

ANALYSIS ON NATURAL GAS RESOURCE, MARKET, AND PIPELINE IN NORTHEAST ASIA (STRATEGY OF NATURAL GAS TRUNKLINE DEVELOPMENT)

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1. INTRODUCTION

In Northeast Asia, there is a high possibility to establish a mutual dependence relation (in other words, the Energy Alliance) for natural gas energy, considering the population, the distribution of resources, the situation of economic development, the energy demand prospects and so on. An international natural gas pipeline will become a strong driving force for realizing the Energy Alliance.

Under the backgrounds as stated above, the Northeast Asian Gas & Pipeline Forum (NAGPF) was established by NPOs of Russia, China, South Korea, Mongolia and Japan, and has been carrying on related research projects.

As the 1st research, we summarized a great deal of related knowledge and information of the NAGPF and put it them together in to "A Long-term Vision of Natural Gas Trunkline in Northeast Asia".

The NAGPF organized seven times "International Conference on Northeast Asian Natural Gas Pipeline". These conferences provided great opportunities to present papers on related themes, such as pipeline plans, technology and economy, and exchange information for the purpose of promoting the construction of international pipelines in Northeast Asia. Consequently, the NAGPF has been able to store great knowledge of natural gas policies, present situation and trend of natural gas infrastructures and pre-feasibility study of international pipeline projects in Northeast Asia. Figure 1 shows an international pipeline network of Northeast Asia in the year 2020 which was proposed in the 1st research. This 1st research is reputable among persons concerned with the world energy.

In the process of conducting the 1st research, it was pointed out that analysis on natural gas market is one of the most important key factors toward the realization of natural gas trunkline in Northeast Asia. Therefore, we focus on natural gas market and related resource and pipeline as the 2nd research and are carrying on this research on issues related to "Analysis on Natural Gas Market, Resource, and Pipeline in Northeast Asia".

This research will be finished by November 2003 when the 8th International Conference on Northeast Asian Natural Gas Pipeline will be held in Shanghai, China. In this paper, we show an interim report of case study on market in Japan and South Korea.

As international pipeline construction projects will start in Northeast Asia in the near future, this

research will be expected to work as a reference guideline that can be used for planning and undertaking the projects.

