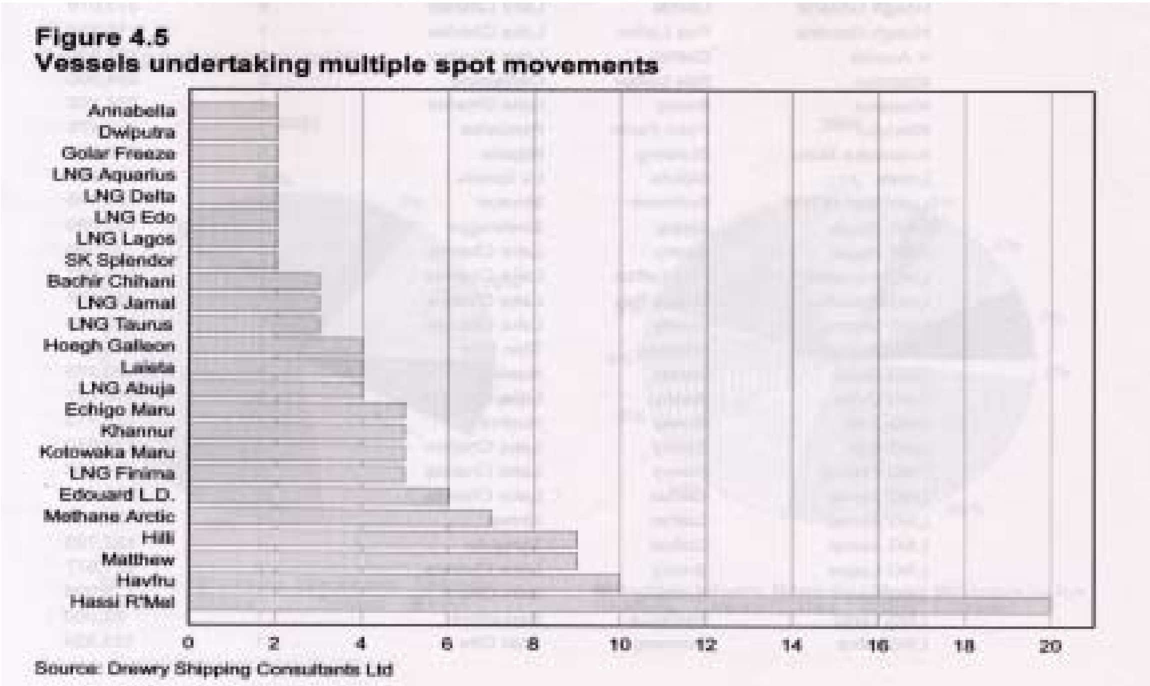
In contrast, starting from Algeria, it made a total of 27 voyages, to the countries of Turkey, Spain, and Italy, in 2000; 30 voyages, to those of France, Turkey, Spain, and Italy, in 2001; and 50 voyages, to those of Spain, France, and Italy, in 2002.

The tanker has been chartered by Gas de France (GdF) for transport mainly to Spain based on a long-term contract, and therefore was not designed for short-term transactions.

In 2001, however, spot transport accounted for about 70 percent of its total transport volume, and this is definite evidence that it offers a high degree of freedom in operation.

Built in 1971, the Hassi R'mel is an old tanker and has a small load capacity of 39,900 cubic meters. It is consequently thought to play a supplementary role for other Algerian tankers.

Figure 3-6 LNG tankers used two or more times for spot transport in 2001



Source: Drewry Shipping Consultants Ltd.

3-2 Japan

3-2-1 Trends in ownership of LNG tankers

Transactions for LNG shipments to Japan have usually been based on ex-ship contracts, with the sellers making arrangements for the LNG tankers. In recent years, however, it has become common for the Japanese LNG buyers to conclude FOB contracts for LNG sales with a view to reducing the cost of LNG import and making purchase more flexible.

The following are the major developments leading up to the incorporation of FOB tankers along with the spread of FOB contracts.

