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Energy Outlook of China and Northeast Asia And Japanese Perception toward Regional Energy Partnership*

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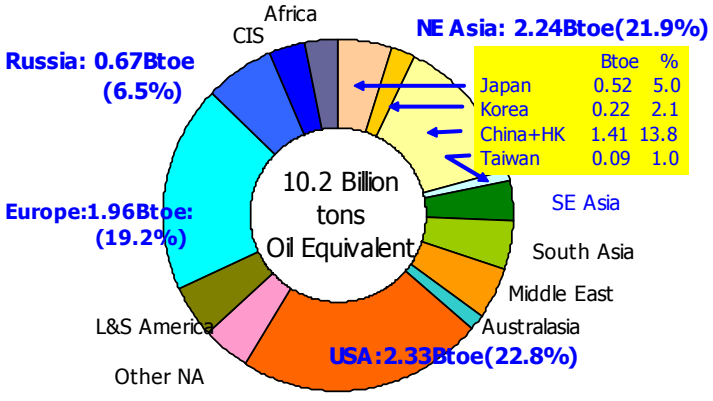
In the past two years, we have been experiencing relentless resource inflation and shortage worldwide. Prices of energy and raw materials are soaring rapidly. Power shortage in industrial regions of China is serious and energy might become a serious hindrance to development. In this report, the author will review energy situation of China and Northeast Asia and discuss on direction of the possible energy cooperation among these countries, which is essential to ensure region's sustainable development.

1. Asia in the world

Today, Northeast Asia ranks as one of the three major energy markets of the world together with North America and Europe. The sub-region consumes over two billion-ton oil equivalent of energy, which shares more than 20% of the world energy consumption. It is apparent that the recent trend has been driven by high economic growth of China. China's energy consumption recorded burgeoning jump of 15.1% in 2004, while the rest of the world recorded 2.8%; oil consumption 15.5% and 2.1%, respectively. This trend is continuing in 2005, though China's oil import is being curbed substantially.

Figure 1. World Energy Consumption (2004)



Energy Total	Oil Equiv. Growth	
	Btoe	%
China	14.1	+15.1
India	3.8	+7.2
Othe Asia	17.6	+4.4
US, Europe, Others	66.8	+2.1
World	102.2	+4.3
Oil		
China	3.2	+15.5
India	1.2	+5.5
Othe Asia	5.1	+4.7
US, Europe, Others	28.2	+1.9
World	37.7	+3.4

Source: BP Statistical Review of the World Energy 2005

According to the IEA Energy Outlook of 2004, energy consumption of Northeast Asia will continue rapid growth and will exceed that of North America in 2020s. Looking to the future energy demand, Japan will be moderately leveling off, as its economy has reached a matured stage and its population will

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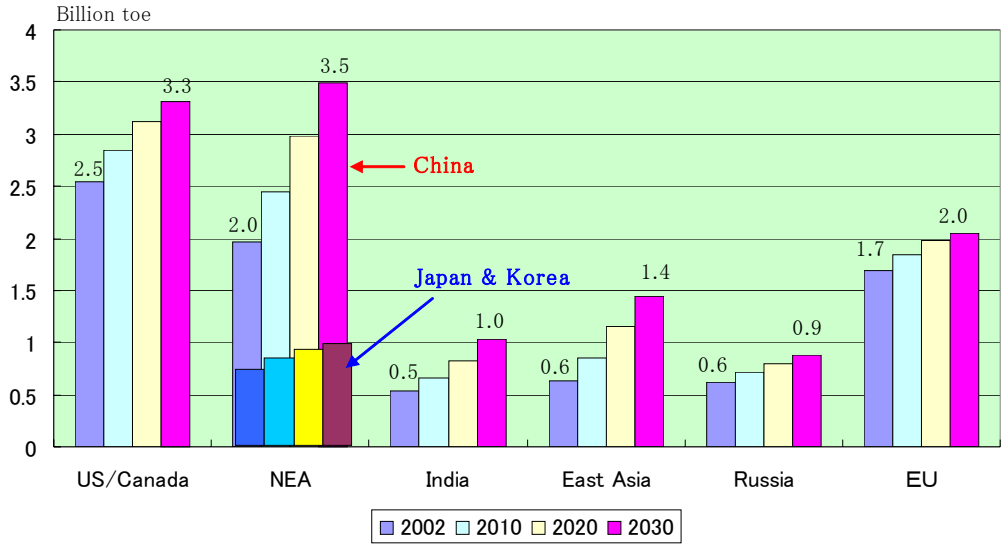
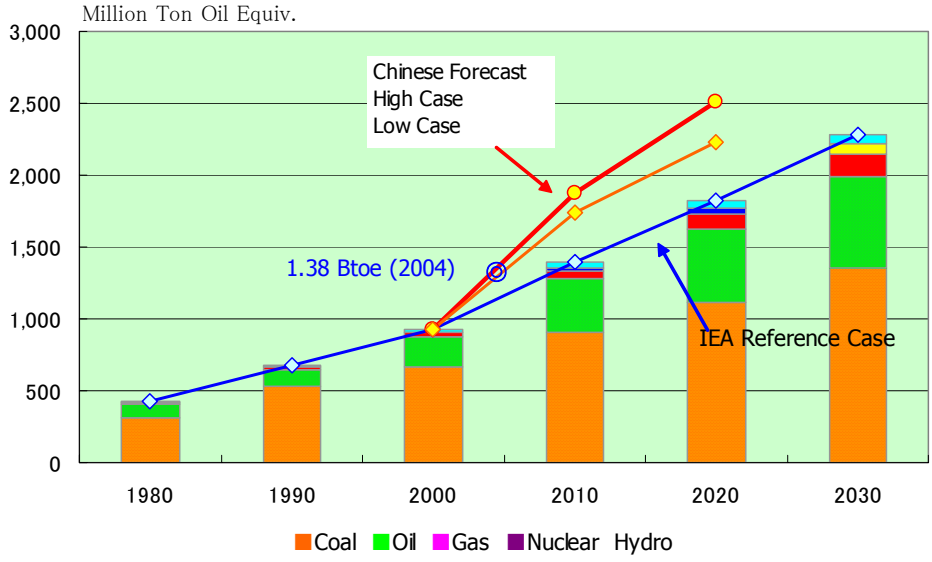
start decreasing within several years. Korea recorded substantial increase of energy consumption in 1990s, but it may become moderate in the coming decades. Its economy will be shifting to hi-tech, less-energy-use structure while energy consumption in the residential/commercial sector will be maturing. In contrast, China will continue rapid increase of energy consumption driven by high economic growth. With vast land and big population, China's taking-off takes time and consumes huge amount of energy for a prolonged period.

Figure 2. IEA World Energy Outlook 2004



Compared to the recent energy trend, however, we notice that IEA's projection substantially undershoots the actual trend. The energy consumption of China recorded 1.38 billion tons in oil equivalent in 2004, which compares to the IEA's projection for 2010 that is 1.39 billion tons. It is apparent that China's energy consumption will grow faster than IEA's projection. Many of Chinese research institutes forecast that it may reach 2.0 to 2.5 billion tons in 2020, but this could only be realized with enormous efforts of energy conservation and rationalization while BAU cases would exceed 3 billion tons.