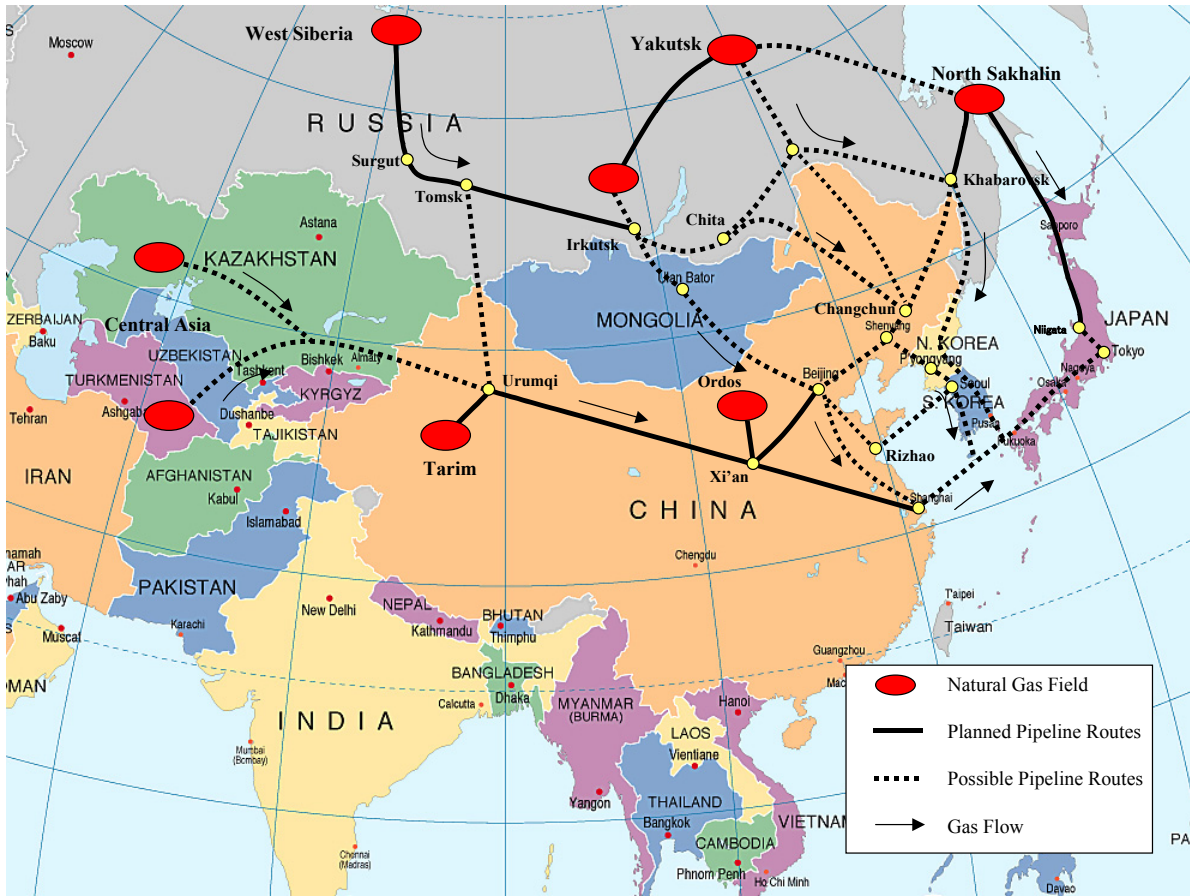


Figure 1 International Pipeline Network of Northeast Asia

Source: Northeast Asian Gas & Pipeline Forum, "A Long-term Vision of Natural Gas Trunkline in Northeast Asia"

2. Contents of the Research

A flow chart of the 2nd International Joint Research “Analysis on Natural Gas Resource, Market, and Pipeline in Northeast Asia ” is shown below.