- Early 1980s: construction of LNG tankers for FOB contracts by Japanese shipping companies

The application of an FOB format for the 1981 contract with Indonesia (for increased shipments from the Badak and Arun projects) may be cited as the start of diversification in LNG transaction patterns. This was the first time for a Japanese shipping company to participate in the LNG transport sector. Prior to it, loads had been carried by LNG tankers that had been chartered by sellers. The conclusion of FOB contracts made it possible for Japanese shipping companies to bring LNG to Japanese LNG buyers on ships they owned themselves.

- Early 1990s: construction of LNG tankers for FOB contracts jointly by LNG buyers and shipping companies

The F-train project in Indonesia represented the first case of participation by a Japanese LNG buyer in LNG transport, based on a 50-percent outlay for an LNG tanker (the other 50 percent of the total outlay was made by a Japanese shipping company). A contract was concluded for purchase of 2.3 million tons of LNG annually for a period of 20 years beginning in 1994, entirely on the FOB basis. The three companies Tokyo Gas, Osaka Gas, and Toho Gas together own two LNG tankers through their respective subsidiaries Tokyo LNG Tanker (TLT), Osaka Gas International Transport (OGIT), and Toho LNG Shipping (TLS). They apply these tankers for transport of their own LNG supplies.

In other words, following the conclusion of the FOB contract with Indonesia in 1981 for increased shipments from the Badak and Arun projects, there arose a movement for participation in the LNG transport sector, first by the shipping companies and then by LNG buyers, for the purpose of diversifying patterns of transaction and transport. During the initial period of LNG import, LNG buyers were not interested in owning LNG tankers because they did not perceive a need to assume even the risks of tanker ownership and transport. However, there arose mounting demands for contracts reflecting the strategies and circumstances of the buyers, and it was subsequently considered necessary for the buyer side to participate in the LNG transport sector. This led to the decision in favor of joint ownership by the three major city gas companies.

Thereafter, LNG buyers began to gradually raise their rates of investment in ownership of LNG tankers for the purpose of getting further flexibility in the operation aspect. This is linked to the current movement to own LNG tankers themselves.

3-2-2 Differences of stance on LNG tanker ownership among buyers

Figure 3-7 presents the ownership of LNG tankers by Japanese shipping companies and LNG buyers thus far. It can be seen that there is a slight difference of stance between city gas companies and electric power companies. The former began to participate in LNG tanker ownership arrangements in 1993, but Tokyo Electric Power became the first of the latter to own an

LNG tanker only in 2003.

Early on, city gas companies came to the conclusion that participation in the LNG transport business was necessary both to assure supply stability and provide for sufficient economic merit and flexibility. Ownership of an LNG tanker gives them more flexibility in the operation and procurement aspects, but also saddles them with operation-related risk.

Figure 3-7 LNG tankers (FOB-base) owned wholly or partially by Japanese shipping companies/LNG buyers (with ownership rates in parentheses)

Tanker name	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
Bishu Maru	For the Badak production increase (even three-way split among HYK, MOL, and K-LINE)																				Extension of the contract in April 2003											
Banshu Maru	For the Badak production increase (even three-way split among HYK, MOL, and K-LINE)																				Extension of the contract in April 2003											
Senshu Maru		For the Badak production increase (even three-way split among HYK, MOL, and K-LINE)																			Extension of the contract in April 2003											
Echigo Maru	For the Arun production increase (NYK 40%, MOL 45%, K-LINE 15%)																						Extension of the contract in January 2005									
Kotowaka Maru		For the Arun production increase (NYK 40%, MOL 45%, K-LINE 15%)																					Extension of the contract in January 2005									
Dewa Maru		For the Arun production increase (NYK 40%, MOL 20%, K-LINE 40%)																					Extension of the contract in January 2005									
Wakaba Maru			For the Arun production increase (NYK 40%, MOL 50%, K-LINE 10%)																				Extension of the contract in January 2005									
LNG FLORA											For the Indonesia F-train project (TLT 10%, OGIT 35%, TLS 5%, total 50%)																					
LNG VESTA												For the Indonesia F-train project (TLT 35%, OGIT 10%, TLS 5%, total 50																				
LNG JAMAL																		For the Oman project (Osaka Gas 60%)														
New Tokyo Gas tanker 1																					For the Malaysia 1 project (TG 100%)											
New Tokyo Gas tanker 2																							NWS expansion (TG 100%)									
New Osaka Gas tanker 1																								NWS expansion (OG 60%)								
New Tokyo Electric Power tanker 1																					For the Malaysia 1 project (TE 70%)											
New Tokyo Electric Power tanker 2																								For the Darwin project (TE 70%)								

