LNG Market and Price Formation in East Asia

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1. Introduction

As far as referred to in this paper, "East Asia" specifically means Japan, South Korea and Taiwan. Of the world's LNG trade of 137 billion cubic meters in 2000, East Asia's imports accounted for 75%. By destination, Japan is responsible for 74% of the East Asian LNG imports, South Korea 20%, and Taiwan 6%. By source, Indonesia is responsible for 38%, Malaysia 22%, Qatar 13%, Australia and the United Arab Emirates 7% each, and Oman and the U.S. 2% each. Japan is dominant among importers, while Indonesia and Malaysia claim massive shares among exporters.

Thus, in East Asia, LNG import prices have been formed in reference to Japan's trading prices, particularly those with Indonesia and Malaysia. Focusing on changing price formations for Japan's imported LNG and likely trends ahead, this paper discusses the mechanism of LNG price formation in East Asia, as well as a preferable way of rational price formation from importers' perspectives.

Given that from 75% (FY1990) to 70% (FY2000) of Japan's LNG imports is used in power generation, saying that the Japanese electric utilities have a crucial influence on buyers' price formation won't be an exaggeration.

2. Dearer LNG import prices for Japan

In 1988-2000, LNG import prices averaged $3.58/MMBTU in Japan, compared with $2.56 in the EU and $2.52 in the U.S. It means the Japanese importers paid roughly $1/MMBTU more than their Western counterparts. Moreover, in oil equivalent terms, an average price offered to Japan is as much as $6/bbl dearer. The differentials are due to what it is linked to: the LNG import price, popularly linked to the pre-burner price of alternative fuels (heating oil, heavy fuel oil, coal, etc.) in the U.S./Europe, is linked to the crude oil import price in Japan. As well known, taking Middle Eastern crudes as an example, those shipped to Japan are higher-priced than those bound for the U.S./Europe by the same margin as Asia Premium, or $1-3/bbl. Asia Premium is attributable to that Japan's crude oil import contracts, largely long-term, often have the contract price linked to an average of Dubai and Oman prices. Partly because few alternatives to Middle Eastern crudes are available on the East Asian market, unlike the Western markets, Japan is heavily dependent on long-term contracts and strongly more security-conscious than caring prices, which is often cited as the primary cause of Asia Premium.

However, even after the crudes-linked extra portion is subtracted, differentials remain as much as $3-5/bbl in oil equivalent terms. The remaining gap can be explained by that Japan's LNG

import contracts, mostly long-term, are linked to, not a pre-burner competitive price, but an average CIF price for Japan's crude oil imports. How come linked to, not competitive prices, but the average crude oil import CIF price favorable to suppliers?

3. Changes in Japan's LNG import price formation

Japan's LNG imports started in 1969 first from Alaska. At that time, with the price fixed, LNG import CIF prices have stayed at $0.53/MMBTU in four years over 1969-1972, which consequently proved higher than the-then crude oil prices. Later, during the days from 1973 hit by the first oil shock to 1984 when the converging second oil shock sent crude oil prices down, LNG has been priced cheaper than crude oil. But, since 1985 to date, LNG has consistently been priced dearer. It is largely due to a LNG pricing formula. Whenever a new project starts up, its initial days are dearer-price-prone to recover fixed costs. When they were put on stream, a Malaysian project (1982), an Australian project (1989), a Qatar project (1996), and an Omani project (2000) all showed such a tendency.

In addition, Indonesian LNG projects, which form the mainstream of LNG supplies to East Asia, are characterized by dearer prices despite their long history. The primary reason is that the indicator to which Indonesian LNG prices are linked was changed in the mid-1980s from Japan's average CIF price for crude oil imports to Indonesia's FOB price for crude oil exports. Moreover, the LNG price is linked to a FOB price in not preceding but corresponding quarters, which means an upward crude oil price precipitates a dearer price. Since the mid-1980s when the crude oil price collapsed, the crude oil price has stayed long at a rising phase. Given a quality premium for low-sulfur Indonesian crudes and the higher freight cost involved in LNG than crude oil, linking to Indonesia's crude oil FOB price means that Japan's LNG import CIF price naturally results in dearer than an average CIF price for crude oil imports.

