

*The Northeast Asia Natural Gas Pipeline Network

A desirable way of diversifying energy sources of northeast Asia

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Since last summer, we are facing with simultaneously soaring resource prices that we have not experienced for more than a decade. Crude oil price is hovering around \$30/Bbl, spot price of coal has hit \$50/ton and iron ore term price for 2004 is increasing more than 20%. All of these may indicate that we are facing shortage of resource supply. Another concern in northeast Asia is the severe air pollution in China caused by heavy use of coal without flue gas treatment. We know that rich oil and gas resources exist in eastern Russia, and *developing supply and use of the natural gas will be the desirable measure to solve energy and environment issues facing northeast Asia*. But, the regional natural gas pipeline network is still not past the conceptual stage. Severe natural conditions in Siberia and the substantial distance between resource and market have hindered its development. To progress this dream plan toward materialization, regional cooperation led by government initiative is very important. This report tries to clarify fundamental elements we should consider in designing the regional energy cooperation.

1. China and Northeast Asia

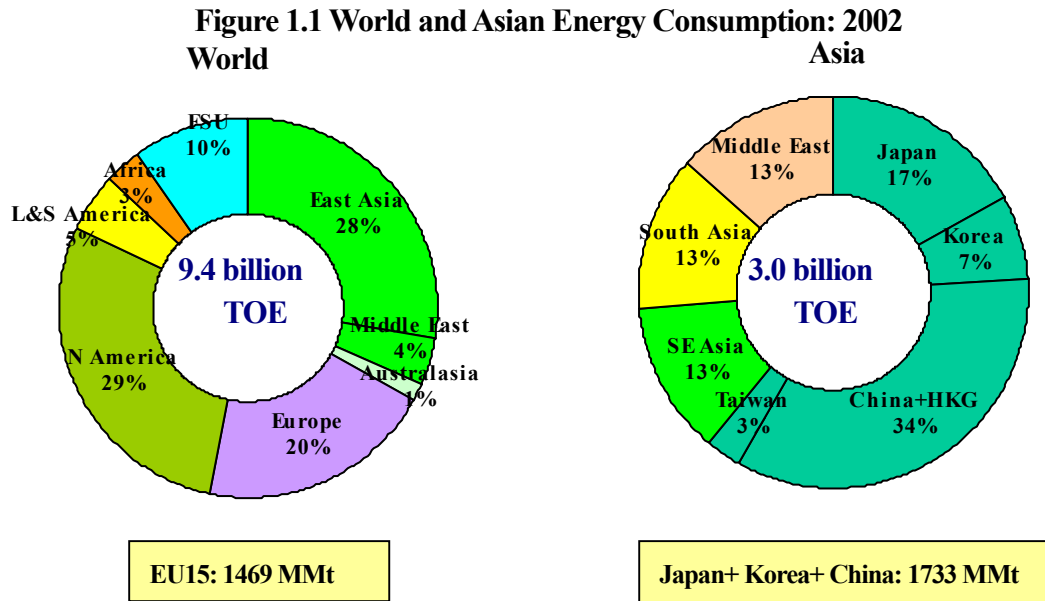
Today, the northeast Asia region is the world growth center led by vigorous development of China. China's impact on Northeast Asia, from Japanese viewpoint, may be summarized that:

- a. The 1980s was the decade of *industry enhollowment*. Many factories moved to Southeast Asia and China, but Japan was still enjoying a bubble economy.
- b. Then, the 1990s was the decade of *deflation* as a boomerang effect. Low priced products hit the Japanese economy and the industry enhollowment was further accelerated.
- c. In the 2000s, especially since last summer, we are experiencing *resource inflation*. Prices of oil, coal and iron ores are soaring rapidly and power shortage in industrial regions of China is getting worse. All these symptoms might develop into a serious ill if not properly taken care of.

On the other hand, Northeast Asian countries are getting more interdependent as seen in the facts that China is now the number one trade partner of Japan and a huge number of Japanese and Korean firms have heavily invested in China. With China's accession to WTO, region's economy and industry will be further consolidated. Therefore, China's problem is now the region's common problem to be mutually solved. Among others, *securing Energy Supply in harmony with Environment* is one of the most serious challenges in sustaining development of northeast Asia. The Figure 1.1 shows that Asia shares 30% of the world primary energy consumption, and northeast

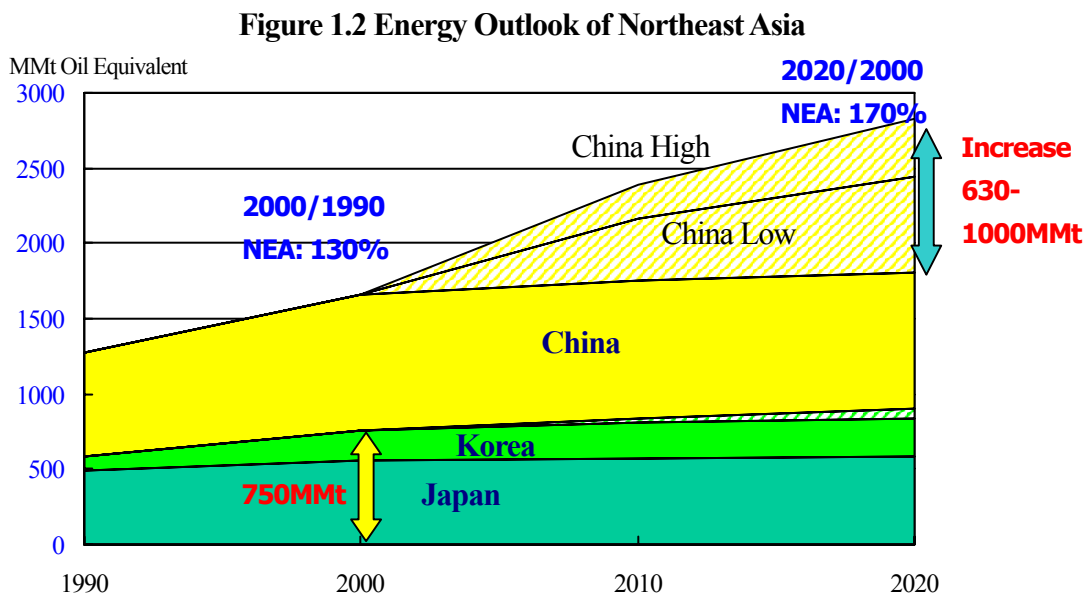
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Asia shares 60% of the Asian energy consumption. Today, our region consumes much greater quantity of energy than the EU fifteen. We are too large to fail.