Note: Some LNG tankers could leave fleets due to the substantial downward revision in contract volumes upon extension of the contract for production increase in the Arun project in Indonesia.

Source: based on data from interviews

Tokyo Electric Power, on the other hand, initially did not perceive a need to shoulder risks extending to LNG tanker ownership and transport.

Nevertheless, the progress of deregulation in recent years is increasing the uncertainty surrounding the future course of the demand for electrical power and the company share of the market. Tokyo Electrical Power apparently decided to own its own LNG tanker after recognizing higher levels of economicality and flexibility in LNG procurement and stronger price competitiveness as urgent tasks.

4. Implications for LNG tanker operation

This final section views the changes in the patterns of LNG tanker operation in the Pacific region and considers their implications as regards influence on LNG transactions and measures for promotion of flexibility in these transactions.

4-1 Changes in the patterns of LNG tanker operation and higher flexibility in LNG transactions

Table 4-1 classifies patterns of LNG tanker operation into four categories of type. Type 1 consists of LNG tankers committed to the conventional long-term sales contracts, and Type 2, of LNG tankers that are basically committed to long-term contracts but also used for other transactions if surplus capacity arise. The tankers in Type 3 are ordered by companies such as Shell and BP for their own use and are not committed to any specific project on a long-term basis . They are flexibly operated, in correspondence with items such as LNG supply-demand balance and price, through efforts to assure a prescribed volume of supply and demand on both the LNG source and destination sides. Type 4 contains LNG tankers operated mainly for short-term transactions.

Figure 4-1 shows the changes in each of these types over time in the Atlantic and Pacific regions. The vertical axis indicates the degree of flexibility, and the horizontal axis, the degree of risk associated with investment in LNG tankers.

The size of the tanker mark indicates the rough image of combined tanker loadage capacity. The figure therefore shows not only changes in capacity but also shifts in the direction of higher flexibility over time, as in the case of Type 2.

Table 4-1 Types of LNG tanker operation

Types of LNG tanker operation	Characteristics
1. Complete commitment to a specific project on a long-term basis	Low flexibility, low risk of low operation
2. Long-term commitment to a specific project, but use of surplus capacity for spot transactions, etc.	Low - medium flexibility, low risk of low operation
3. Involvement by the chartering company in the entire LNG supply chain, and operation adapted to the situation as regards demand, etc.	High flexibility, medium risk of low operation
4. Operation mainly for short-term transactions	High flexibility, high risk of low operation

Source: Prepared by the Institute of Energy Economics, Japan

There is also a difference of plot distribution in the same year between the Atlantic and Pacific regions. The findings of interviews with experts in Europe suggest that operation in the Atlantic region is more advanced and that the Pacific region would eventually follow its lead. However, in light of their different circumstances, the patterns in the two regions would probably not be exactly the same.

Figure 4-1 Changes in the patterns of LNG tanker operation by region (conceptual graphs)