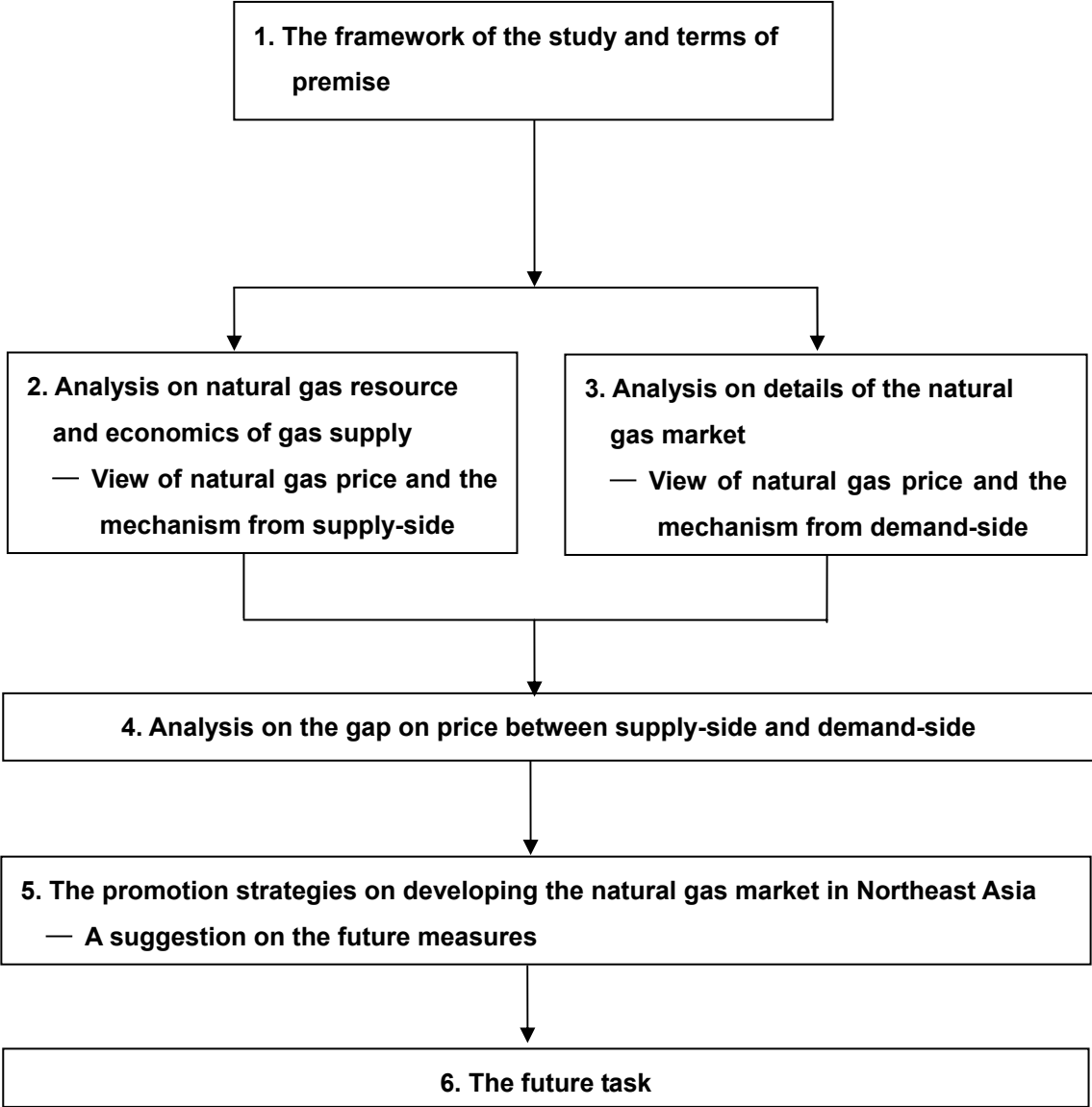


Figure 2 Flowchart of the Research

2.1. The framework of the study and terms of premise

In Russia, East Siberia and the Russian Far East, which are geographically close to the areas that demand natural gas in Northeast Asia, are the main targets.

- West Siberia
- East Siberia (Krasnoyarsk and Irkutsk)
- Far East (Sakha Republic and Sakhalin)

In fact, Beijing, where natural gas consumption has increased fivefold from 1997 to 2002, is the most advanced city in terms of natural gas introduction. In preparation for the Olympics in 2008, Beijing will introduce much more natural gas. In addition, the 10th Five-year Plan covers construction of CCGT (Combined Cycle Gas Turbine) power plant as well as natural gas development project of "West Gas to East".

Japan and South Korea import liquefied natural gas (LNG), which accounts for almost 100% of their total imported natural gas. Therefore, we focus on LNG market as a competitive fuel of PNG. For LNG, costs for liquefaction, / shipment and terminal / storage / regasification have to be considered, in addition to the same costs for gas field development and production for PNG. These costs are evaluated based on the data from similar projects.

2.3. Analysis on details of the natural gas market

— View of natural gas price and the mechanism from demand-side

Obviously, it is expected that there is a gap between the price in terms of supply-side and that of demand-side. Therefore, it is necessary to compare both of them and calculate the gap. In case here is a gap between price of supply-side and demand side, the price adjustment mechanism is required.

Based on the above analysis, we will suggest the measures for creation of favorable natural gas market in Northeast Asia by discussing natural gas pipeline, mechanism of price adjustment, deregulation, taxation, and so on.

3. ANALYSIS OF NATURAL GAS PRICE MECHANISM — CASE STUDY ON JAPAN AND SOUTH KOREA —

The Intermediate Workshop of the 2nd International Joint Research was held in Irkutsk in November 2002, in which each member organization made a presentation of an each natural gas market.

In this section, we show an interim report of case study on Japan and South Korea including an ongoing research based on some assumptions. A final report will be presented at the 8th International Conference in Shanghai.

Firstly, we show the mechanism of LNG price which is a mainstream of natural gas trade in Japan and South Korea for the present. Secondary, on the assumptions regarding wellhead price and pipeline route, we estimate PNG prices in the future. Thirdly, we make a pre-feasibility study of PNG in Japan and South Korea.

3.1. LNG Market in Japan and South Korea

3.1.1. LNG prices: Oil price linkage

At present, Japan and South Korea import natural gas by LNG. In the Far East LNG market, buyers can expect favorable circumstances due to more competition among LNG sellers, reduction of LNG ships construction costs and stagnant natural gas demand. In order for PNG sellers in Northeast Asia to succeed in Japan and South Korea markets, it is essential to have price competitiveness against LNG.