Source: BP Statistical Review of World Energy June 2003

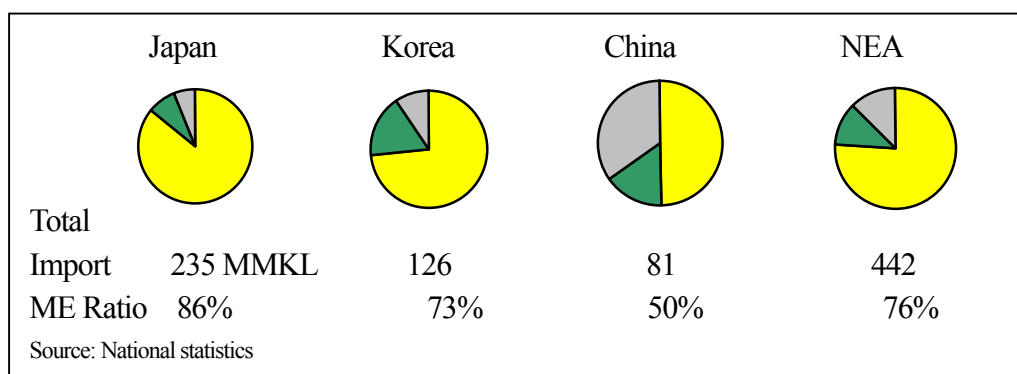
Looking at future energy demand of the region, Japan may be moderately leveling off. Korea recorded rapid increase of energy consumption in 1990s, but demand growth may become moderate in the coming decades. Anyway, the absolute increase in these two countries will be minimal. On the other hand, China is expected to continue rapid increase of energy consumption driven by high economic growth. Symptoms such as resource price hike may indicate demand explosions occurring in the market. China's energy demand would grow even faster than the high case projection shown in Figure 1.2.



It is usually observed that growth of energy consumption exceeds that of GDP during the taking-off stage of an economy. The society needs construction of fundamental platform requiring plenty supply of fundamental materials that are high energy consuming. Also, commercial energy is one of basic supplies when people modernize their life. Today, China's per capita income on average is still low compared with world standard of developed countries. It is not easy to predict how long the taking-off stage would last before the country reaches a cruising altitude. It may continue for a decade or two. Then, China's incremental demand in the coming two decades will be greater than the current energy consumption of Japan and Korea.

Regarding the energy structure, oil and gas play major role in Japan and Korea, while coal dominates in China. Out of this, our serious concern is that Northeast Asia depends upon the Middle East over 3/4 of the crude oil import. Watching the unstable situation in the Middle East, this highlights the region's great vulnerability. On top of this, we are experiencing real effects. Without other reliable supply sources in the adjacent area, northeast Asia is forced to accept unstable oil pricing based on very limited spot transactions of Dubai and Oman crude oils and unfair treatment such as Asian Premium.

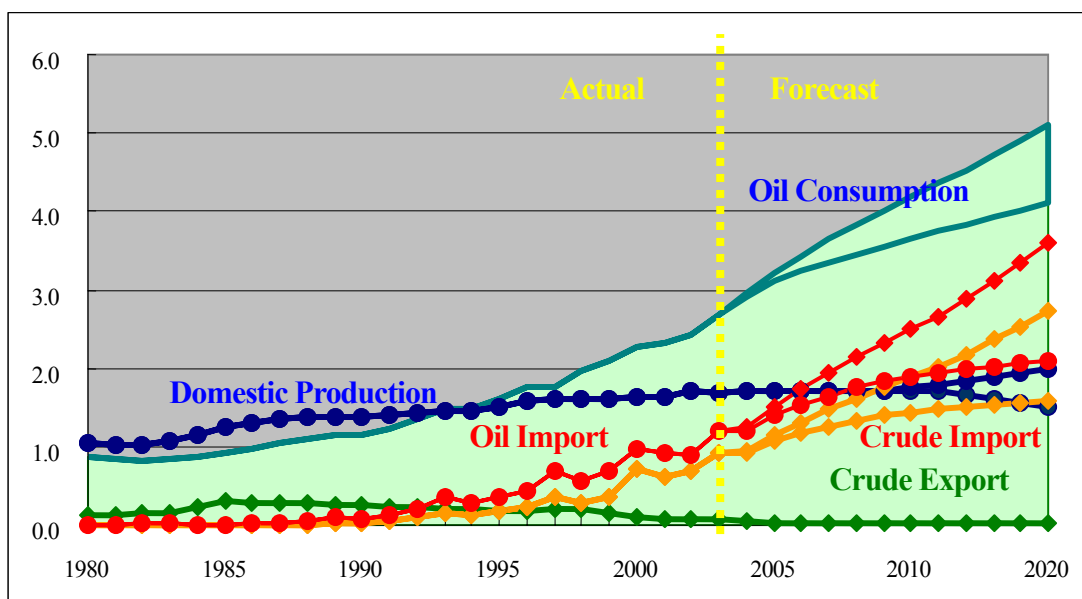
Figure 1.3 Crude Oil Import by Source: 2002