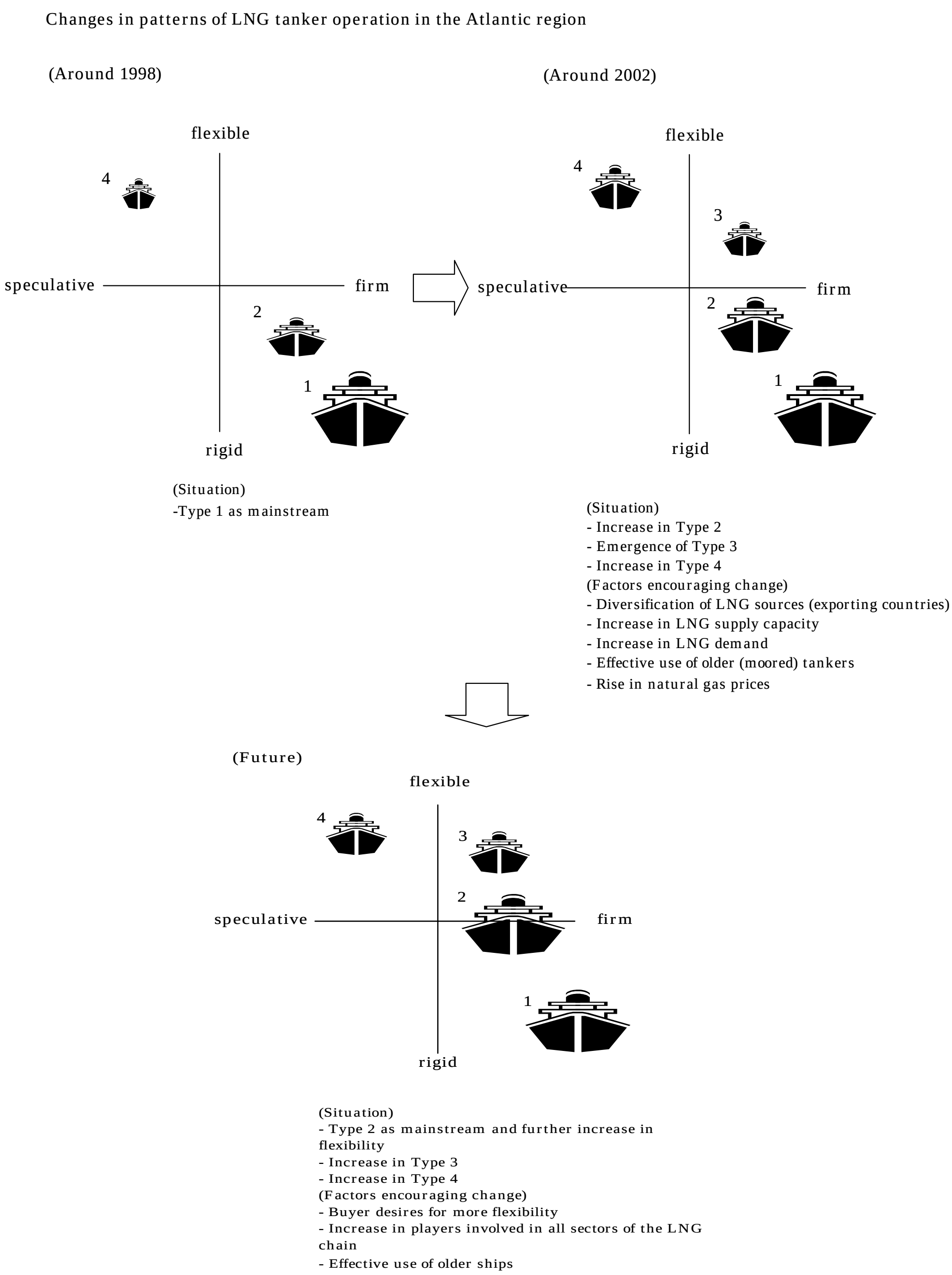
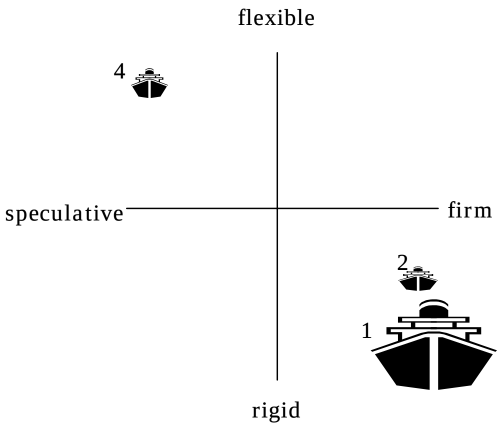