4. LNG pricing formula

Different LNG trading contracts employ different price formulas, which are rarely disclosed. Therefore, there is no choice but to surmise. Basically it is linked to an average crude oil import CIF price. And yet, to the author's certain knowledge, demarcated by a certain price level, the formula reportedly results in a cheaper LNG price than crude oil when the crude oil price is high, and a dearer price when the crude oil price is low. These can be put to the following formula.

$$Y = a + bX$$

Here, Y is a LNG price and X is a crude oil price, both in equivalent heat quantity terms. "a" is given in order to prevent the LNG price from falling below a certain level, so that huge capital costs can surely be recovered by taking project investors' risk avoidance into consideration. "b" is a coefficient dependent on the crude oil price and smaller than 1. It provides a mechanism to

prevent the LNG price from rising 100% in reflection to its link to the crude oil price, when skyrocketing, for consumers' interests. Then, which of suppliers' or consumers' interests are taken into consideration stronger depends on where a cross point (P) of Y=X and Y=a+bX is located. Also, as already explained, the magnitudes of "a" and "b" are correlated to suppliers' and consumers' interests.

During the 1970s, when the crude oil price set upward, an underlying trend was to put "b" near 1, and "a" liable to slide. During the 1980s, when the crude oil price set downward, the underlining trend reportedly changed, with "a" raised and "b" lowered. From the 1990s through 2001, except around 1998 when the crude oil price plummeted, crude oil has been priced rather high. So, in order to take advantage of rising pressures of the high price, an underlying trend was to raise "b" and lower "a," which reportedly worked favorably for suppliers. In addition, the cross point (P) of X=Y and Y=a+bX is estimated at around $25/bbl, thus showing LNG prices tended to remain high despite a rather oversupply.

5. Toward a new LNG pricing formula

LNG price formulas employed so far have been advantageous for suppliers or gas-producing countries. Including Japan, typical consumers in East Asia have been forced to buy dearer LNG by $1/MMBTU ($6/bbl in oil equivalent terms) than Western consumers. Thus, Asia Premium on LNG produces even larger differentials than Asia Premium on crude oil.

Hence, a pricing formula capable of reflecting a true competitive market is crucially in need of. It is essential to establish a rational formula designed to calculate a pre-burner or a fuel-inlet price, in which gaps in capital cost burdens as well as quality differences (environmental premium, etc.) are properly taken into account. At this point, to be highlighted is competitive relation between LNG and steaming coal on the fossil-fired power generation market. According to calculations made by using Competitive Power Production Model developed by IEEJ, at present (2000) the CIF price for imported LNG is found dearer than that for imported steaming coal by an estimated $25/ton steaming coal equivalent. Also, assuming that steaming coal exporters, typically Australia, would export a set of coals and CO_2 emissions credits in the future, calculations were made to learn at what price for emissions credits LNG-fired power could be competitive with coal-fired power. Calculation results confirmed that, if priced below $80/t-C, steaming coal could rival LNG even under CO_2 emissions control on the premise that present differentials between LNG and steaming coal would continue. This means the LNG price should be lowered if CO_2 emissions credits are priced below $80/t-C and, if so, there are extremely huge potentials for a LNG price cut. On these accounts, the author propose to lower dearer LNG import prices for East Asian consumers, including Japan, and seek a more rational LNG price formation, which can help expand the natural gas market further.

Table.1 Trends of LNG Imports by Source in East Asia(Japan,Korea and Taiwan)

Billion cubic meters

	Indonesia	Malaysia	Brunei	USA	Australia	UAE	Qatar	Oman	Algeria	Total
1989	24.9	8.7	7.1	1.3	0.9	3.1			0.3	46.3
1990	27.6	8.6	7.2	1.4	3.9	3.2				51.9
1991	30	9.5	7	1.3	5.2	3.5				56.5
1992	31.6	9.8	7.1	1.4	6.2	3.4				59.5
1993	31.9	10.5	7.6	1.4	6.7	3.4				61.5
1994	35.1	11	7.8	1.6	8.1	4.3				67.9
1995	33.2	12.9	8.5	1.6	10.1	5.4				71.7
1996	36	17.7	8.7	1.8	9.5	6				79.7
1997	35.7	20.1	8.2	1.7	9.7	6.2	2.7			84.3
1998	36.1	19.4	8.1	1.8	9.76	6.3	3.7			85.16
1999	38.81	20.47	8.41	1.65	9.88	6.48	6.57			92.27
2000	35.7	20.88	8.79	1.65	6.93	6.93	12.28	2.23		95.39