Figure 3. Energy Outlook of China



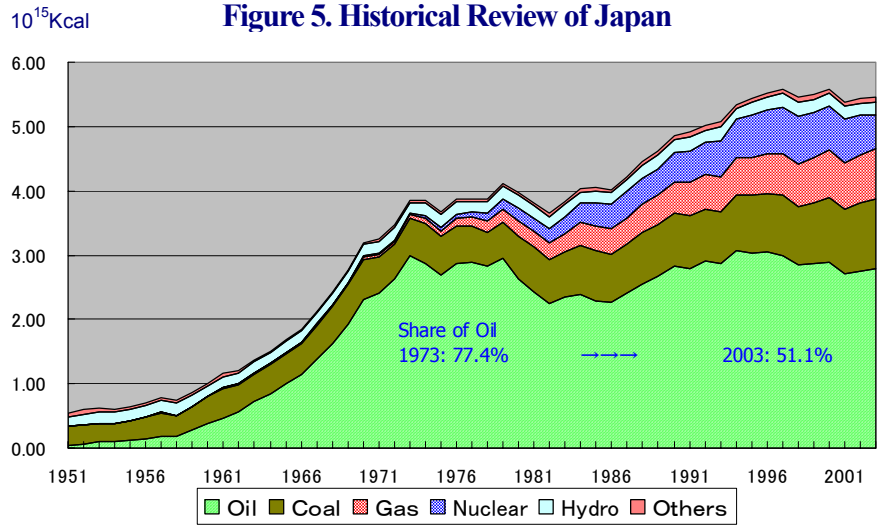
Regarding the energy structure, Japan and Korea almost entirely depend on imported energy with oil and gas playing major roles. In contrast, coal dominates in China. With plenty of domestic coal resources, China's import dependence is only 13%. China depends on oil only 1/4 of its energy consumption, but its oil import is increasing rapidly. China's oil consumption is increasing rapidly, but its production is leveling off. Its oil import will increase faster than the increase of consumption, and the absolute incremental quantity will be also huge. During the oil crisis of 1970s, Japan successfully diverted oil use in power and industry sectors to natural gas and nuclear. However, this cannot be expected again since oil is scarcely used in these sectors in China. Therefore, among energy sources, guiding oil consumption to a rational balance with economic growth and securing oil import are the most important policy objective of the region.

Figure 4. Energy Structure of Northeast Asia (2004)

	Total	Oil	Coal	Gas
	MMtoe	%	%	%
Japan	515	47	24	13
Korea	217	48	24	13
China	1410	23	68	3
Total	2142	31	53	6

Source: BP Statistical Review of the World Energy 2005

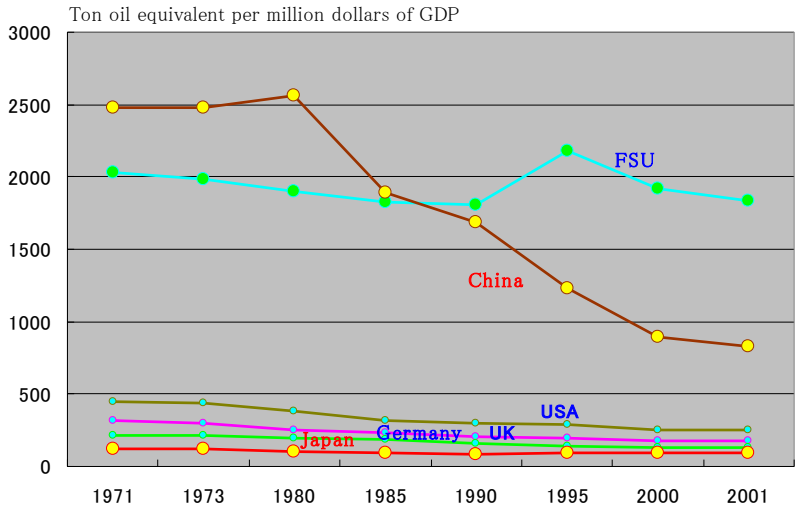
Figure 5. Historical Review of Japan



Source: METI

In the past decades, China has dramatically improved its energy efficiency. China's energy consumption per unit GDP has decreased to 1/3 of that of 1970s. But, it is still three times worse than that of the United States and nine times that of Japan per purchasing power parity (PPP) adjusted GDP.

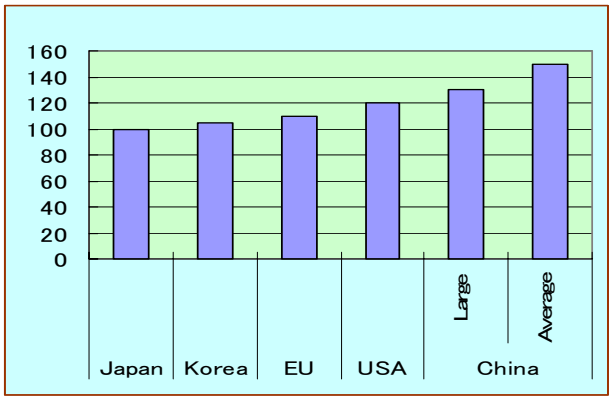
Figure 6. Energy Efficiency of Selected Countries



Source: IEA/IMF

This may have been exaggerated by monetary terms of calculation. However, in physical unit comparison, industrial energy consumption per unit is still considerably higher than the international standard. For example, energy consumption rate at steel mills in China is 50% higher than that of Japan. Small and inefficient plants scattered over rural towns are problematic, but integrating them into world-class plants would incur negative effects on rural economies, such as job security, income source and modernization. It is not an easy task to improve them as theoretically thought. In addition, China being a vast continental country, transportation sector is another fetter in curbing energy consumption.