Figure 4-1 (continued)

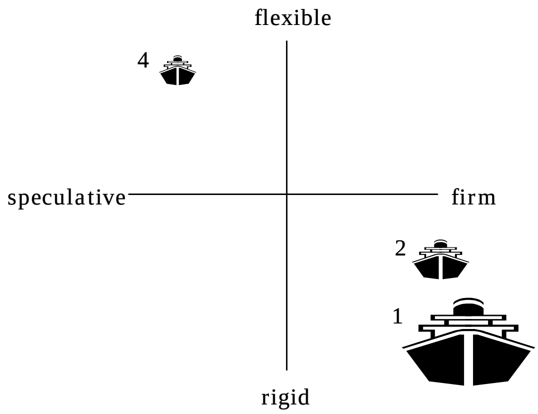
Changes in patterns of LNG tanker operation in the Pacific region

(Around 1998)



(Situation)
- Type 1 as mainstream
- Type 4 at peak times

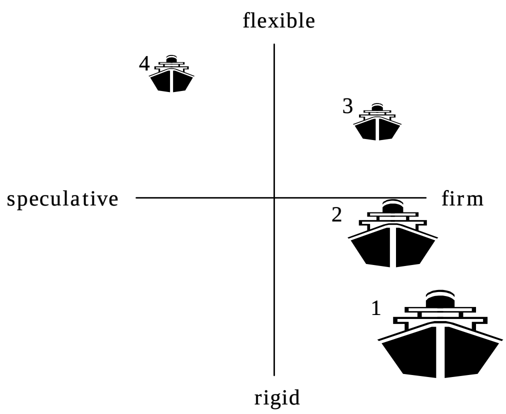
(Around 2002)



(Stuation)
- Increase in Type 2

(Factors encouraging change)
- Buyer desires for more flexibility
- Increase in LNG supply surplus
- Expansion of the range of fluctuation in the natural gas demand

(Future)



(Situation)
- Type 2 as mainstream and further increase in flexibility
- Spread of Type 3 from the Atlantic region
- Increase in Type 4

(Factors encouraging change)
- Buyer desires for more flexibility
- Increase in surplus bottoms on the seller side due to FOB inclinations among buyers
- Effective use of older tankers
- Construction of new LNG receiving terminals on the U.S. West Coast

In the Pacific region, Type 1 will presumably continue to occupy a significant position because of the base demand in spite of the major change in LNG tanker operation. Type 2 brings both avoidance of the risk of low operation and higher flexibility, and is likely to spread through buyer ownership of tankers or effective use of surplus capacity among sellers. Although matters could vary considerably depending on the proportion of capacity committed to long-term contracts to those applied for spot transactions, the coming years should see a shift in the direction of higher flexibility.

Type 3 is anticipated to spread along with the increase in players involved in all sectors of the LNG supply chain, but the true worth of this vertically integrated business model will probably be tested in the future.

The Type 4 LNG tankers for short-term transactions may be expected to increase due to factors such as the release of existing LNG tankers from specific projects along with the revision of LNG sales contracts and the construction of new receiving terminals on the U.S. West Coast. For sellers in the Pacific region, the West Coast is becoming an attractive market for sales of surplus LNG on the short-term basis.

Nevertheless, the scope of Type 4 utilization will probably be limited, because spot transactions in East Asia, which accounts for a substantial part of the demand in the entire Pacific region, should be confined to the winter peak and unforeseen occurrences for the time being. Type 4 tankers are not going to be tied to the Atlantic region, and should come to the Pacific region in peak seasons even while operating mainly in the Atlantic.

Spot transactions for LNG picked up from 2002 to 2003 due to cold winters worldwide and the shutdown of nuclear power plants in Japan (mainly those owned by Tokyo Electric Power). In the United States, Henry Hub spot prices rose to 13 dollars per MMBtu for a time as the demand surged. In spite of this, however, more extensive transactions in LNG were reportedly bottlenecked by the short supply of LNG tankers.