Source:Cedigaz

Fig.1 Trends of LNG Imports by Source in East Asia (Japan, Korea and Taiwan)

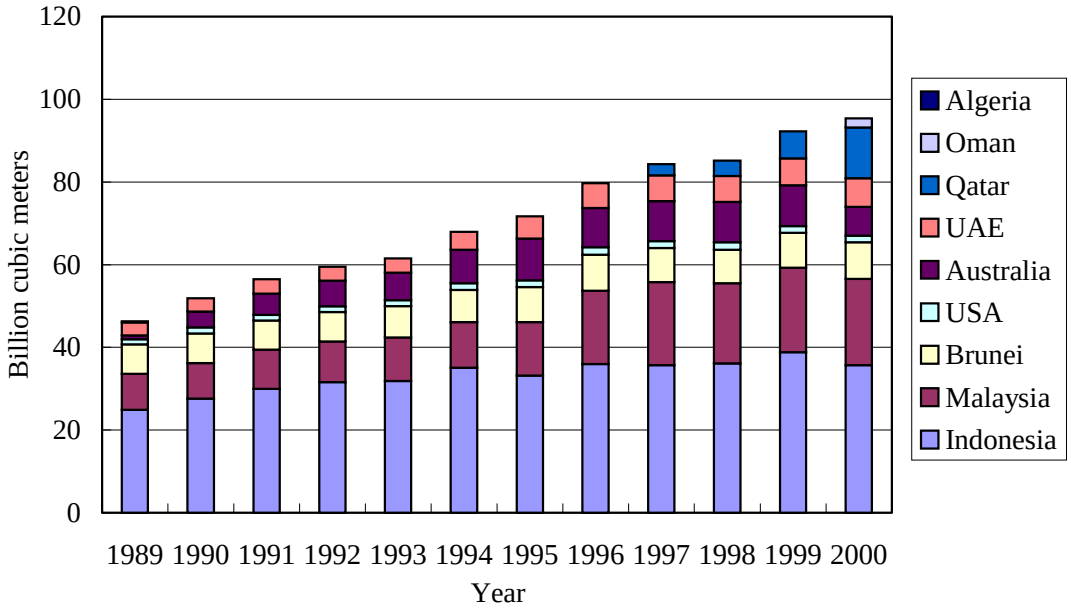

Fig.2 Trends of % by Source Country for LNG Imports in East Asia

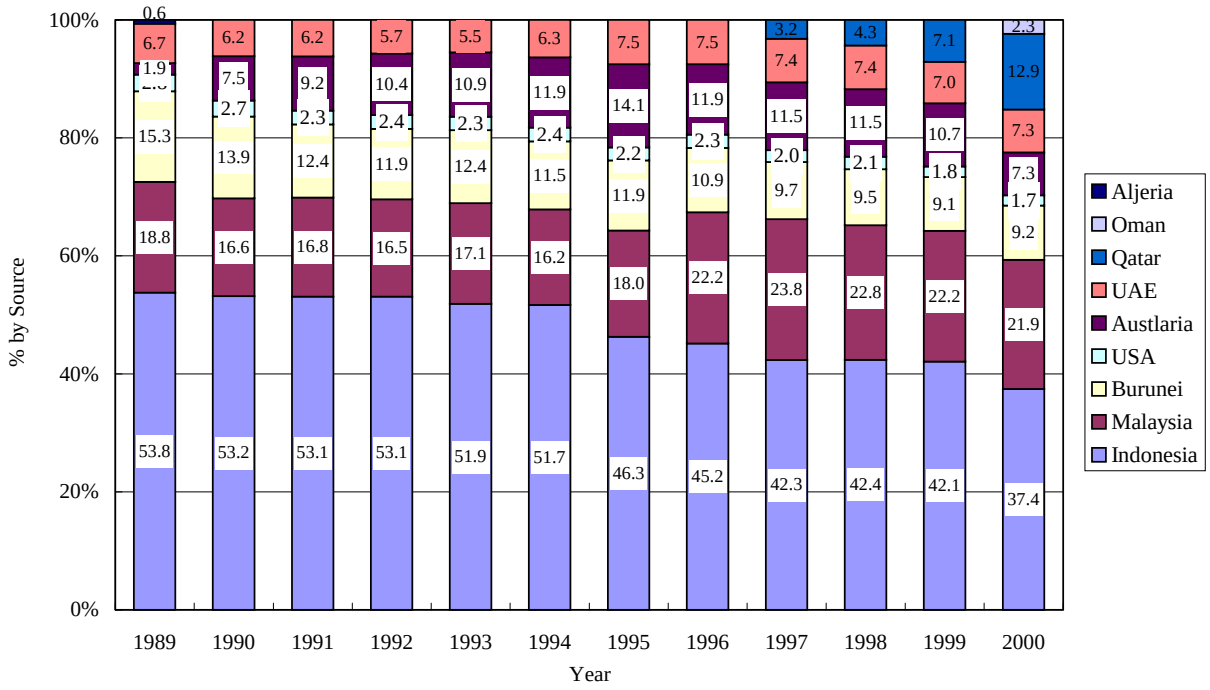

Table2	Trends of LNG Lmport Prices in Japan,USA and EU(1988-2000)					
			$／MMBTU			
	Japan	EU	USA			
1988	3.12	2.15	2.66			
1989	3.27	2.21	2.18			
1990	3.64	2.77	2.42			
1991	4.02	3.13	2.31			
1992	3.65	2.71	2.66			
1993	3.56	2.55	2.15			
1994	3.21	2.4	2.23			
1995	3.48	2.35	2.25			
1996	3.67	2.64	2.74			
1997	3.91	2.84	2.67			
1998	3.08	2.4	2.67			
1999	3.18	2	2.47			
2000	4.73	3.1	3.39			
Source:IEA						