China's petroleum outlook typically shows the situation of northeast Asia. China's oil consumption exceeded that of Japan in 2003, to make her the world second largest oil consuming country after the United States. The oil demand is forecast to keep growing and reach almost 500 million tons in 2020, while the domestic production may be leveling off as major oil fields like Daqing are maturing. In 2003, China's crude oil import jumped over 30% to exceed 90 million tons. But this is just a beginning of new drama. It may triple in the next two decades as shown in Figure 1.4.

There is a dream plan being suggested to control the demand at 400 million tons and enhance the domestic production to 200 million tons, and thus to control the import at 200 million tons. Even if this dream plan were materialized, the oil import will double in the same period, but the drama does not end in 2020. Sooner or later, another Japan, the world second largest oil importing country, is emerging in the region. This will inevitably increase our dependence on the Middle East. We need to prepare for increase of oil import.

Figure 1.4 China's Petroleum Outlook



2. Energy Challenges facing Northeast Asia

Energy challenges facing northeast Asia will be summarized as follows. Facts are, firstly, mismatch of demand and supply in this region. We are facing energy shortage in the market, in the short run and long run. But, if we just look back, huge energy resources exist untapped in eastern Russia; coal, oil, natural gas and hydropower. Another fact is that, due to heavy use of coal, environment pollution is serious in China. Thermal power mostly using coal comprises over 80% of the Chinese power supply. Most of the coal firing power stations are not equipped with flue gas treatment system and China is releasing 20 million tons of SO_x every year that is the world largest quantity. The situation would further deteriorate as power demand grows.

Thus, our concerns are to secure sufficient energy supply to sustain development of the region, to reduce the Middle East dependence that is the cause of our vulnerability and unfair price, and improve environment with clean coal technologies and cleaner fuels. In this context, our policy objectives are:

- a. Energy conservation with proper environmental protection,
- b. Rationalizing and diversifying the energy structure,
- c. Increasing the regional and domestic energy supply, and
- d. Diversifying supply sources.

And, *introduction of natural gas will be the very right answer to the above.*

Improving energy security, which is one of our major concerns, we need to accommodate short-term and long-term problems. Short-term turbulences may be caused by extreme weather or unexpected supply disruptions due to accidents, regional turmoil, etc. in and adjacent supply chains. Cures are to eliminate anxieties and speculations with quick and accurate information/statistics to know the accurate position and status, preparedness such as stock piling and emergency response program to

flexibly counter. Short-term problems will also be mitigated if the long-term objective is accomplished by enhancing reliable energy supply.

Long-term mismatch of supply and demand may be caused by demand movement difficult to control or predict; due to abrupt market enthusiasm for cars, electric appliances, houses, etc., or untransparent policies including incoherent laws, guidance or enforcement in particular on utility tariff and environment regulations. Then, to adjust supply capacity, long lead-time is necessary while mismatch in the market accumulates for years as symptoms are not noticed or properly taken care of. Cures are to increase supply steadily developing new energy projects, which are huge and time-consuming, by proper navigation and initiative.

Potential energy projects in northeast Asia as candidate to enhance energy supply base are listed in Figure 2.1. Rich resources are expected in eastern Russia such as coal, oil, gas and hydropower. To utilize them in our region, however, question is if the market forces could work and automatically link these resources with market. *Despite the huge resource potential, we need long distance transportation and promised market.* Another recognition is that nature of problem differs by energy source. In case of coal, the long distance railway transport may substantially affect the overall economics. In addition, the big market is China but coal is presently not a desired one as its heavy use is causing serious air pollution. Oil may have least problem since the pipeline cost is rather cheap, it is able to handle large quantity and market is readily available. Natural gas is a desirable energy source, but its transportation cost is high for long distance movement and market is not readily available. Gas markets in Japan and Korea are maturing to provide only limited incremental demand, not justifying a large-scale new project building up in a short time, and Chinese market is still in its infancy. Hydropower may be transmitted via 500 kV line but it would cost prohibitively high, while linkage to the local market is yet to be investigated technically.