The prospects for higher degrees of flexibility in LNG transactions depend on factors such as the LNG supply-demand balance and power relationships between sellers and buyers. At the least, LNG transactions will presumably become more flexible in the event of a transport bottleneck, because operating available tankers more flexibly and efficiently may be expected as a response in addition to that of increasing the absolute number of tankers.

4-2 Changes in the LNG supply chain in the Pacific region

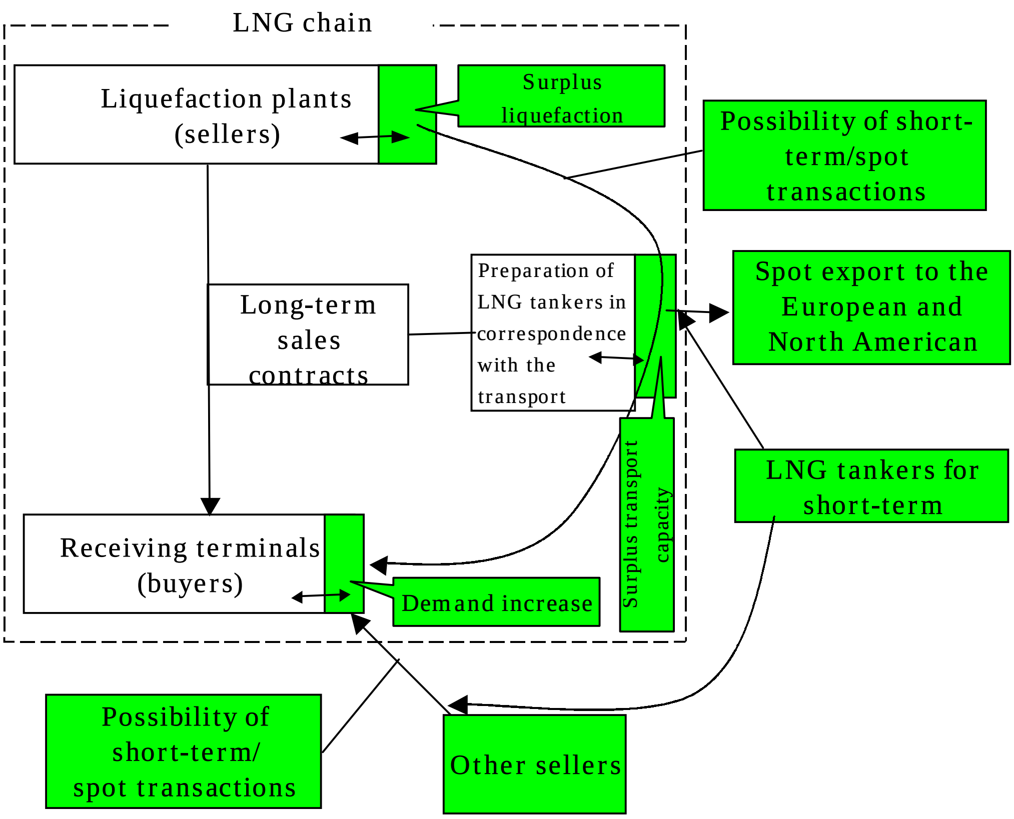
In the Pacific region, a major change in the framework of the LNG supply chain is not on the horizon, but projects that do not entail commitments to long-term contracts for the entire liquefaction capacity could emerge over the coming years.

The resulting surplus will probably be exported mainly to the European and North American markets for the foreseeable future.

However, buyers in the Pacific region could also conceivably turn to spot transactions as a means of coping with demand runs at times such as the peak winter season. While there would be no problem if the transport capacity for the project has margin, tanker unavailability could form a bottleneck to increased LNG transactions.

As noted in the forecast in the preceding section, an increase in the number of LNG tankers with a high degree of operational freedom could reduce such bottlenecks and make LNG transactions in the Pacific region more flexible (see Figure 4-2).

Figure 4-2 LNG supply chain in the Pacific region (conceptual diagram)



Note: For the purpose of simplification, the ratio of liquefaction plants to receiving terminals is assumed to be 1:1.