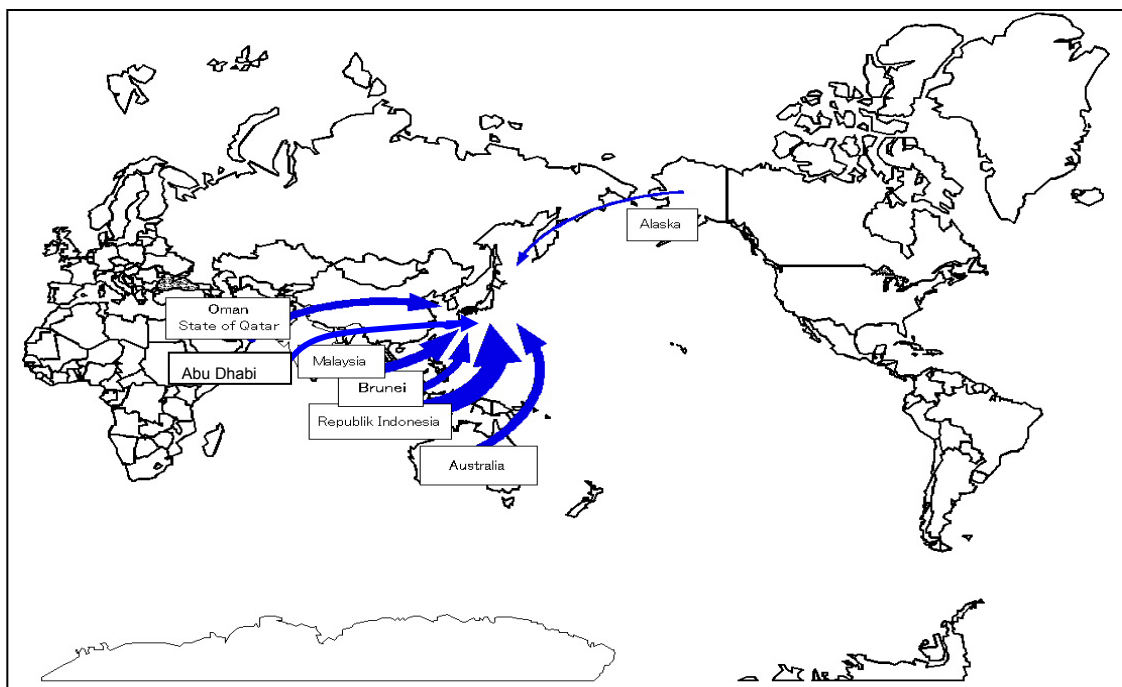


Figure 3. LNG supply to Japan and South Korea

Existing projects

- (A) LNG prices of existing projects to Japan and South Korea are linked with JCC (Japan Crude Cocktail, Crude oil CIF prices to Japan) and Indonesian REP (Realised Export Prices). LNG chains are composed of exploration, liquefaction, transportation and receiving facilities, however, these costs do not have direct relations with actual LNG prices.
- (B) LNG projects to the Far East markets started with Alaska LNG to Tokyo Electric and Tokyo Gas (1969) and later came Brunei, Abu Dhabi and Indonesia. Right now 8 countries sell LNG to the Far East markets. In early years, LNG prices were fixed, which let us believe that prices those days were based on actual costs, at least partly. But since the first oil shock, LNG sellers have preferred prices to be linked with skyrocketing oil prices, which resulted in LNG price independence of actual costs. Because LNG was originally introduced as an alternative energy source to oil, buyers also found no objection against oil linkage and ever after we have seen oil linked LNG prices.
- (C) As long as price comparability between oil and LNG and among different LNG projects was kept, people believed that buyers did good jobs. It is certain that buyers were interested in upstream costs but that was a secondary issue.
- (D) South Korea has followed Japanese LNG formula, as when they entered LNG business where Japan had been already dominant in the Far East LNG market and established pricing methodology. Since then South Korea has not produced any new LNG pricing formula other than JCC/REP linkage.

Recent trends

Recently, we have seen that buyers directly participated in upstream investments and tried to reduce LNG prices, however, as long as prices were concerned we have not seen any new methods. Due to market liberalization of electricity and gas, it is expected to see more short-term contracts and spot contracts. But the fact still remains that the Far East buyers' concern is focused on CIF prices at their own terminals.

Crude oil and LNG prices

Let us see how LNG prices are linked with crude oil prices.

We have made regression analysis on JLC (Japan LNG CIF) and JCC for the period from 1997 to 2001 FY. As JCC is about 1 \$/b less than WTI, when WTI is 25\$/b, JLC is 220\$/ton and KLC (Korean LNG CIF) is 230\$/ton.

Adding regasification cost to the above will be on the same basis as PNG in price comparison for delivery prices to Japan and South Korea. Regasification cost is estimated as 20\$/ton.