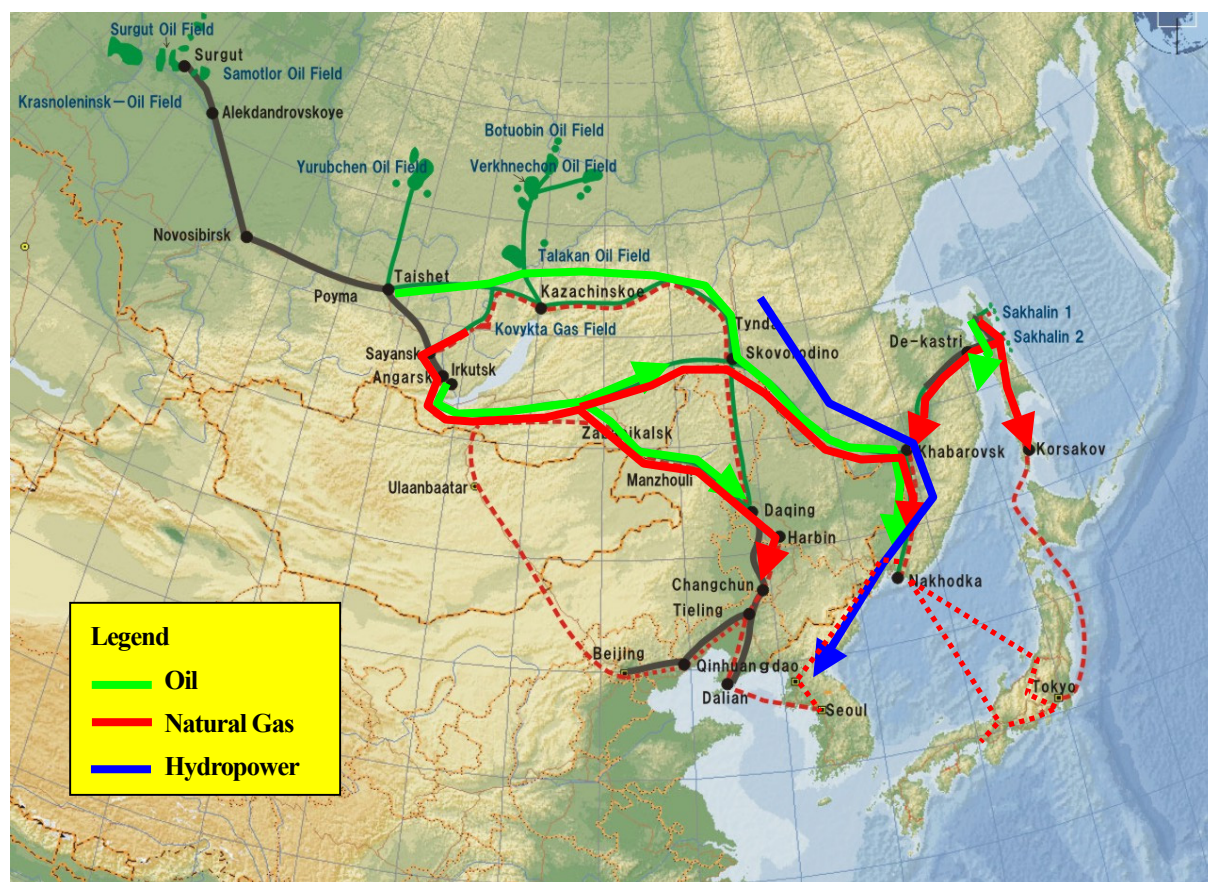
Figure 2.1 Potential Energy Projects in Northeast Asia

	Upstream	Transportation	Market
Coal	Rich resource, Abundant low quality coal	Railway and shipping port are congested	Japan & Korea: Available China: Heavy use of coal is causing serious pollution
Oil	Potentially rich, but yet to be confirmed	Pipeline is huge but relatively cheap	Readily available
Natural Gas	Rich potential	Pipeline is huge project and costly	Japan & Korea: Maturing China: Yet to develop
Hydropower	Rich potential	HV transmission is very costly	Japan & Korea: Matured China: Main market is remote

The map in Figure 2.2 shows potential energy flows from eastern Russia to northeast Asia. The green line shows oil, red line gas and blue line power. Some may be directly connected to the market, while oil may be shipped from Nakhodka and De-Kastri and LNG from Korsakov for

various destinations. Among these energy sources, this paper will concentrate on natural gas in the following pages.

Figure 2.2 Potential Energy Flow in Northeast Asia



3. Developing Natural Gas Pipelines in Northeast Asia

Developing natural gas located in the interior area of east Siberia, great social benefits are expected as below, though long distance pipeline system as mass carrier is necessary:

- a. Reinforcing the region's energy security by increased energy supply and diversification of energy type and source,
- b. Improving environment by wide use of the cleaner fuel,
- c. Reducing transportation congestion, fuel needed for transportation of energy and resultant pollution,¹
- d. Developing eastern Russia and enlarging regional trade, which will substantially stimulate economic development of the region and enhance regional peace and stability, and
- e. Providing a rational measure to cope with increasing GOR (gas/oil ratio) as oil production progresses in future.