Source: prepared by the Institute of Energy Economics, Japan

4-3 Measure for promotion of flexible LNG transactions

-effective use of order (contract expired) ships-

To conduct LNG transactions with more flexibility requires more flexible transport. This, in turn, demands the availability of LNG tankers for short-term transactions, with assumption of a certain attendant risk of a low operation rate. Because newly built LNG tankers which have not been amortized could not be exposed to this risk, older LNG tankers that have been completely amortized could be put to use for short-term transactions.

While such older tankers could be separately owned and managed, the option of using them as part of a large fleet would presumably be more advantageous in respect of cost. Separate use for short-term transactions would entail an excessive burden of fixed (management) costs that would make it hard to continue the business if demand dropped off. Operation as part of a large fleet, on the other hand, would offer lower fixed costs and function as a buffer for the other LNG tankers committed to long-term contracts.

Although assurance of safety would be a fundamental prerequisite, effective use of older tankers merits consideration as a means to reduce costs.

Beginning in 2003, a stream of current LNG projects will come to the expiration deadline of their contracts. By 2010, charterage contracts are expected to be over for a total of 34 LNG tankers (see Table 4-2). Of this total, it is thought that 19 would not be tied to specific projects on the basis of other contracts or extensions of existing ones, and therefore would possibly be available for use by third parties.[4]

In addition, in the case of existing LNG tankers, the charter fee is influenced by the vessel age and contract term (short, medium, or long). Ordinarily, the level of charterage fee is a confidential matter known only to the contracting parties, and is not made public. Investigation of fee levels therefore would have to depend on market information not in the public domain (see Table 4-3).

Table 4-2 Large (or medium-scale) LNG tankers whose charterage contracts expire by 2010

Year	2003	2004	2005	2006	2007	2008	2009	2010
Ships	Galea	Excalibur	Dewa Maru	Tenaga Lima	Edouard LD	Larbi B M'Hidi	Arctic Sun	Ekaputra
	Golar Freeze	Gimi	Echigo Maru	Tenaga Satu	Galeomma	N.W.Sanderling	Dwiputra	
	Hilli	Tenaga Dua	Kotowaka Maru		Golar Spirit	N.W.Sandpiper	Polar Eagle	
	Mostefa B Boula	Lakshmi	Tenaga Tiga		Hoegh Gandria	W.W.Seaeagle		
	Tenaga Empat		Wakaba Maru		Mourad Didouch	N.W.Shearwater		
						N.W.Snipe		
						N.W.Stormpetrel		
						N.W.Swallow		
						N.W.Swift		
Total	5	4	5	2	5	9	3	1
Cumulative	5	9	14	16	21	30	33	34

Source: Poten&Partners

[4] Availability is termed a possibility here because, in some cases, the chartering party is given a priority right to use after the expiration of the contract.

Table 4-3 Sample charterage fees for older LNG tankers

Name	Year of building	Capacity	Charterage fee	Additional information
Khannur	1977	125,000 m^3	70,000 $/day	Transport to Gas Natural (Spain)
Golar Freeze	1977	125,000 m^3	110,000 $/day	Operation between Algeria and Lake Charles (United States)
			150,000 $/day	Rechartered for one voyage between Nigeria and Lake Charles (United States) when the Henry Hub price jumped in January 2001
			140,000 $/day	Operation between Qatar and Korea
Gimi	1976	125,000 m^3	73,000 $/day	Transport to BP (for 15 months)
Tenaga Satu	1981	130,000 m^3	41,000 $/day	Transport to Gas de France (three years + one year option)
Hoegh Galleon	1974	87,600 m^3	30,000 $/day	Equivalent to $43,000/day in the case of a tanker with a capacity of 125,000 m^3
Havfru	1973	29,388 m^3	24,000 $/day	Equivalent to $100,000/day in the case of a tanker with a capacity of 125,000 m^3

Note: Charterage fees vary with the time of year.

Source: Prepared by the Institute of Energy Economics, Japan based on data from various sources.