These make LNG end user price at 240\$/ton in Japan and 250\$/ton in South Korea.

3.1.2. Pipeline natural gas price and LNG

For Northeast PNG to succeed in the Far East markets, it will be a good idea to produce pricing mechanism completely independent of LNG. But nonetheless this is not a final answer as it will be very possible for LNG to develop new pricing index other than JCC/REP. Northeast PNG, brand new project and possibly seeking for long term stable contracts, will find above-said short-term / spot LNG contracts as obstructive.

Having said that, it is concluded that unless Northeast PNG prices will be fully competitive enough, PNG cannot even walk to starting block as there is no reason for the Far East buyers to purchase PNG.

They have no trouble in finding new / expansion LNG projects, gas demand in Japan and South Korea is mature. With same price levels as LNG and without any incentives given, buyers will select LNG as proven technology (particularly in Japan).

3.2. PNG (Pipeline Natural Gas)

3.2.1. Assumption of PNG price

To assume the PNG price, we would like to set these pre-conditions as follows. Though there are several possible gas sources that can supply natural gas to Japan and South Korea such as East Siberia, Sakhalin, Sakha etc. We chose East Siberia as a gas source for an example case this time. However, of course other gas sources can be possible and in the future, pipeline network that will connect Northeast Asian nations will be expected.

Natural gas source

Kovikta, East Siberia

Pipeline Route (refer to the Fig.4 Possible P/L Routes)

Kovikta (a) -> Irkutsk (b) -> Chita (c) -> Harbin (d) -> Shengyang (e) -> Beijing (f) -> Tsingtao (g) -> Pusang (h) -> Fukuoka (i)

(Tsingtao -> Pusang -> Fukuoka section is off-shore line)