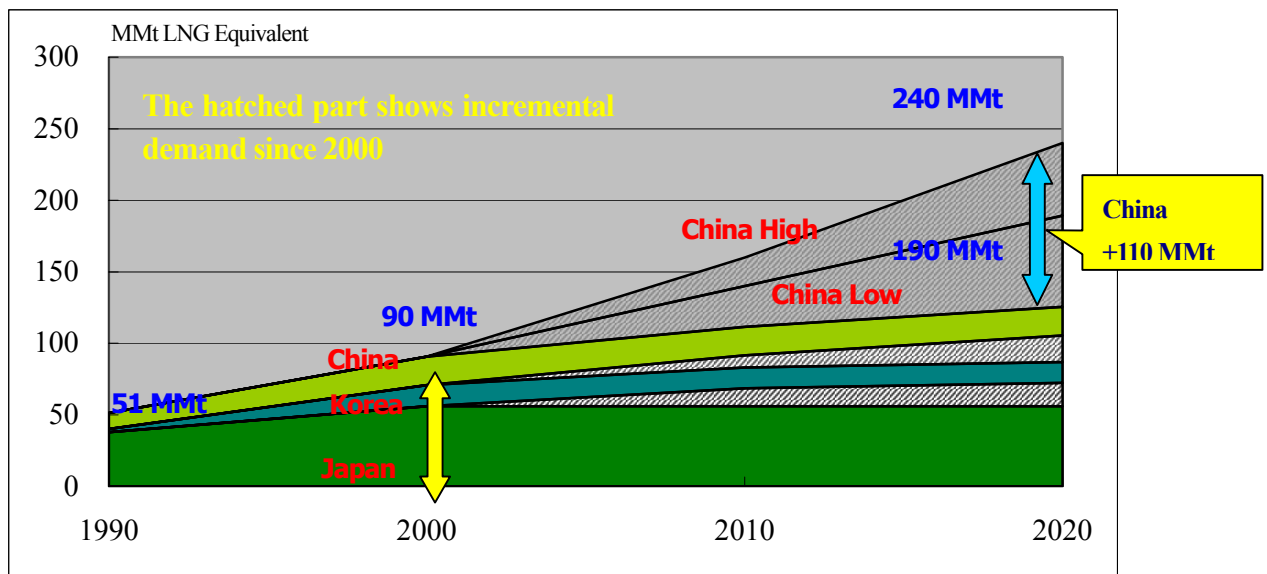
¹ For example, delivery of coal by lorries causes heavy traffic in cities.

At the same time, we face with various challenges in implementation such as:

- a. Resources and markets are very far apart,
- b. Demand is not sufficient or surely predictable at this moment,
- c. Institutional structures and roles of players are yet to be discussed internationally, in particular on the rules for investment, operation, transit and delivery, and
- d. The project is gigantic for private business.

In the contemporary world, people are likely to discuss that, if great benefit is expected, just let the market forces work. But, is that true? No, we have rather experienced so many market failures such as blackouts elsewhere in the world, speculative up and down of energy prices, and so on. Recent incidents show that market tends to go for a handy sized business and short-term profit, since the modern MBA economics does not encourage taking of long-term business risks. However, in the human history, great work such as construction of the Suez Canal took very long time and brought us tremendous benefit. Today, even if a project is expected to bring great social benefits in the long run, contemporary corporate accounting rule does not allow us to incorporate them into project evaluation. Market forces cannot work automatically to reflect the overall value of a project.

Figure 3.1 Natural Gas Outlook of Northeast Asia



The Figure 3.1 shows natural gas outlook of Northeast Asia in LNG equivalent quantity. Demand increase in Japan and Korea will be moderate, while the potential demand increase of China in the next two decades will be greater than the current gas demand of the region. However, in China, nationwide gas market is just to emerge. Its future growth will be substantially affected by the country's environmental policy and power industry policy, which are not transparent at present in terms of law and administration system as well as determination on enforcement. China's domestic natural gas production is growing at the same time, being given priority. The upstream sector in general wants to recover the past sunk cost as soon as possible, and new discoveries are growing rapidly. The upstream operators are the buyers of international gas at the same time. Although

there would be great potential of importing natural gas, these elements make it very hard to predict the import potential with certainty that is deadly needed to consider actual investment in the international pipeline. Perhaps, we need to wait for some time to find out a plausible path of gas market development in China.

Then, in considering project materialization, we need to design the business structure properly. To achieve this, firstly, we should consider the characteristics of each sector of the project, namely, upstream, pipeline and market. They may be summarized as follows:

- a. The upstream sector is very adventurous business competing each other with own insights and hi-techs. It is a high-risk high-return business with success ratio of 10% or so, and hence the typical play ground for the private sector.
- b. The pipeline sector is stable once resource and market are assured. This is a typical utility type business.
- c. The market is sometime unpredictable and the mass-market for small unit users, such as commercial/residential sector, needs long lead time to build up. This sector is a mixture of commercial and utility businesses.

It is also necessary to consider project values for implementation. In terms of economic analysis, projects will be classified as:

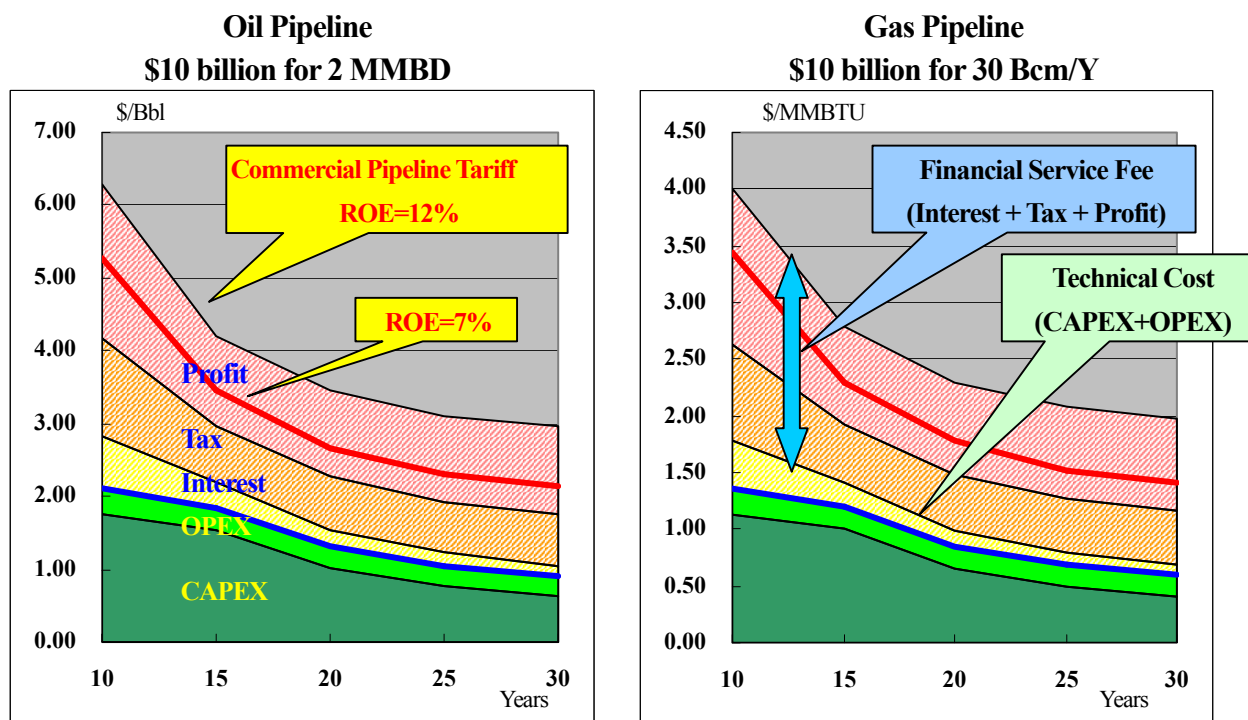
- a. Commercially viable. Such project qualifies certain commercial criteria, for example 12% rate of return, and should be in a pretty size for the private sector to handle comfortably. If it is too large, the private sector may just dismiss it.
- b. Other projects may be economically viable; that is, cost recovery with a certain margin is affirmative but it does not clear commercial criteria, or its economics is very attractive but it is too large in size for private sector's challenge.
- c. Projects are not viable in economic term. But such project may be required socially, while its social benefit cannot be measured explicitly to improve economics.

Given that a project is commercially viable, we can just let it go ahead pushed by market forces. But, if they are not as seen in many cases of large sized projects, its social benefit at the market is the key whether we should consider any political actions or not as explained later. The Russian natural gas may fall in this second category. That is, resource potential is huge but remote. Economics of developing them may be justified only if the transportation cost were reasonably low. Then, the pipeline economics is the key, which can be politically adjusted if substantial social benefit is expected. To justify the political action, such social benefit needs to be defined as a political consensus. In this case, the benefit should be more than just replacing the existing gas market, typically LNG market in Japan and Korea, and the implicit social benefit should be assured for distribution to the society in a fair manner but not to a particular business entity.

Figure 3.2 shows how the contemporary project evaluation works. As shown in these charts, a pipeline tariff comprises CAPEX, OPEX, interest on borrowing, corporate tax and duty, and fair return. Its economics depends upon the project term also. The longer the project duration or the cost recovery period, the lower the average pipeline tariff as common among capital intensive

investments. To illustrate an example, a rough calculation is made to show cost elements of project economics for a case of 12% return on equity investment that covers 35% of the total required investment, assuming that the initial investment for a pipeline covering 4000km is \$10 billion (a very generous budget?) for transporting two million barrels per day of oil, or the same amount for 30 billion cubic meters of natural gas.

Figure 3.2 Economics of Pipelines



One very apparent fact is that, in justifying the commerciality, the financial service fee composed of interest, tax and profit is more than double of the technical cost, namely CAPEX plus OPEX. Therefore, there is a big room for the society to consider the project and maneuver its economics artificially. This observation indicates that, *what we should study regarding pipeline economics at this stage is not to merely upgrade the cost estimation but rather to consider appropriate financial structure.*

Let us look into their economics more in detail. As shown in Figure 3.3, the commercial pipeline tariff may be about \$3/Bbl for oil and \$2/MMBTU for natural gas. These are more than double of the costs via conventional ocean transportation for crude oil and LNG. On the other hand, the technical cost is 1/3 of them. Compared with the prevailing imported price, \$30/Bbl for crude oil and \$4/MMBTU for natural gas² for example, the pipeline cost is only 10% of the final price for oil, but 50% for natural gas. This means that the transportation cost is the key in realizing the regional natural gas pipeline network.

² LNG price as a marker of international gas price in northeast Asia is expected to decrease significantly in the coming years.

Figure 3.3 Economics of Pipelines: Observations

Project Term 25 years	Commercial Tariff at ROE=12%(A)	Technical Cost (B)	Expected Price (C)	B/A	A/C	B/C
	\$/Bbl	\$/Bbl	\$/Bbl	%	%	%
Oil	3.10	1.05	CIF 30.0	34	10	4
	\$/MMBTIU	\$/MMBTIU	\$/MMBTIU			
Gas	2.08	0.69	At city gate 4.00	33	52	18

As shown in Figure 3.3, in case of oil, we observe that:

- a. Pipeline can offer substantial cost improvement compared with railway transportation, the latter being about \$10/Bbl,
- b. Market is readily available as the contract term is relatively short and flexible for crude oil³, and hence Japanese and Korean crude oil purchase contracts may be deemed very flexible, but,
- c. Project size is gigantic for private businesses.

Only the last item is the obstacle for implementation of an oil pipeline.⁴ Then, provision of super long term finance may be able to provide an easy solution.

In case of natural gas, on the other hand, questions are:

- a. The Pipeline tariff comprises more than 50% of the final price, being a substantial hurdle,
- b. Market is yet to be developed, in particular in China, the most expected market in northeast Asia,
- c. Competition with other gas sources is harsh in the market, and
- d. Project size is gigantic for private businesses.