Fig.3 Trends of LNG Import Prices in Japan ,USA and EU

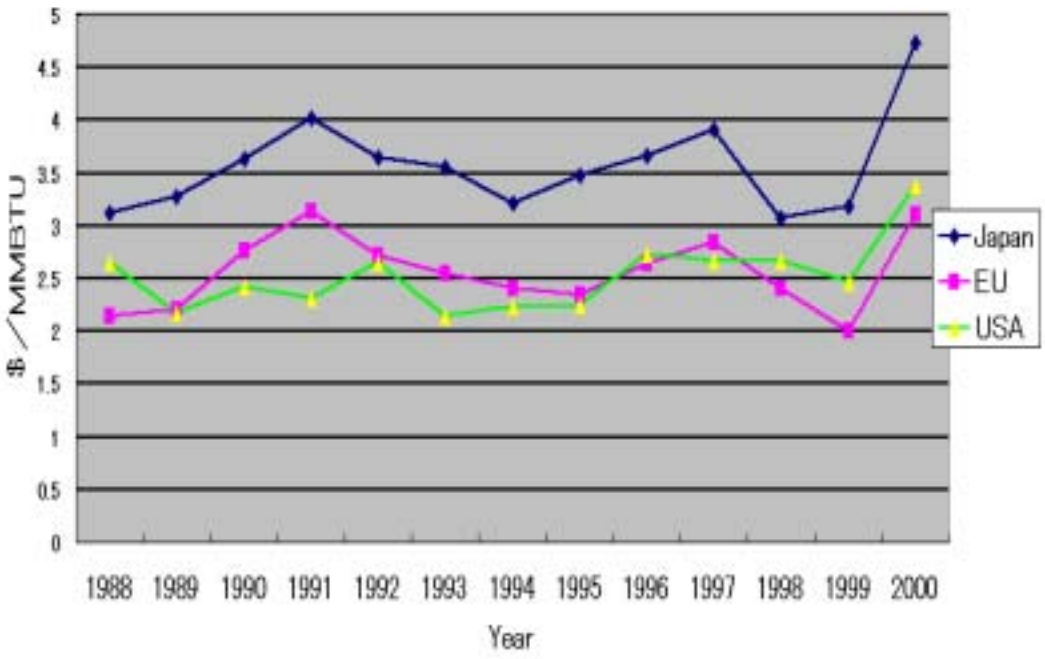

Table3 Trends of Energy Import Prices in Japan				
$／MMBTU				
	LNG	Crude Oil	Steam Coal	
1965		0.34	1.62	
1966		0.32	1.68	
1967		0.33		
1968		0.32		
1969	0.53	0.31	0.57	
1970	0.53	0.31	1.08	
1971	0.53	0.39		
1972	0.56	0.44		
1973	0.72	0.83		
1974	1.50	1.98	1.39	
1975	1.73	2.07	1.46	
1976	1.89	2.17	1.37	
1977	2.13	2.34	1.42	
1978	2.41	2.38	1.53	
1979	3.34	4.01	1.73	
1980	5.56	5.93	2.25	
1981	5.89	6.32	2.73	
1982	5.74	5.95	2.61	
1983	4.95	5.08	2.15	
1984	4.96	5.00	1.97	
1985	5.03	4.66	1.82	
1986	3.42	2.37	1.77	
1987	3.45	3.10	1.65	
1988	3.12	2.53	1.80	
1989	3.36	3.07	2.04	
1990	3.92	3.90	2.06	
1991	3.72	3.23	2.02	
1992	3.24	3.30	1.94	
1993	3.38	2.87	1.83	
1994	3.25	2.96	1.77	
1995	3.47	3.13	2.02	
1996	3.87	3.72	1.98	
1997	3.73	3.22	1.80	
1998	2.86	2.19	1.59	
1999	3.52	3.54	1.42	
2000	4.88	4.86	1.41	
Source:Ministry of FINANCE(Monthly Statistics of Trade)				