Figure 7. Energy Efficiency of Steel Mills



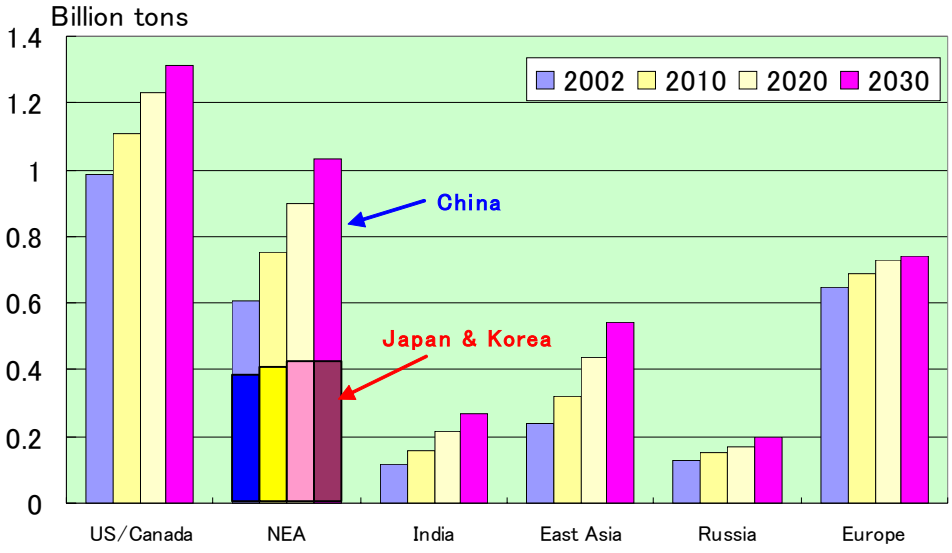
Source: Japan Steel Association

2. Oil and Gas Outlook of Northeast Asia.

Oil Demand and Supply

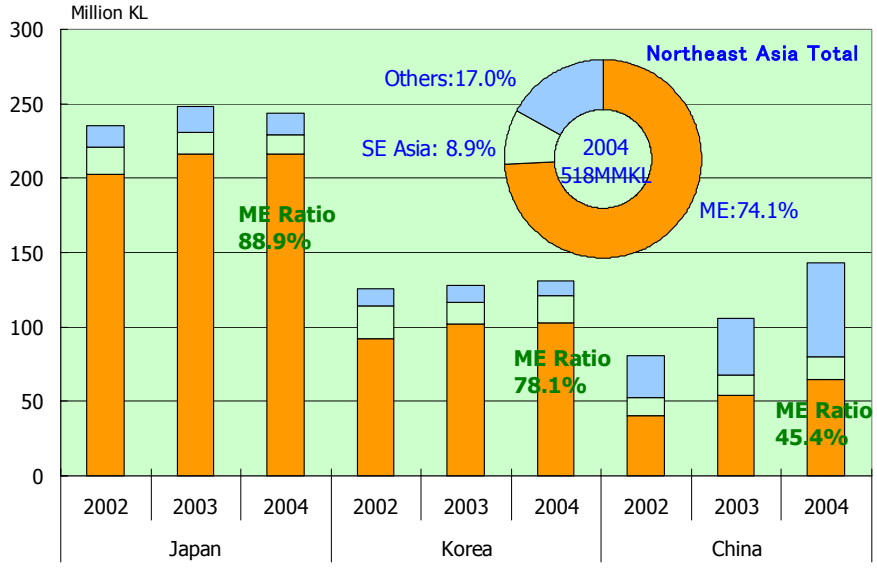
According to IEA, oil consumption of Northeast Asia will continue to increase rapidly, exceeding that of Europe and approaching North America. Among three countries, China's oil consumption will increase rapidly, while Japan and Korea will be leveling off.

Figure 8. World Oil Outlook (IEA 2004)



One serious concern is that we depend upon the Middle East over three quarters of the crude oil import: namely, Japan 89%, Korea 78%, China 45% and Northeast Asia total was 74% in 2004. Then, to accommodate large import increase in future, it is inevitable that the Middle East dependence should go up further. Watching the unstable situation in the Middle East, this is the region's great vulnerability.

Figure 9 Crude Oil Import of Northeast Asia

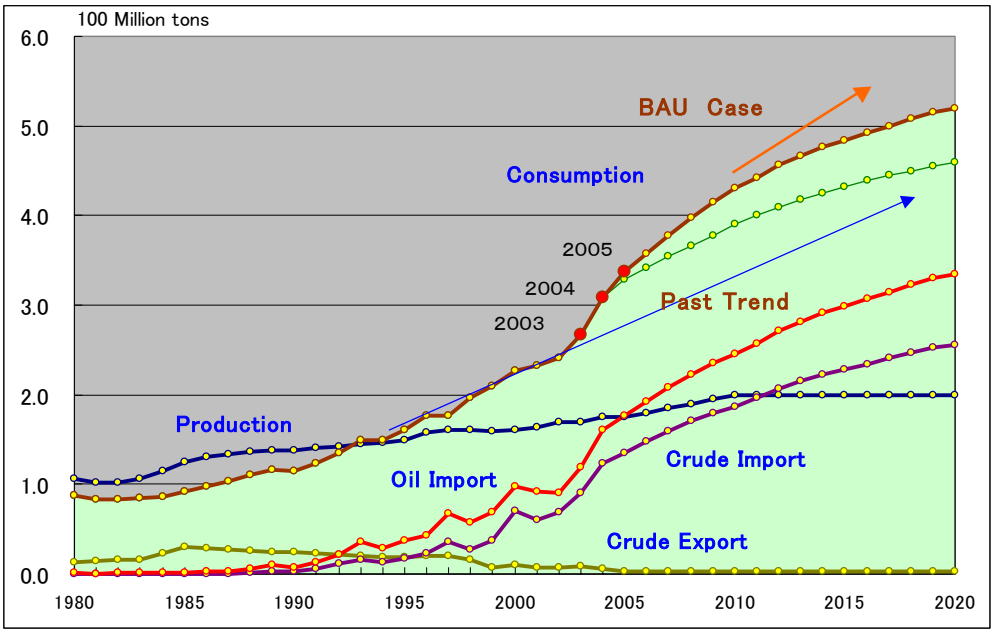


Source: METI, MOCIE, China OGP

Despite the above tendency in the background, in 2004, China's import of the Middle East crude decreased its share to 45.4% from 50.9% in 2003 although the Middle East crude import quantity increased by 20%. This was due to sharp increase of lighter crude import from the Atlantic basin (+66%). Among others, the share of African crude increased from 24.3 % to 28.7%. This was caused by lack of refining capacity in China, in particular cracking and desulfurization facilities to catch up rapid demand growth.[1] Another important factor is that China plans to improve its motor fuel quality to Euro 4 level by 2010. This requires construction of the above secondary facilities in a huge size. Therefore, the same tendency in crude oil preference will continue if such investment were not made in time.

Looking to petroleum outlook of China, China's oil consumption exceeded that of Japan in 2003, to make her the world second largest oil consuming country after the United States. It jumped another 15% in 2004. According to IEA, the oil demand is forecast to keep growing and reach 503 million tons in 2020. However, as shown in Figure 10, the current trend apparently indicates even 600 million tons for the business as usual case. We should note that, although the Chinese government maintains its propaganda to quadruple GDP by 2020, which means 7.2% growth on average for 20 years, IEA assumes 6.4% from 2002 to 2010 and 4.9% for the next decade.[2] Further, IEA's alternative scenario says that, enhancing energy conservation and introducing alternative energies, oil demand could be curbed by 10% or down to 464 million tons. Watching that China keeps growing fast so far, we are puzzled on which scenario would be feasible.

