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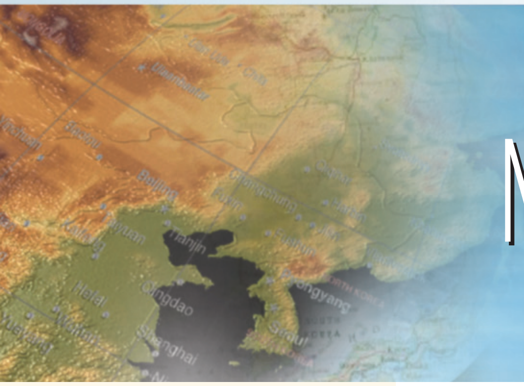

Northeast Asia Energy Focus

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CERNA
Center for Energy Research, Northeast Asia
KEEI

Editor's Message

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Preparing for the first issue of *Northeast Asia Energy Focus* in 2006, we came to look back at what we had observed and achieved in 2005 and get wish for 2006.

International oil price still maintains to stay at a high level of around US$60.00 per barrel, and the geopolitics surrounding the Middle East remains in a fog of uncertainty. Political climate in Northeast Asia looks under a grey cloud.

Progress of the six-party talks to tackle nuclear weapon issue in DPRK, although the second phase of the talks held in Beijing on September 19 adopted a 6-point joint statement on the goals of the denuclearization of the Korean Peninsula, still appears to be stagnant. It is very obvious that the tangled North Korean nuclear issue is a serious deterrent to energy cooperation in Northeast Asia. Good bilateral relations are a necessary condition for good multilateral relations in the region, while good multilateral relations may serve as a sufficient condition for good bilateral relations. In this respect, improved cooperative relationships between two Koreas are very important in promoting the overall energy cooperation in Northeast Asia. In 2006, we wish for a peaceful solution to the North Korean issue so that it may provide significant momentum to energy cooperation among the countries in Northeast Asia.

Yet, there are no positive evidences implying for improvement of Sino-Japanese relationship on account of the 'history issues.' These issues are still perceived as the primary factor that worsens the current political and diplomatic relationships between Japan and China / Korea.

Russia still looks pretty inactive in promoting energy cooperation with the countries in Northeast Asia. This slow pace is contradictory to the scheme which was announced by itself in a process for the development of energy resources in the Russian Far East. The detailed scheme of the UGSS (United Gas Supply System) plan has not yet been announced nor decided. Having large uncertainties in its investment climate, Russia need to assure that the country will be an attractive place to make an investment particularly in development of energy resources in its eastern territory.

In 2006, Russia is due to host the G-8 summit, and reportedly energy security issue will be a highlight of agenda for the summit meeting. Northeast Asia, where are located three giant energy-importing countries, namely Japan, China and Korea, will face more pressure for energy security in the face of increased competition for securing energy resources among major energy-consuming countries

Natural energy resources in Russia, particularly in East Siberia and the Russian Far East, can play an important role in improving energy security capability for the countries in the region. However, a window of opportunity for Russia to cooperate with Northeast Asian countries may become narrower unless the country shows clear direction for the energy development in the region.

It is our sincere hope that political environments in Northeast Asia may move toward more friendly regional energy markets in 2006, so that this year will be able to be marked as a significant momentum in the energy diplomacy and history in Northeast Asia.▣

News Update

Inside the KEEI

Signing the MOU between KEEI and Energy Research and Development Center (ER&DC) in Mongolia

In the recognition of mutual interests in promoting cooperation in areas of energy policy and planning research, the Korean and Mongolian governments agreed to establish a formal framework to facilitate energy research cooperation between Korea and Mongolia. Accordingly, the KEEI in Korea and the Energy Research and Development Center (ER&DC) in Mongolia signed the Memorandum of Understanding (MOU) in order to promote energy policy and planning research cooperation between Korea and Mongolia.
Singing ceremony for the MOU was jointly hosted by Dr. Ki-Yual Bang, President of the KEEI and Mr. Ts. Altangadas, Director General of the ER&DC on December 06, 2005 at the occasion of the fifth Meeting of the Korea-Mongolia Committee for Energy and Mineral Resources Cooperation which was held at the Ministry of Commerce, Industry and Energy, Gwacheon, Korea.
Under the MOU, the KEEI and the ER&DC will undertake mutual research cooperation through academic information exchanges and joint research activities on energy issues of the two countries in their common interest. Both organizations also agreed to enhance bilateral research cooperation in the context of multilateral research cooperation among the relevant research organizations in the countries in Northeast Asia.