Fig 4.Trends of Energy Import Prices in Japan

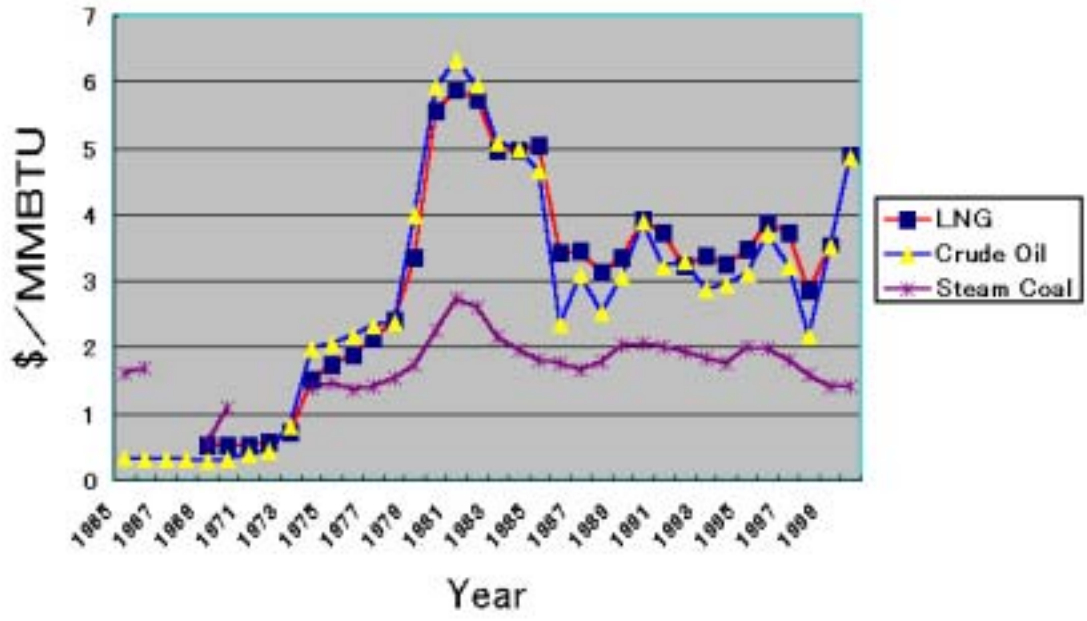

	Fig. 5 Trends of LNG Imports by Source Country in Japan								
	1000 tons (%)								
	USA	Brunei	UAE	Indonesia	Malaysia	Australia	Qatar	Oman	Total
1970	977								977
	100								100
1975	1017	3988							5005
	20.3	79.7							100.0
1980	872	5418	2001	8674					16965
	5.1	31.9	11.8	51.1					100.0
1985	990	5188	2257	14826	4572				27831
	3.6	18.6	8.1	53.3	16.4				100.0
1990	982	5254	2272	17609	6775	3185			36077
	2.7	14.6	6.3	48.8	18.8	8.8			100.0
1995	1221	5507	4096	17476	8559	6827			43689
	2.8	12.6	9.4	40.0	19.6	15.6			100.0
2000	1260	5715	4802	18123	10923	7154	6000	123	54100
	2.3	10.6	8.9	33.5	20.2	13.2	11.1	0.2	100.0
	Source:Ministry of Finance(Monthly Statstics of Trade)								