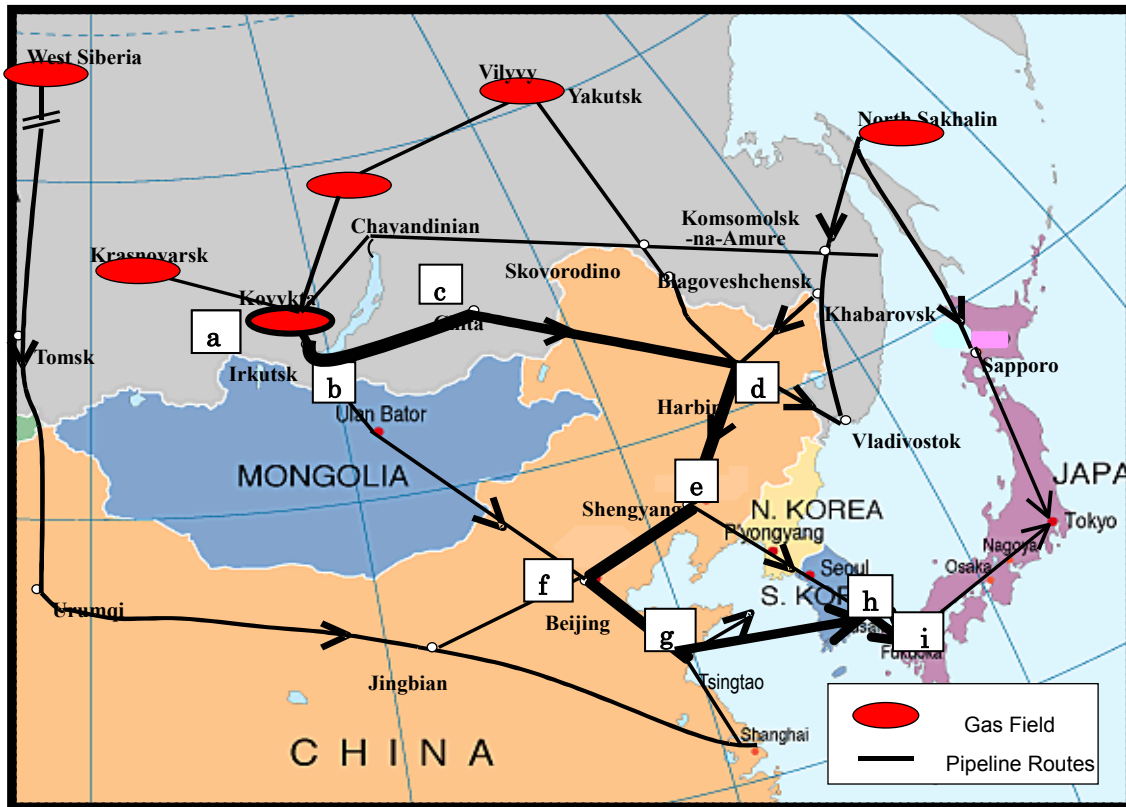


Figure 4 Possible Pipeline Routes

Gas flow rate

Proven gas reserve of Kovikta gas field is at least 1.5 TCM which is enough amounts for large scale gas production. We tentatively assumed the annual production of 30 BCM/year (15 BCM/year for China, 5 BCM/year for South Korea and 10 BCM/year for Japan). That means the flow rate of each section will be as follows:

- Kovikta (a) -> Tsingtao (g)(about 5,100km) : 30 BCM/year
- Tsingtao (g) -> Pusang (h)(about 1,000 km) : 15 BCM/year
- Pusang (h) -> Fukuoka (i)(about 200km) : 10 BCM/year

Pipeline construction cost

Normally pipeline construction cost is to be estimated after basic design that can provide site conditions, specifications and quantities of materials and work volume. So it would be better that each country will estimate the pipeline construction cost of their own portion.

3.2.2. PNG price assumption

The price of PNG is consist of wellhead price, gas storage price and pipeline transportation tariff. However, we cannot calculate pipeline transportation tariff now because pipeline construction cost is

not yet available (Investigation of pipeline construction cost can be the next task for our International Joint Research). Then, we would like to look at our target “PNG price shall be lower than LNG price” and consider the desirable pipeline tariff that can be competitive for LNG price.

Natural gas wellhead price

As the wellhead price at Kovicta gas field is not clear now, we would like to refer the paper “Comparative Efficiency of Different Technologies for Fuel and Energy Transport from Asian Regions of Russia to Northeast Asia “(Energy Systems Institute of RAS, Irkutsk@1999 The 5th International Conference on Northeast Asian Natural Gas Pipeline) to ”Natural gas price at the production site was taken equal to \$30/thousand m³ “. And this price can be converted into \$37/ton.

Natural gas storage price

We need the natural gas storage price in each country, but we cannot find out adequate cost data for it at present. So, we would like to assume it roughly as a half of LNG vaporization cost: 10 \$/ton as storage cost (assumed that half of LNG terminal cost is for vaporization and rest of it is for storage.)

Pipeline transportation tariff (target price)

As the model LNG import price: 240 \$/ton for Japan and 250 \$/ton for South Korea shown in below table (in the case that crude oil is 25 \$/b) are the target price of PNG gas.

Pipeline transportation tariff (estimated price)

On the other hand, we can assume the tariff by referring similar existing data. “PNG Price in Europe Transported from West Siberia” (the transportation length is about 4,500 km) is said to be 130 \$/ton. Then we can roughly assume those tariffs by reducing assumed wellhead price and simply calculating in proportion to each length as follows:

Kovikta (a) -> Tsingtao (g)(about 5,100km): 105 \$/ton

Tsingtao (g) -> Pusang (h)(about 1,000 km): 41 \$/ton

Pusang (h) -> Fukuoka(l) (about 200km): 8 \$/ton

Tariff of off-shore portion (Tsingtao (g) -> Pusang (h) and Pusang(h) -> Fukuoka(l) are doubled with consideration to higher construction cost of off-shore pipeline compared with on-shore pipeline.

That means the estimated price of pipeline transportation tariff to South Korea is 146 \$/ton, and 154 \$/ton to Japan. We should add the domestic pipeline transportation tariffs to them.

In South Korea, the domestic pipeline tariff : (X) may not so high because there are almost completed domestic trunk line network. So it may be easy to satisfy the target price.

On the other hand, satisfying the target may be a little difficult in Japan because there is not

domestic pipeline network yet. Japan needs to construct it at low price in order to save the domestic pipeline tariff (Y). Perhaps the area where the gas can be provided below, the target price would be limited. Though it is desirable to have over all domestic pipeline network, but we might select efficient gas consumption area and land fall point of international pipeline.