2006 Working Group on Energy Cooperation in NEA

In February 6-7, 2006, Working Group on Energy Cooperation in Northeast Asia was held in Honolulu, Hawaii. The Meeting was organized by The Northeast Asia Economic Forum(NEAEF) in cooperation with Korea Energy Economics Institute.
The main topics are 'Energy Cooperation in Northeast Asia: Achievement, Trends and Prospects in Oil and Gas Cooperation.', 'Energy Conservation & Efficiency: Know-How and Technology Transfer Challenges', 'Institutional Arrangements', and 'Geopolitics and Energy Cooperation in Northeast Asia'.
Beginning with presentation about Russian oil and gas industry, the Meeting explored the prospects of the energy cooperation between

producers and consumers in Northeast Asia. Also the economic impact of more prevalent energy conservation technology in Northeast Asia was discussed for sustainable development. To realize those benefits, the necessity and role of institutional establishment were explained in detail. Intergovernmental Collaborative Mechanism currently promoted by Korean government was suggested as a reliable example. In the final session, the comprehensive geopolitics perspectives were provided as supplementary tools for the successful implementation of energy project.

Dr. Ki-Yual Bang, President, KEEI, made the keynote speech and Dr. Euy Seok Yang joined in as a commentator & modulator, and Dr. Yongduk Pak and Dr. Kyung-Sool Kim ascommentators.

13th Korea-Japan Energy Senior Officials Meeting

On January 24, 2006, the 13th Korea-Japan Energy Senior Officials Meeting was held in Tokyo, Japan. The intensive discussion of oil and gas market prospects reminded both countries of the importance of cooperative strategies on LNG market. The realized benefits from the liberalization of Japanese electricity market was explained and both countries agreed on the advantage of decentralized decision making process in electricity industry. Building a favorable environment for the public approval to the nuclear power related issues is also seriously discussed based on the recent Korean experiences. Compared to the approving atmosphere for above issues, the promotion of Intergovernmental Collaborative Mechanism for Northeast Asia Energy Cooperation was faced with the Japanese strong reluctance as before.

Finally, both Korea and Japan strongly recognized the beneficial interdependence and made a consensus to hold the next Energy Seniors Officials Meeting as soon as possible in Korea.

The Fifth Meeting of the Korea-Mongolia Committee for Energy and Mineral Resources Cooperation

In accordance with the Protocol between the Ministry of Commerce, Industry and Energy (MOCIE) of Korea and the Ministry of Industry and Trade (MIT) of Mongolia, the fifth meeting of the Korea-Mongolia Committee for Energy and Mineral Resources Cooperation was held in Gwacheon City, Korea on December 6 – 7, 2005. The delegation of Korea was headed by Dr. Oh, Young-Ho, Deputy Minister for Energy and Resource Policy of the MOCIE, and the delegation of Mongolia was headed by Mr. Enkhtuvshin Tsagaandari, Vice Minister of the MIT.

Dr. Dal-Seok Lee, senior fellow of the CERNA, made a presentation on the trends and prospects for the demand for energy in Korea and policy directions / measures.

Second Progress Meeting of 2005 Research Projects by the CERNA

The Center for Energy Research, Northeast Asia (CERNA) held the second progress meeting for 13 research projects as 2005 Northeast Asia Energy Research of the CERNA, KEEI on December 27, 2005 at KEEI conference room. Those projects are scheduled to be finalized at the end of April, 2006.