Figure 10. Petroleum Outlook of China



Source: Author's estimation

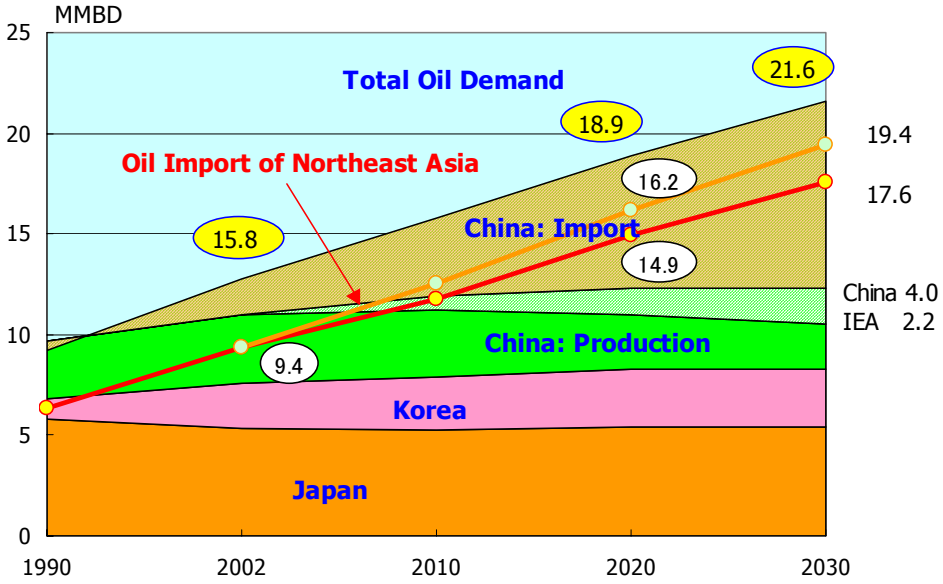
1 This tendency is continuing. During the first half of 2005, the Middle East crude import regained its share to 49.2% while the African crude import share further increased to 30.3%. In contrast, Southeast Asian crude import recorded sharp decrease of -37.3% in the same period.

2 However, deducting higher growth exceeding 9% attained by 2005, this assumption produces only 4.9% average growth for the period of 2005-2010.

In China, major oil fields like Daqing are maturing. The domestic oil production may be leveling off in an optimistic case, while IEA estimates that it would decline to 140 million tons by 2020. Considering the recent high oil price, we may comfortably go for the optimistic scenario. Then, China's oil import may more than double in the next two decades. However, suppose IEA's alternative scenario is possible, this scenario would not be substantially affected.

In summary of the above observation, oil consumption of Northeast Asia will reach almost 20 million barrels per day by 2020. Net oil import will exceed 15 million barrels per day, increasing five million barrels per day from now. That is something like that another Japan, the world second largest oil importing country, is emerging in the region. The Middle East dependence will inevitably go up, as it could be the last resort having substantial potential for incremental supply.

Figure 11. Petroleum Outlook of Northeast Asia



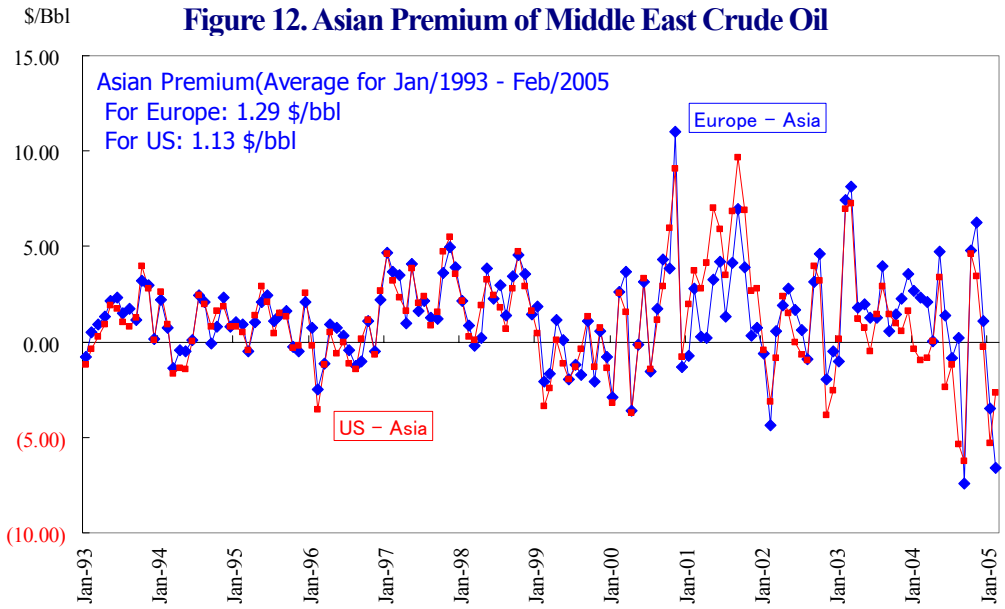
Source: Author's estimation

Oil Price

With the supply/demand tendency in the background as above, Northeast Asia faces with two major problems regarding international crude oil prices in the market, namely, Asian premium of the Middle East crude and expanding light-heavy spread.

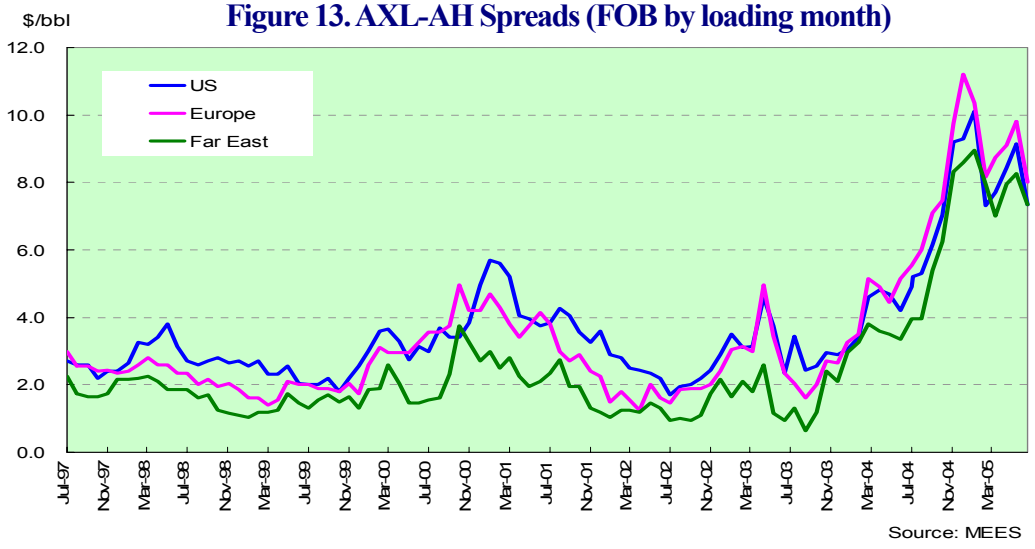
Historically, Middle East crude oils have been priced about one dollar per barrel higher for Asia, although the relationship is reversed since last year. The recent trend may have been caused by the global abnormal appetite for lighter crude oils as explained below. However, since the Middle East is the only reliable source as mega-supplier while China and India keep increasing import, the upward price pressure on the Asia bound crude oils is anticipated to continue in the background. Effective cure to the Asian Premium will be to develop new supply sources other than the Middle East.