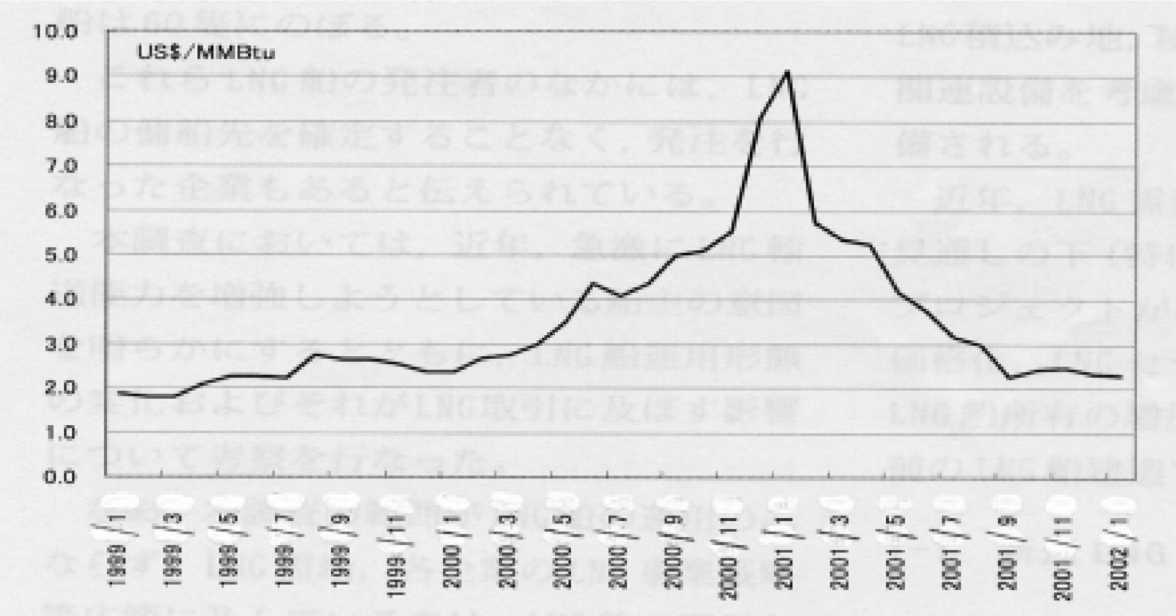
To a large extent, charterage fees are shaped by the prevailing tanker supply-demand situation and the cost at the time of construction. When the supply is short, even older LNG tankers that have been in operation for 20 years may command a premium and fetch higher fees in charterage contracts. They could also be chartered for fees that do not differ greatly from those for newly built LNG tankers. Overall, charterage fees could very well rise to the level of 150,000 dollars per day during demand upswings.

For example, the outbreak of the energy crisis in California caused Henry Hub prices to soar from the end of 2000 to January 2001 (see Figure 4-3), and charterage fees jumped in response. The fees for the Golar Freeze, which was sub-chartered for a single voyage between Nigeria and the United States in January 2001, were reportedly on the order of 150,000 dollars per day. Similarly, in the winter of 2002, Qatar chartered a tanker to accommodate desires for spot purchase by Korea Gas Corporation (KOGAS) at a fee on the level of 140,000 dollars per day.

The Tenaga Satu was in service for the Satu project in Malaysia until the end of 2002, but was subsequently chartered to Gas de France (GdF) for a period of three years beginning in January 2003, at a fee said to be in the area of 41,000 dollars per day. Its first commission after chartering by GdF was for trade from Algeria to Korea (triple cargo). Seeing that the basic tone of the LNG tanker market is one of demand surplus due to the sharp increase in demand for LNG in this winter, it is highly likely that the tanker is being sub-chartered for GdF trade over this route at a fee of 100,000 dollars per day (or more).

More effective use of older LNG tankers is going to come to the fore as LNG transactions quicken over the coming years.

Figure 4-3 Trend of Henry Hub prices



Source: Natural Gas Week

Contact: ieej-info@tky.ieej.or.jp