Fig5 Trends of LNG Imports by Source Contry in Japan

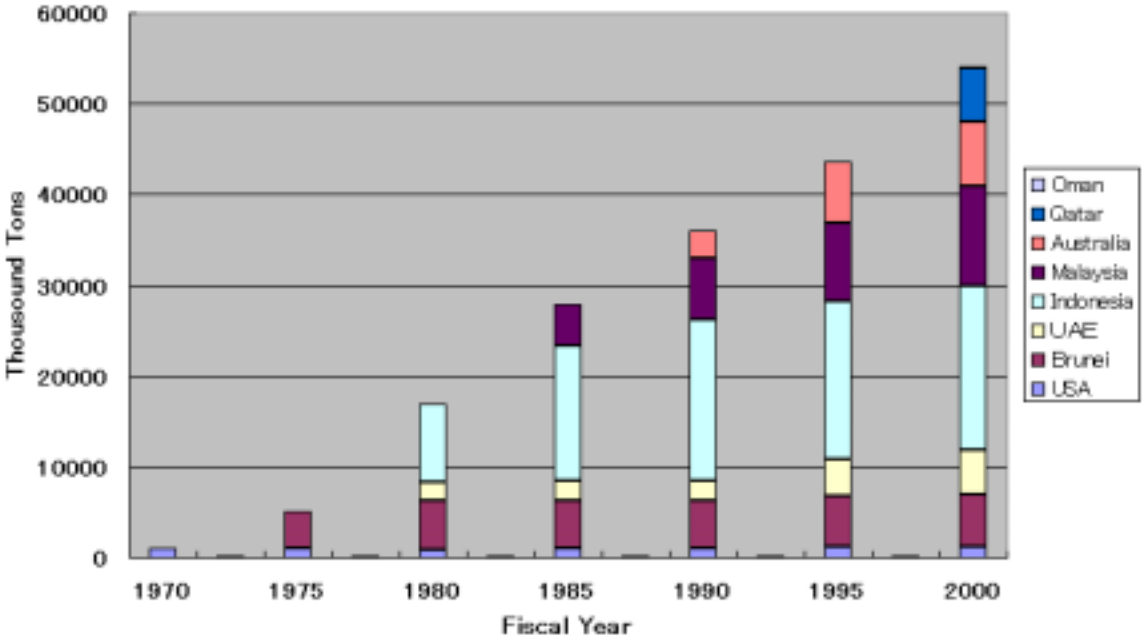

Fig6 Trends of LNG Imports by Source Country in Korea

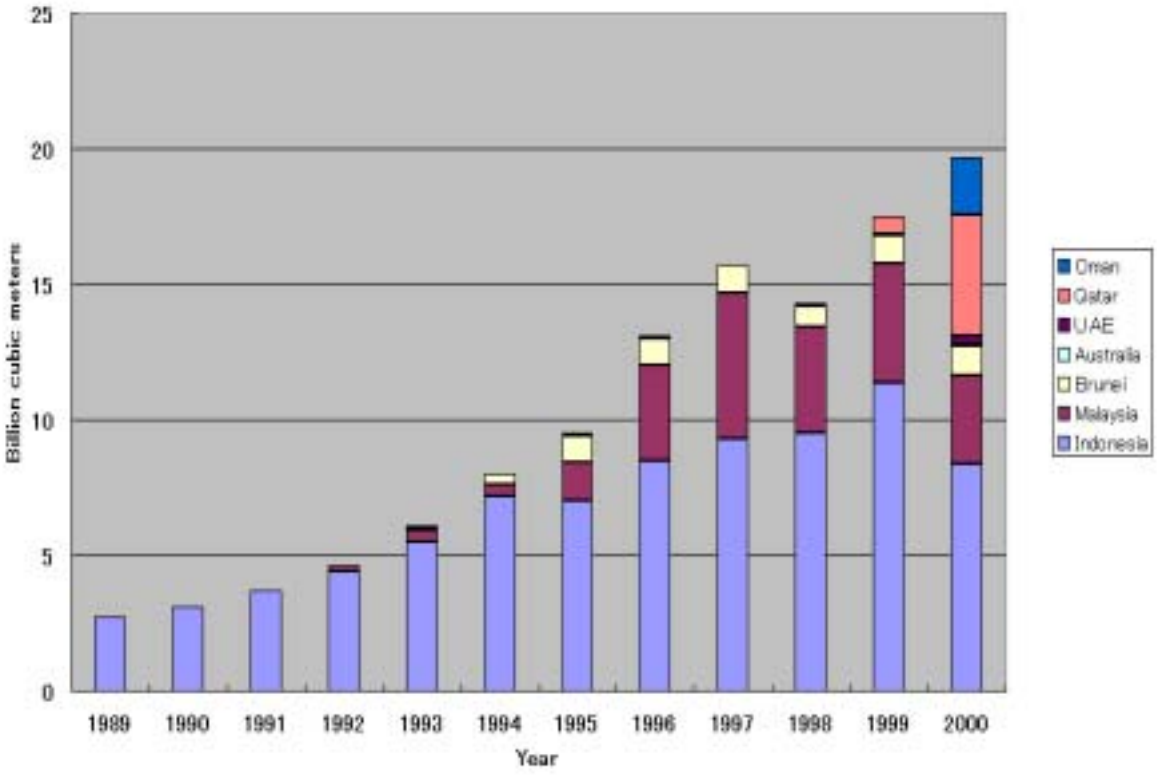

Fig.7 Trends of LNG Imports by Source Country in Taiwan

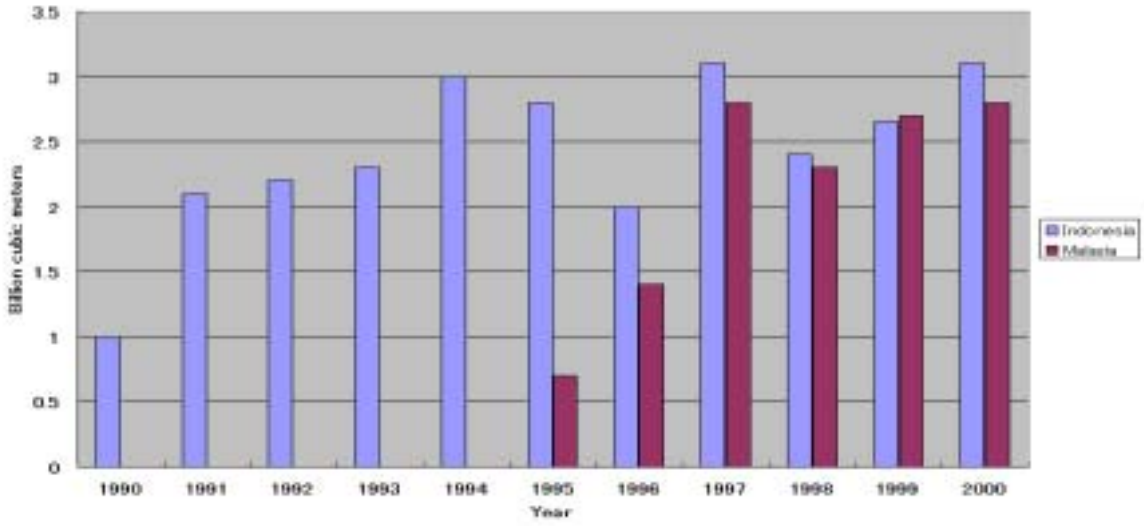

	Table6Trends of LNG Imports by Country in East Asia(Japan, Korea and Taiwann) 1989-2000										
	Billion cubic meters										
		Indonesia	Malaysia	Brunei	USA	Australia	UAE	Qatar	Oman	Algeria	Total Impo
1989	Japan	22.2	8.7	7.1	1.3	0.9	3.1			0.3	43.6
	Korea	2.7									2.7
	Taiwan										
		24.9	8.7	7.1	1.3	0.9	3.1			0.3	46.3
1990	Japan	23.5	8.6	7.2	1.4	3.9	3.2			0.1	47.9
	Korea	3.1									3.1
	Taiwan	1									1