The 13 research projects are as follows:

- USA Energy Development Strategy in Eastern Russia and Energy Cooperation in Northeast Asia
- Analysis of Northeast Asia Energy Market
- A Study on the Comparison of Energy Resources Statistic Systems in Northeast Countries
- Establishment of Institutionalized Framework for Energy System Integration in the Korean Peninsular: The Petroleum Sector
- A Study on the Action Plan for the Strengthening of DPR Korean Non- Physical Capacity in Energy Sector

- Study on Institutional Arrangement for FTA in Northeast Asia: Energy FTA among Korea, China, and Japan
- On the Model Analyzing Economic Impact of Northeast Asia FTA in Energy Sector
- The Impact of Chinese Oil Market Opening on the Oil Product Trade in Northeast Asia
- A Strategy for Exploring Energy Resources in the Sakhalin: 2nd Phase
- The Russian oil market expansion in Northeast Asia and import & utilization strategies of NEA countries
- Economic benefit analysis for energy efficiency improvement of Korea, Japan and China
- Importation Plans of Natural Gas from East Siberia and Far East Russia under UGSS
- Economic Benefit Analysis of Northeast Asian Strategic Petroleum Reserve Cooperation

Brainstorming Workshop for the Development / Designing of the CERNA Research Projects / Activities for 2006

Research fellows of the CERNA / KEEI had a brainstorming workshop at Young-In on December 20 – 21 with an objective to develop a research plan for 2006. Reviewing performance of the CERNA during the period of 2004 – 2005, the participants actively exchanged their views on directions for new research agendas and activities of the CERNA for years ahead and identified the area for further improvement of the management. Outcomes of the workshop are directly to be reflected in designing the CERNA's research agenda / activities for 2006.

Participation in Regional Energy Expert Workshop on 'the Coexistence of Energy consuming Countries in North East Asia'

Dr. Ji-Chul Ryu, Executive Director of the CERNA participated in the 3rd Meeting for Scenario Planning Group for 'the Coexistence of Energy consuming Countries in North East Asia' which was held on January 25, 2006 in Beijing, China. The meeting was jointly organized by the China Institute of International Studies (CIIS) and the Institute of Energy Economics, Japan (IEEJ), following the 2nd meeting held in Euiwang, Korea on November 07, 2005, The objective of this meeting was to develop various strategies scenario for promoting regional energy cooperation in Northeast Asia.

Participation in 'East Asia Logistics & Energy Forum 2005'

Dr. Euy Seok Yang, research fellow of CERNA participated in 「East Asia Logistics & Energy Forum 2005」, organized by The Asia Economy Daily (AKN), 19 December, Business Leaders Club of the FKI Building. This forum was organized for discussing the future of logistics and energy market in Asia and giving advice on how to design strategies for the government officials, business leaders and related institutions. Dr. Euy Seok Yang presented the paper entitled 「New Dimension of Korea-Russia Energy Cooperation and Challenge of Joint Energy Projects」.

Others in the CERNA

▶ Dr. Euy Seok Yang, research fellow of CERNA published the interim report of the Baseline Study and Capacity Building for Energy Cooperation in Northeast Asia(UNDP / TRADP Research Project: RAS / 01 / 430-Tumen River Area Development Program). This study is being carried out in order to review the current status and perspectives of energy infrastructure in the Great Tumen region. The interim report presents the national energy supply and demand data by surveying and compiling physical energy capacities by energy sources in a consistent manner.

▶ Dr. Sung Kyu Lee of CERNA participated in the regular academic seminar "Siberia: Yesterday, Today, and Tomorrow", which was organized by the Korean-Siberian Society on November 26 in Seoul. Dr. Lee made a presentation with a theme on “The Changes of Russia-China Relation in Energy Sector”.

- Dr. Sung Kyu Lee of CERNA participated in the Council for inroads of Korean companies and organizations into the Central Asian region (including Azerbaijan), organized by the Office for Government Policy Coordination. Dr. Lee made presentations with a theme on “Supply and Transportation Potential of Oil and Natural Gas Reserves in Central Asian region” on January 9, and “Current Situation and Strategy of U.S. Oil Company in Central Asian region” on January 25. This Council is consisted of several government organizations (MOFAT, MIC, MOCT, MCT, MOCIE) and private organizations (KEEI, KIEP, KOICA, OKF, ICAK, IFANS, KNOC, KOGAS, KORES, etc.)