We need to solve all of these issues.

Investigating the project economics, the pipeline tariff is crucial in realizing the Northeast Asia Gas Network. Then, since the financial service fee is enormous among components of the pipeline tariff, we can consider some political actions. In order to justify such action, however, it is necessary to establish the national and international consensus that the pipeline should bring a great social benefit. Given that this is the case, the pipeline tariff can be lowered substantially by reconsidering the commercial criteria, for example 7% ROE as utility business, lowering tax rate, providing institutional finance of super long term, and/or subsidizing. These are very common political measures. In applying them, however, we should always be conscious that sound cost recovery should be assured autonomously and that proper norm should be placed to prevent cost expansion prone to government controlled type businesses. Application of auction system may be one suggestion in deciding the pipeline tariff, if technically feasible, so that market mechanism shall control the project operation.

³ So called term contract of crude oil, rolling green light contract is common that affirms another one year contract per se if any of the other party does not advise otherwise. In addition, Japanese oil firms usually retain about 20% as spot room in overall crude oil procurement. Thus, one Japanese company lowered the Middle East dependence 10% in 2002 when Iraqi war was anticipated.

⁴ Regarding oil export pipeline to northeast Asia, please refer to Ken Koyama and Kensuke Kanekiyo "Russia's Oil Development and its Implication for Japan: Part I & II", September 18, 2003, IEEJ Homepage.

4. Role of Government Initiative

In implementing these measures toward materialization of the northeast Asian gas pipeline network, government initiative is essential. For simplicity to understand the whole picture, if a project is under one government, the following principle will apply.

- a. The aggregate government take is determined by the final market price however the tax rates are distributed among project sectors. It is the sum of the *social benefit plus tax* on the aggregate profit from the whole project that can be *determined by the balance of the final market price and the total project cost in upstream and pipeline*.
- b. Then, if favor is given to the pipeline sector, it can be recovered from the other sector.

Such total benefit can be realized, however, only when the whole project is materialized. As analyzed in the foregoing pages, if economics of the long distance pipeline is the obstacle to this project, the above principle should be considered seriously.

Here, the project being an international one, we should also consider fair distribution of the government takes among countries at stake. It would be a messy procedure to obtain a unanimous agreement among them, but here we should not aim at only low hanging fruits. We should harvest rich fruits on the high branches mobilizing various measures and human wisdom. To achieve this objective, government initiative is essential in implementing the Northeast Asia Gas Network. As observed in this analysis, the project is not yet readily commercial but is expected to bring great social benefits. Magnitude of such implicit social value could be defined only as a political consensus, and, to realize it, various international and institutional issues should be moderated through functions of government.

Then, government roles may be different by sector as follows:

- a. In the upstream sector, the government role is to prepare a proper play ground for the private sector, that is, to set forth appropriate and clear mining right as institution to invite active investment of private business firms.
- b. In the pipeline sector, lowering the pipeline tariff is essential. To this end, government can consider suitable financial and tax structures, and provision of institutional finance and subsidy as appropriate.

One important note here is that, in discussion of cross border pipeline trade, *transit fee* is always controversial. Lack of standard rules for transit casts a great uncertainty on an international pipeline. They should be agreed internationally to assure a reasonable and stable tariff sufficient to justify a whole project. *A careless approach on transit fee is to just mention an economic rent.* The concept sounds greedy and hostile, as the project promoters are taking every effort to implement a project bearing all the risks while the transit country is just sitting in between the origin and destination. The theory of economic rent would not lead to a fruitful discussion. Rather, I would recommend to think it same as inviting foreign investment. Then, we can make this most untransparent part of international pipeline transparent. For example;

- a. Consider it as a transform of corporate tax on foreign investment assuming a deemed fair return, say, ROE of 12% or 7%, as appropriate.

- b. Then, no other tax should be levied on the pipeline business. This principle would provide an assurance that transit fee would give no influence on the overall pipeline economics.
- c. Such fee should be fixed for certain duration to provide a transparent basis in designing the pipeline project.

Applying this principle, a reasonable fee passing through Mongolia, for example, would be less than 10 cents per MMBTU. Inviting such business, in addition, the transit country may enjoy side effects such as technical transfer, raising related industries and increasing jobs.

Thirdly, natural gas market needs to be identified by clear policies of member countries. Each government should indicate:

- a. National energy policy to diversify energy structure,
- b. National environment policy to introduce cleaner fuel, accompanied with determination of strictly enforcing such regulation,
- c. Long term energy plan as navigator, and
- d. Legislation and arbitration system on international pipeline trade

These should be based upon a regional Energy/Environment Master Plan with realistic implementation programs endorsed by countries at stake, but they should not be just picture of vision.

5. Designing Northeast Asia Gas Network

As a conclusion of the above analysis, we should consider forming an international forum of governments at stake, where *the agreement of the forum should be legally binding* to provide an assured institutional structure in designing the Northeast Asia Natural Gas Network. In this context, government initiative is essential to make the project move forward.

In the above forum, the followings should be considered as the fundamental principles.

Firstly, the origin country as supplier is required to show a transparent mining right policy and legislation that should be assured for a reasonably longer period to justify long-term investments in exploration and development of resources.

Secondly, regarding the trunk pipelines to major hubs,

- a. Build it under government initiative as social infrastructure in a manner to reasonably lower the pipeline tariff, provided that its market and social benefit are confirmed. Then, efficient operation principles to curb cost increase needs to be placed.
- b. Establish *standard transit rules* showing clear economic and regulatory frameworks of the origin, transit and destination countries.