Table 1 Target Price of PNG

Crude Oil (\$/b)	WTI	20	25	30	35
	JCC	19	24	29	34
LNG(\$/t)	JLC(Japan LNG CIF)	185	220	255	290
	KLC(South Korea LNG CIF)	195	230	265	300
	Expenses	20	20	20	20
	Total Japan	205	240	275	310
	Total Korea	215	250	285	320
PNG(\$/t)	Wellhead price		37		
	Storage Plant Cost		10		
	Domestic P/L Tariff	Tokyo	Y		
		Seoul	X		
	Frontier price	Tokyo	201+Y		
		Seoul	193+X		

(unit: \$ / ton)

Supply		Demand	
Wellhead price	37	South Korea	250
International Pipeline Cost (Kovykta – Pusang)	146		
Border price to Korea	183	Japan	240
Storage	10		
Domestic pipeline tariff	X (to be investigated)		
South Korea PNG cost total	193+X		
International Pipeline cost (Pusang – Fukuoka)	8		
Border price to Japan	191		
Storage	10		
Domestic pipeline tariff	Y(to be investigated)		
Japan PNG cost	201+Y		

note:This calculation is based on some assumptions. Final output will be presented at the 8th International Conference on Northeast Asian Natural Gas Pipeline held in Shanghai in November 2003.

4. FUTURE TASK

This paper shows an interim report of case studies on Japan and South Korea. Those findings are scheduled to be presented at the 8th International Conference on Northeast Asian Natural Gas Pipeline in Shanghai, China in November 2003.

The left-behind tasks are as follows.

- To make a further analysis on supply-side in Russia
- To make a further analysis on markets in Japan and South Korea
- To add an analysis on demand-side in China.
- To make an analysis on the gap on price between supply-side and demand-side.
- To make a suggestion on the promotion strategies of development the natural gas market in Northeast Asia, based on the above data.

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APPENDIX : The Activities of the NAGPF

The NAGPF was established at the 3rd International Conference on Northeast Asian Natural Gas Pipeline, which was held in Seoul in November 1997, for the purpose of being a driving force toward the construction of the International Pipeline Network which seemed to be essential for the sustainable development in Northeast Asia as a basic infrastructure of the 21st century. The NAGPF organizes an annual international conference and leads cooperative activities with the member organizations.

As the first step of multilateral cooperation with the Northeast Asian countries and areas toward the realization of the International Pipeline, the 1st International Conference on Northeast Asian Natural Gas Pipeline was held in Tokyo in March 1995, with 60 participants from China, Japan, the Republic of Korea and Sakha Republic.

Continually, the 2nd Conference was held in Beijing in September 1996 and its participants increased to 170, (which particularly focused on the Northeast Asian Natural Gas Pipeline as a start of the Trans-Asian). At the Round Table Discussion of the 2nd conference, it is proposed and adopted to establish an organization called "Northeast Asian Gas & Pipeline Forum" which will lead joint activities with related countries and areas in order to promote mutual cooperation for the enlargement of natural gas utilization.

In the 3rd Conference held in Seoul in November 1997, the representatives of China, Japan and the Republic of Korea adopted the statutes and established a non-profitable organization, the Northeast Asian Gas and Pipeline Forum.

From that time, the NAGPF has been taking the responsibility of organizing an annual international conference and leading cooperative activities with the member organizations. The 4th Conference was held in Ulaanbaatar in August 1998, with the participants from all the Northeast Asian countries and areas. The 5th Conference held in Yakutsk in July 1999 and the 6th Conference held in Irkutsk in September 2000 provided a precious opportunity to exchange massive information between the participants due to the submission of a great number of papers.

Each member organization of Northeast Asia has already hosted the international forum, and the 8th Conference in Tokyo in December 2001 was the first forum in the second round. During the first round period, we have thoroughly discussed and seem to have sufficiently recognized the necessity of promoting natural gas utilization in Northeast Asia, as well as the need for rapid preparation of the pipeline network. The Tokyo conference was positioned as a fruitful step toward giving shape to the natural gas pipeline networks in Northeast Asia.

In November 18-20, 2003, the NAGPF will organize the 8th Conference in Shanghai, China

Currently, there are 5 ordinary members - Asia Gas & Pipeline Cooperation Research Centre of China (AGPRCC), Korea Pan-Asian Natural Gas & Pipeline Association (KPGA), Asian Pipeline Research Society of Japan (APRSJ), Asian Pipeline Research Society of the Russian Federation (ROSASIAGAS), Petroleum Authority of Mongolia (PAM) - and 2 sustaining members - AMEC Japan

and Marathon Oil Company.

Organization of the NAGPF