		27.6	8.6	7.2	1.4	3.9	3.2			0.1	52
1991	Japan	24.2	9.5	7	1.3	5.2	3.5				50.7
	Korea	3.7									3.7
	Taiwan	2.1									2.1
		30	9.5	7	1.3	5.2	3.5				56.5
1992	Japan	25	9.6	7.1	1.4	6.2	3.4				52.7
	Korea	4.4	0.2								4.6
	Taiwan	2.2									2.2
		31.6	9.8	7.1	1.4	6.2	3.4				59.5
1993	Japan	24.1	10.1	7.5	1.4	6.6	3.4				53.1
	Korea	5.5	0.4	0.1		0.1					6.1
	Taiwan	2.3									2.3
		31.9	10.5	7.6	1.4	6.7	3.4				61.5
1994	Japan	24.9	10.6	7.4	1.6	8.1	4.3				56.9
	Korea	7.2	0.4	0.4							8
	Taiwan	3									3
		35.1	11	7.8	1.6	8.1	4.3				67.9
1995	Japan	23.4	10.8	7.5	1.6	9.2	5.4				57.9
	Korea	7	1.4	1		0.1					9.5
	Taiwan	2.8	0.7								3.5
		33.2	12.9	8.5	1.6	9.3	5.4				70.9
1996	Japan	25.5	12.8	7.7	1.8	10	6				63.8
	Korea	8.5	3.5	1		0.1					13.1