Figure 12. Asian Premium of Middle East Crude Oil



In addition, light-heavy spread of Middle East crude oils jumped tremendously in 2004 as shown in Figure13. The technical cost deferential of light and heavy crude oils may be in the range of two to four dollars per barrel, which was represented in the market trend band historically. The oil product demand pattern is shifting globally to lighter transportation fuels such as motor gasoline, jet fuel and diesel gas oil. The abnormal phenomenon in the light-heavy spread suggests lack of sufficient cracking and desulfurization facilities to meet this demand pattern. In 2004, China and the U.S. were scrambling for lighter crude oils in the Atlantic basin, as both of them are in short of secondary facilities in the downstream. This competition was magnified in the market by speculative funds.

Figure 13. AXL-AH Spreads (FOB by loading month)



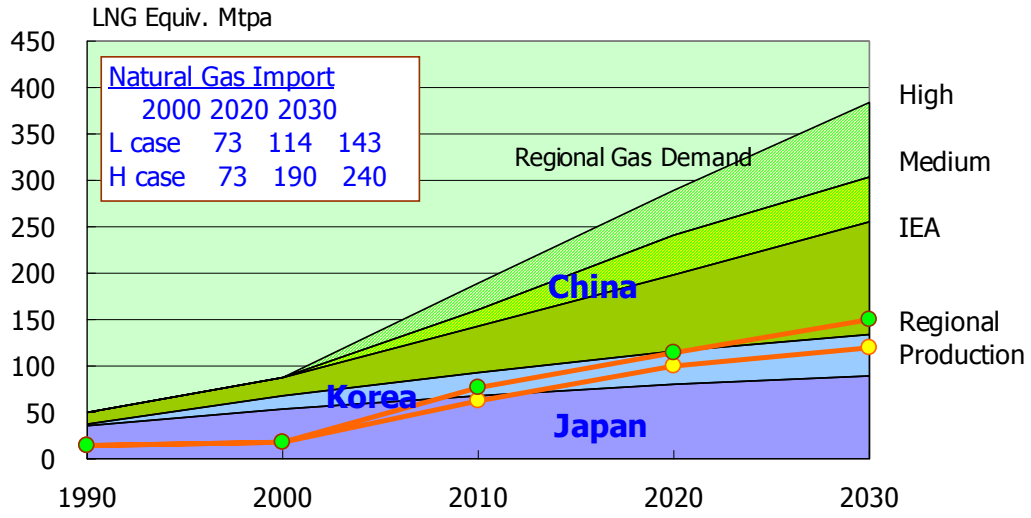
In summary, the above phenomena indicate lack of effective investments in upstream as well as downstream in the global oil supply chain.

Natural Gas

In addition to oil, region's natural gas demand is also expected to grow fast. In Northeast Asia, Japan and Korea has established nationwide gas use based on LNG. These markets are already nearing maturity and future growth is forecast to become moderate.

In early times of China, natural gas had been used in limited gas producing provinces like Sichuan until the first long distance trunk line was completed from Shaanxi to Beijing in 1997. The great project "West-East gas pipeline" connecting interior Tarim basin to Shanghai started transmission in 2004. Its capacity is 12 billion cubic meters per annum with an upgrading plan to 17 billion cubic meters. This pipeline has surely opened up a new era of nationwide gas use in China.

Figure 14. Natural Gas Outlook of Northeast Asia



Source: Author's estimation

Today, China's nationwide gas market is just to emerge. While IEA showed a very conservative view toward gas market development[3], it is now generally expected that Chinese gas use will increase faster. To cope with power shortage in peak hours seriously affecting the development centers of China since 2003, gas turbines is a very effective measure. Gas is also a cleaner energy friendly for environment. The central government recommended introduction of natural gas, pending controversial price negotiation. Thus, upon launching of the West-East pipeline, a bulk of gas utilization plan has come up along the pipeline routes. The upstream provinces of the pipeline moving fast for natural gas, Shanghai, the destination of the pipeline, suddenly found herself that the city could not receive the originally allocated quantity of indigenous gas and is now scrambling for an LNG import plan. Although the expansion plan of the West-East gas pipeline is being advanced, upstream gas field development is also necessary. Under the circumstance, in addition to domestic gas supply plans being aggressively developed, almost 20 LNG import projects have coming up nationwide. Should China's gas market develop as expected above, the region's gas use would double by 2020.

3 IEA "Developing China's Natural Gas Market", 2002

3. Areas for Regional Cooperation: Three "S" on energy

In summary of the foregoing review, Northeast Asia is one of the world-class energy markets. It is expanding fast and expected to become the world largest energy consumption center in 2020s. At the same time, it is the development center driving the world economy and interdependence of the regional economies is progressing fast. The mutual trade in Northeast Asia exceeds 1/4 of total import/export of each country. Japan and Korea have heavily invested in China, and the economic/industrial mosaic of the region is tightly concreted today.

From the observations shown in the previous pages, we are facing with various challenges in the field of energy and environment such as increase of the Middle East dependence, unstable and unfair oil pricing, security of sea lanes, on supply side, and low energy efficiency, environment pollution, etc., on the demand side. To solve, or at least alleviate, these problems that are closely relating to international intricacies, concerted efforts as a region is essential. Northeast Asia being a world-class energy center, the magnitude of issues is too large for an individual country to cope with independently. Counter measures should require a grand size beyond national border.

Then, areas for such regional cooperation will be classified into three categories, namely, *security, stability and sustainability* of energy, which are called as the *Three S of Energy*.

Energy Security

Areas for regional cooperation to enhance energy security will be classified into two. They are measures to respond against short-term turbulences and to reinforce energy supply security in the long run.

Regarding the preparedness against short-term disruption, several actions are being taken since last year. One is the Joint Oil Data Initiative (JODI) covering 94 countries, being promoted by collaboration of six international institutions, namely, APEC, EUROSTAT, OECD/IEA, OLADE, OPEC and UNSD. This system compiles and reports monthly data of oil production, consumption and inventory on the 20th day of the next month, covering over 90% of the world oil movement. The other one is the Real-Time Emergency Information Sharing System (RTEISS) among APEC countries. This is a real time communication system among government officers to share and exchange information and intention. IEEJ is working as secretariat of both systems.

Regarding oil stock piling, Japan has 173 days stock and Korea 67 days already. Recently China has decided construction of four terminals with the first target of 20 days import quantity equivalent. The first batch of 16 tanks at the Zhenhai terminal was completed in August 2005. 52 oil storage tanks will be completed at the four terminals by 2008 under the above program and China plans to upgrade it to 30days by 2010. Although China is considering increasing the oil stock pile up to 90 days import equivalent in the long run, the program has just started and the current size is still minimal. Regional co-use system of them is yet to be discussed internationally.