As shown in the consideration on economic mechanism, *what we need at this moment is not to upgrade the cost estimation but to set forth an appropriate financial structure* to encourage the pipeline construction. Here, in order to simplify the discussion, it will be better to consider that

only the trunk pipeline should be discussed internationally that link gas gathering centers in the origin country and the major hubs near the consumer centers. Any branch lines for gas gathering or delivery systems beyond the hubs should be the responsibility of each supplier and market, since inclusion of the latter in international discussion would add only complexity.

Thirdly, regarding market buildup, clear policies of member countries should be shown on major elements that define market demand, namely:

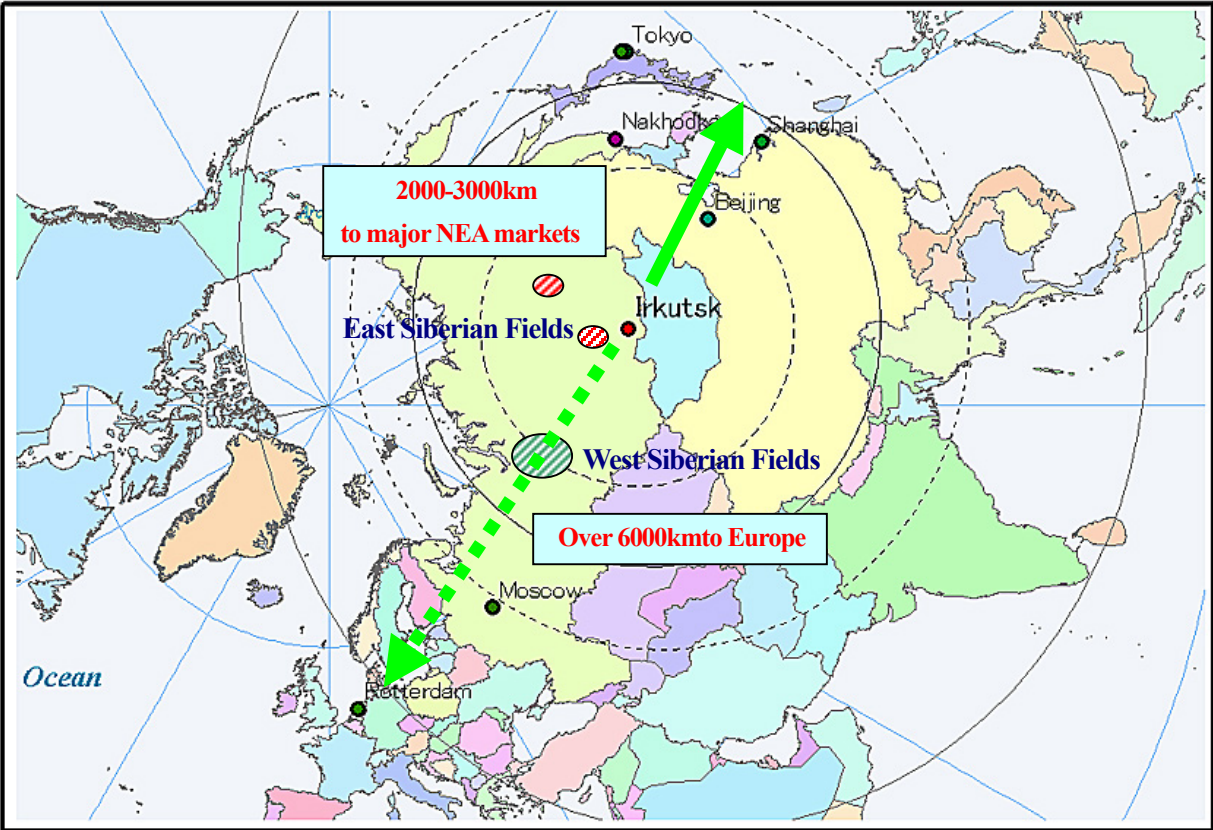
- a. Energy and environment policy,
- b. Long term energy plan,
- c. Coherent and transparent laws and rulings including confidence of enforcement

Here, the final gas price should be an internationally competitive price, which should be decided sometime in future by willing sellers and willing buyers. While the government forum needs to have a good insights and confidence in price prediction before implementing the project, it is not their job to decide it. Everybody has an intent and desire, and the final price as compromise of them is the most difficult factor to theoretically predict. Only market can decide it when situation is matured.

All of the above actions recommended should be progressed orderly and step-by-step considering capability and maneuverability in solving various issues. Then, the first thing required will be the determination of the member countries toward this project recognizing that a great deal of social benefits shall be realized by introducing natural gas to the region. To this end, experts are required to quantify and explicitly explain the social benefit of the project from various viewpoints. During the process, questions to be solved and the order of assessing them may become clearer. Then, discussion on pragmatic issues may follow. The important baseline here is that we need proper market design to encourage private transactions as the ultimate objective so that real flow of energy to northeast Asia will start certainly

The map on Figure 5.1 shows that, compared with the existing market for Russian resources, Northeast Asia is very close. From our eyes, our supply sources are, in the order of distance, Southeast Asia, Middle East, Africa, Caspian countries and west Russia, and Siberia is the farthest. As we look forward for quest of oil and gas, very rich resources are located just on our back but we have not been able to reach them yet. However, I trust that our wisdom can solve this dilemma someday not very much remote.

Figure 5.1 World View from Russia



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