	Taiwan	2	1.4								3.4
		36	17.7	8.7	1.8	10.1	6				80.3
1997	Japan	24.2	12.8	7.2	1.7	9.5	6.2	2.7			64.3
	Korea	9.3	5.4	1							15.7
	Taiwan	2.2	1.9								4.1
		35.7	20.1	8.2	1.7	9.5	6.2	2.7			84.1
1998	Japan	24.2	13.2	7.3	1.8	9.7	6.2	3.7			66.1
	Korea	9.5	3.9	0.8			0.1				14.3
	Taiwan	2.4	2.3								4.7
		36.1	19.4	8.1	1.8	9.7	6.3	3.7			85.1
1999	Japan	24.8	13.37	7.4	1.65	9.76	6.4	5.9			69.28
	Korea	11.36	4.4	1.01			0.08	0.67			17.52
	Taiwan	2.65	2.7								5.35
		38.81	20.47	8.41	1.65	9.76	6.48	6.57			92.15
2000	Japan	24.25	14.79	7.71	1.65	9.81	6.3	7.87	0.08		72.46
	Korea	8.35	3.29	1.08		0.07	0.33	4.41	2.15		19.68
	Taiwan	3.1	2.8								5.9
		35.7	20.88	8.79	1.65	9.88	6.93	12.28	2.23		98.04
	Source:Cedigaz										