In addition, we are facing with security issues at choke points of sea-lanes such as piracy at Malacca

straight. Since huge amount of oil is being transported sea bone, safety of oil tankers and oil spill response are very important issues common to us.

Energy Stability

Major issues on energy stability relates to stability of the market and oil/gas pricing. Despite that Northeast Asia is already a world-class energy market, its reality is not well reflected to oil pricing in the international market. Our concerns are:

a. Pricing of crude oils for Asia, even for term contract, depends on scarcely traded Dubai and Oman. The scarcity makes the pricing quite vulnerable to slight incidents or speculation.
b. Asian Premium of Middle East crude oil, and
c. Expanding Light-Heavy Spread exaggerated by speculation

Counter measures to these issues will be, firstly, to compile and make available accurate information on the market as quickly as possible through JODI, close communication among policy makers through RTEISS and frequent exchange of views on future outlook. These will help avoid obsession and upset in the market. Secondly, to realize rational pricing, it is desirable to create new price marker for Asian market. Russian crude ex-Perevoznaya, a Pacific coast port, may provide a good marker, like that Sakhalin-2 crude sales has been put on truck since they started to apply a new pricing system to align with Japanese oil product market price. To make it more stable, it is desirable to promote international product trade in the region that would provide international price index. To this end, Northeast Asia should cooperate to create a proper and matured Asian oil and gas market, hopefully similar to that in Europe.

In the efforts of creating matured petroleum market, it is necessary to make the downstream sector more flexible. These may require alignment of product quality standard, reinforcement of physical capability through expansion and upgrading of refining and storage capacity. Upgrading of product quality should be promoted also for more effective and environment friendly use. To this end, utilization of spare capacities of refining and upgrading facilities in Japan and Korea should be promoted. Then, rationalization of regional and domestic transportation and trade system will be another important factor to create a matured international market and enhance regional energy security.

Energy Sustainability

Sustainability is the most important factor to assure development of the region. To this end, Northeast Asia needs to strengthen energy supply base and rationalize energy use. These measures take long lead-time from planning to operation. However, no material dialogue has started in the region. To assure energy sustainability, there are two aspects we should consider.

One is to reinforce supply of every energy source. Introduction of Russian resources to Northeast Asia will be one powerful option, which may be realized by constructing oil and gas trunk pipeline and promoting upstream exploration and development. E&P should be promoted in other area of the region either, which may require settling territorial disputes. To introduce natural gas and power, construction and modernization of delivery network is necessary to create a matured petroleum market.

Another important aspect is energy conservation and rational use. For this purpose, technology transfer, especially clean coal technology, and CDM/ETS should play important role. Rational market design including tariff system of city gas and electricity is also important. To promote these, joint development of technology as well as socio-economic system should be given appropriate policy consideration.

Nuclear power may be another subject the region needs to consider, not only as the measure to enhance energy base but also in view of concerns on environment as well as political intricacy.

4 Potential Energy Projects

Potential energy projects in the northeast Asia are shown in Figure 15. Potential of coal, oil, gas and hydropower in the eastern Russia is ample, but transporting them to the market requires gigantic energy projects. Among them, Siberian oil pipeline may be the most feasible project as explained later. But, one important note is that, developing oil resources, we should think about disposal of associated natural gas also. We cannot pick up ripen fruits only.

Figure 15. Potential Energy Projects in Northeast Asia

	Upstream	Transportation	Market
Coal	Rich resource Abundant low quality coal	Railway and shipping port congestion	Japan & Korea : Available China : Heavy use 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 a huge project and costly	Japan & Korea : Maturing China : Yet to develop
Hydro Power	Rich potential	Transmission is very costly	Japan & Korea : Matured China : Main market is remote

Figure 16 shows potential energy supply routes from Russia to northeast Asian markets. Oil and gas provinces are west and east Siberia and Sakhalin. Coal is also endowed in east Siberia. Mountainous area along the Amur River provides rich potential of hydropower. But these sources are remote from markets and need to cross international borders. North Korea is located right on the position geopolitically important for South Korea and Japan. Issues on international transit must be coordinated before transmission route can pass through this area.

Siberian Oil Pipeline

On December 31, 2004, the Russian government announced its official decision to construct the Pacific Oil Pipeline from Taishet to Perevoznaya Bay, located along the Pacific coast west of Vladivostok. The total length of the oil pipeline will be 4188km with 11 pumping stations and the initial capacity will be 1.6 million barrels per day. At the Pacific coast terminal, 4.3 million kilo-litter oil storage and shipping facility will be constructed with one SBM to accommodate 300, 000dwt tanker and two SBMs for 150,000 tonners. Ten regional governments of east Russia have already shown their agreement to the construction. Coordination on EIA issues are going on and Ministry of Energy and Industry is waiting

for the final instruction of the Russian government to implement the plan submitted in spring of 2005.

The pipeline will be constructed in two phases. Phase-1 from Taishet to Skovorodino will complete by 2008 and, from there, oil will be tentatively rail transported to the shipping terminal. The shipping terminal at Perevoznaya will also be constructed in Phase-1. Order of additional locomotives for rail transport has been made. China plans to construct a branch line from Skovorodino to Daqing, which carries oil finally to Dalian. Phase-2 will be completed at earliest around 2010.

Figure 16. Potential Energy Flow from Eastern Russia

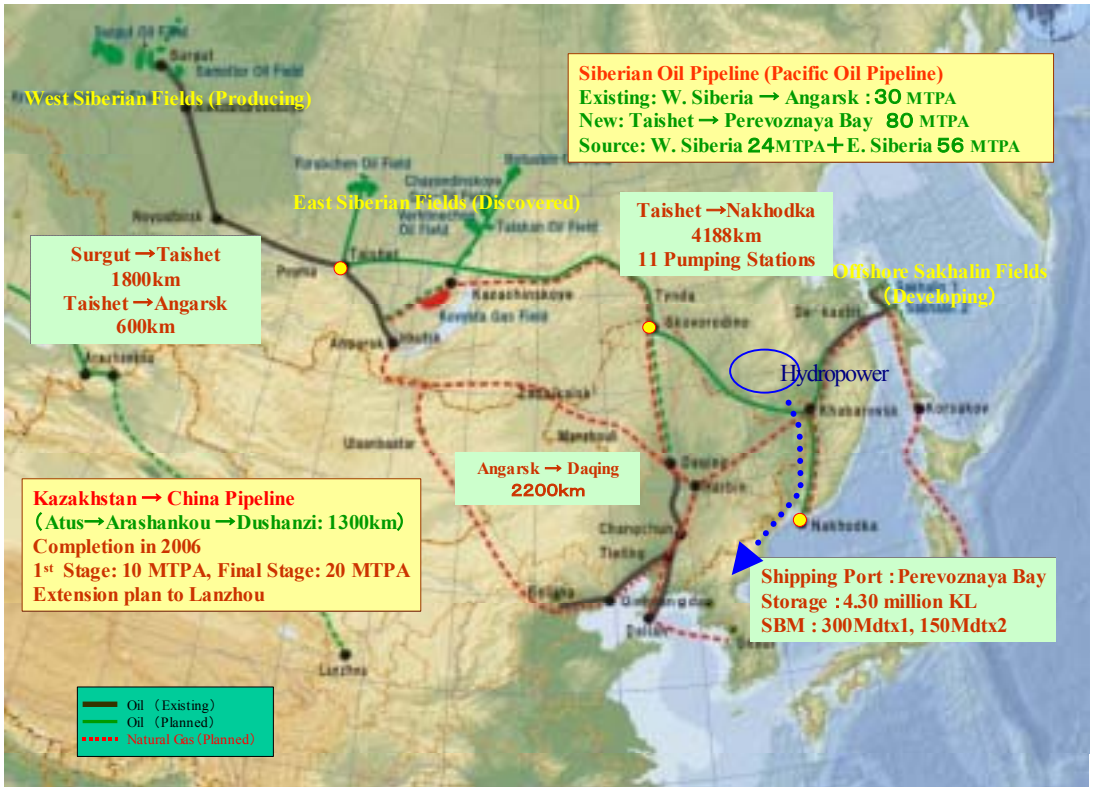


Figure 17. Siberian Oil Pipeline Plan

Destination (To Taishet	Distance 1800km from West Siberia)	Annual Capacity	Construction Cost
Perevoznaya (→Export)	From Taishet 4188km	Export: 50 MTPA Local: 10 MTPA	$ 10-14 billion
China (Daqing further to Dalian)	From Skovorodino 900km (Dalian + 1000km)	20-30 MTPA	$ 1-2 billion

In the recent reports from Russia, the total investment will be in the range of 11 to 14 billion US Dollars. When the first guestimation was given by Transneft in 2002, it was 6.5 billion dollars including a branch line to China. This budget has been doubled since then, maybe due to technical and environmental requirements to cope with permafrost, worldwide inflation in oil material prices and service fees, and so on. The earlier number was comparable to the amount of the investment made in China's West to East

gas pipeline expanding for 4000km.

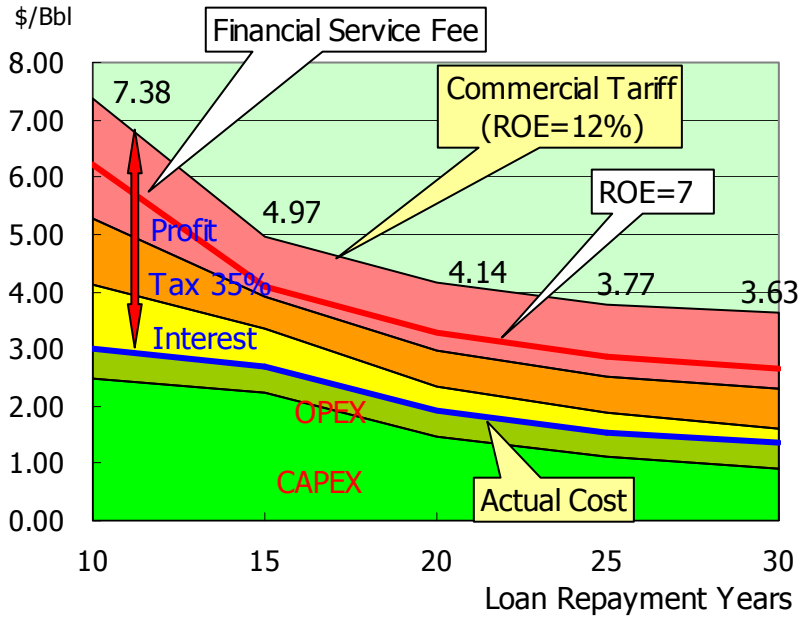
Current anxiety of Japan is that the phase-1 plan seems to serve only China. Only 24 million tons of west Siberian oil is allocated. And, some Russian sources say that the phase-2 construction would be started only when development of east Siberian fields are confirmed. Rail transport is costly and troublesome for world-class oil trade. Japanese government negotiating on institutional loans desires simultaneous construction of the whole pipeline to the Pacific coast.

Economics of Pipeline

In considering pipeline projects, there are several important points we should consider. Let us look into pipeline economics using a simplified model. Pipeline is a very capital intensive project with a prolonged repayment period. As shown in the chart, we observe that:

a. Project economics heavily depends on loan repayment period.
b. Commercial project requires financial service fee of 1.5 to 3 times of the technical cost, namely CAPEX plus OPEX. And,
c. Price risk barrier for commerciality is 2.5 to 4 times of the actual cost.

Figure 18. Economics of Pipeline



These are quite common figures for contemporary commercial projects, but we should note that there is a big room for treating the project economics. This indicates that, what we should study at an early stage on pipeline economics is not to upgrade the cost estimation but to consider appropriate financial structure.

According to Russian information, Transneft has proposed an estimated pipeline tariff of $6.7/Bbl, which is slightly higher than the BTC pipeline. This falls in the range of 10 to 15 year repayment period, which is reasonable assuming the currently available institutional finance. However, this chart suggests that there are many measures to lower the project threshold such as provision of long-term credit, tax

exemption or subsidy. *One important note is that various social benefit expected from such pipeline project could not be incorporated into investment economics of the private sector. Considering this, there is a due reason that government should consider certain assistance.*

Using the same model, the commercial pipeline tariff is below $5/Bbl for oil and around $2/MMBtu for natural gas as summarized in Figure 19. These are more than double of conventional ocean transportation, but the technical cost is only a half of them. Imported price may be in the range of $50/Bbl for crude oil and $6/MMBtu for natural gas. Then, commercial pipeline tariff is only 10% of the final price for oil, but 30 to 40% for natural gas.

Figure 19. Oil Pipeline and Gas Pipeline

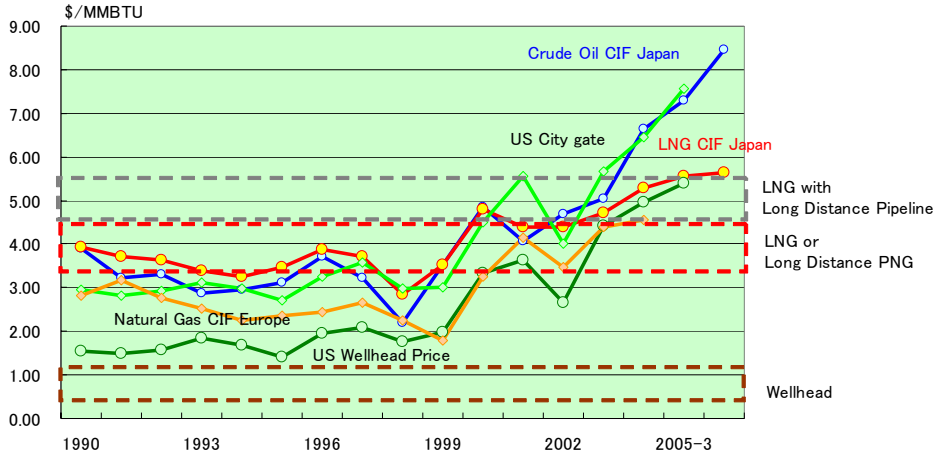
Project Period	Pipeline Tariff ROE=12% (A)	Actual Cost (B)	Market Price (C)	B/A	A/C	B/C
Oil (1.6MMBD)	$/Bbl	$/Bbl	$/Bbl	%	%	%
15 years	4.97	2.70	CIF 50.0	54	10	5
25 years	3.77	1.55		41	8	3
Natural Gas (30 Bcm/y)	$/MMBTU	$/MMBTU	$/MMBTU	%	%	%
15 years	2.37	1.20	At City Gate 6.00	51	40	20
25 years	1.79	0.69		39	30	12

Watching the market, international natural gas price soaring rapidly in recent years seems to have liberated remote stranded gas from cost constraints. Gas prices that would comfortably justify a gigantic project may be as follows.

1) Wellhead gas price may be in the range of 0.5 to 1.5 dollars per million BTU pending size, location and other characteristics of the gas fields. Smaller gas fields of Southeast Asia are on the higher side.
2) Delivered gas price for LNG projects and long distance pipeline such as one for interior Siberian gas may be in the range of 3.5 – 4.5 dollars, and
3) If the remote gas delivered to the shore side needs to be liquefied for further shipping, it may be in the range of 4.5 – 5.5 dollars.

Recent LNG price has surpassed all of these thresholds. Here, we should note that the crude oil price of nearly 70 dollars per barrel prevailing in the market is equal to 12 dollars per million BTU in heat value equivalent. The LNG price delivered to Asia is still much lower than this. If the gas price trend continues further toward the American marker, we can say that most of remote stranded gases have been liberated from cost constraints now.

Figure 20 Remote Gas Liberated from Cost Constraints



Source: Japan Trade Table (Ministry of Finance), Monthly Energy Review (EIA), BP Statistical review of the World 2005

However, when we talk about remote interior gas, there will be another discussion on the competition of piped natural gas (PNG) against sea borne LNG. To implement a grand size project, big amount of demand and supply have to be aligned comfortably to assure project credibility. In the early stage of market development, pipeline can pick up only markets along its route, while LNG can collect any market within a certain shipping distance. Thus, since the global gas price has soared to a level where shipping cost does not matter, LNG has become a global commodity. In addition, a pipeline project needs to resolve transit issues with provinces and nations it trespasses. Many of international pipeline projects are trapped with this problem. Over all, LNG is nimble in market development compared to PNG. We have seen a typical example of this in project development of Sakhalin-1 and Sakhalin-2. At any rate, the remote interior gas from Siberia has to be delivered by pipeline to the market, or to the sea shore for further shipment by PNG or LNG.

On the other hand, it is true that LNG needs liquefaction process, which is not cheap. Our society has to pay for it in any way. Compared with sea borne LNG, PNG can promote development of the region along its route. Once a certain pipeline network has been developed, like in the US and Europe, pipeline may be substantially more beneficial for the society. Sea borne LNG can be sold to any market in the world which offers higher price, for example, the US market, but PNG can be delivered to the markets connected by the pipeline system only. PNG supply is much stable for the region. In this sense, the role of PNG as fundamental supply source should be valued as commoditization of LNG develops in the world. The cost and benefit of PNG and LNG must be assessed carefully when we discuss regional energy system development.

As observed above, there are various hurdles need to be overcome in implementing pipeline projects. Reviewing major factors on feasibility of long distance pipelines, we find that there is a distinct difference in magnitude of barriers between oil and gas.

Major factors to influence feasibility of an *Oil Pipeline* may be analyzed as follows:

a. Commercial pipeline tariff is about 10% of the market price,
b. Commercial pipeline tariff is substantially lower than rail transport that is over $10/Bbl,

c. Crude oil contract term is shorter and flexible, and Northeast Asia provides an international market of sufficiently good size for trade, however,
d. The long distance pipeline is too large in size for private sector

Major factors to influence feasibility of a *Gas Pipeline* may be analyzed as follows:

a. Commercial pipeline tariff amounts to 30 – 40% of the gas price at city gate of market,
b. Existing natural gas market is tightly guarded by long term LNG contracts, though some contracts are coming nearer to expiration/extension,
c. Piped natural gas is inferior to LNG in market development, as the former needs to fix sufficient customers expected only along the line while the latter can collect customers from a wider range within a circle of certain transportation distance.
d. The long distance pipeline is too large in size for private sector

As observed above, in the case of oil, only the gigantic project size is the real problem. In our society, however, institutional finance is already available as an instrument to help this. Russia and Japan are in negotiation on conditions to provide such fund for construction of the Siberian oil pipeline. In the case of natural gas, on the other hand, issues listed here are all substantial but not easy to solve. It may take some more time to find the proper path to develop it.

5. Conclusion and Recommendation

In conclusion, we observe that, while Northeast Asia is already a world-class energy market and growing fast, the region is exposed to vulnerability to short-term disturbance as well as threatening to sustainable development of the region. Despite the size of issues, we lack combined policy as a region against supply disruption and counter measures to speculative price fluctuation. More importantly in preparing long-term measures, we are located far from energy supply sources. China's energy demand is strong, but energy efficiency is weak.

Global actions are already being taken to strengthen energy security reinforcing preparedness against emergency. But, in Northeast Asia, no dialogue has started on issues and projects specific to the region. To improve the situation, major agenda will be:

a. Joint response program on supply disruption
b. Creation of region-wide energy market
c. Investment in energy resource, transportation and market, and expansion/upgrading of energy processing facilities, and
d. Technology transfer and joint technology development including socio-economic systems

The world-class market needs world-class policy. For example, developing and mobilizing Russian resources will require gigantic projects. This in turn requires proper regulatory framework and suitable support promoting cross border investment, trade and technology cooperation. To implement these, concerted efforts of the region are essential with government-level initiative.

All in all, we need regional cooperation, such as Northeast Asia Energy Partnership, to coordinate on projects of gigantic size and international intricacy of energy issues and realize stable and sustainable development. Then, the driver for such action should be shifted from aid to collaboration and the principle there should be equitable contribution for equitable benefit.

To facilitate regional dialogue, we need to create implementing bodies at government level as well as among private players. As the first approach, non-binding dialogue may be called on to identify priority agenda. Joint study on regional energy outlook, not just exchange of individual views, may be the first collaborative job. This looks like a detour, but necessary to give basis and authority to the job to follow.

Next step is, once some road map is given through the dialogue and joint work, to create an organization for regional partnership. Agreements there should be legally binding, if softly, to assure enforcement by each country.

This process may take time, but may be upgraded gradually, step by step confirming that all members recognize the need of such actions. Then, human wisdom will find the desirable path to assure sustainable development of the region, someday not very remote.

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