- Dr. Ji-Chul Ryu, Executive Director of the CERNA made a presentation on ‘Major Issues in Energy Cooperation in Northeast Asia’ at a monthly seminar of the Northeast Energy Forum, Korea, held on December 12, 2005 at the Korea Coal Industry Association.

- The CERNA invites an international visiting scholar, Mr. Xue Xinmin, from China for 6 months from the end of February, 2006. He is, currently, a senior researcher at Research Center for Energy Economics and Development Strategy, Energy Research Institute, NDRC, the People’s Republic of China and a vice-chairman of the Special Committee on Nuclear Energy Economics. He is expected to participate in various activities and collaborate research projects with CERNA to promotes energy cooperation in Northeast Asia. ▣

Briefs in NEA

Six parties expected to lock horns over details

The New Year is beginning in a grave and serious atmosphere for member nations of the six party talks on the North Korean nuclear issue. Pyongyang is sticking to its firm denial of allegations from the United States about illegal activities, and continues to ignore rising international calls for its human rights record to be addressed.

The United States and North Korea, meanwhile, hurl invective at each other, further darkening the prospects of an early resumption of negotiations.

With behind-the-scenes contacts actively attempting to narrow the differences between Washington and Pyongyang – the two most hostile negotiating partners – South Korea remains calm, emphasizing its belief that the six party framework will be maintained no matter what.

The South Korean government believes that despite the latest obstacles, a key development was achieved with the Joint Agreement of principles on Sept. 19, when North Korea made a multilateral pledge to dismantle all nuclear programs in return for economic aid, the normalization of diplomatic ties and security guarantees.

In 2006 the six members including the two

Koreas, the United States, China, Japan and Russia are likely to continue locking horns over the details of their negotiations on implementation but will not be abandoning the fundamental principles already agreed, experts say.

Russia-OPEC Meeting

Russian Foreign Minister Sergei Lavrov (R) shakes hands with the OPEC President Sheikh Ahmad Fahad Al-Ahmad Al-Sabah (L) during their meeting in Moscow, Monday 26 December 2005. Moscow believes that

cooperation with OPEC will promote the achievement of balanced agreements which will take into account the interests of both producers and consumers of energy said Sergei Lavrov.

Korea, Mongolia seek greater cooperation in energy, minerals

Korea and Mongolia agreed on December 5, 2005 to strengthen cooperation in the area of energy and mineral resources.

Deputy Minister for Energy and Resources Policy, Oh Young-ho, and Vice-minister for Industry and Trade of Mongolia, Ts. Enkhtuvshin, met in Korea's Gwacheon government complex to discuss ways to expand trade and step up joint development in the areas of energy and mineral resources.

With both countries currently cooperating in three mineral-related industries, which include gold and fluorite, they decided to invest in expanding refineries and embark on bigger business ventures.

The officials also agreed to create a joint network system to facilitate cooperative efforts in the energy industry. This resulted in the signing of a memorandum of understanding to build an energy research and development center in support of sharing information and conducting joint research.

As Korea is Mongolia's second-largest importer of fluorite after China, Mongolia agreed to diversify its fluorite products and improve infrastructure for more efficient distribution.

As of last year, Korea ranked as Mongolia`s fourth-largest trading partner and second largest investment partner.

Trade volume between the two economies reached $80 million in 2004, with exports to Mongolia totaling $75 million and imports $5 million. Korea's investments there amounted to $40 million.

Kazakhstan – Russia Meeting

Russian President Vladimir Putin (L) and Kazakh President Nursultan Nazarbayev (R) speak during their meeting at the Presidential Palace in Astana, Thursday, 12 January 2006. The two presidents discussed Russian-Kazakh cooperation, in particular, in energy, space, military-technical spheres.

The Oil consumption in Korea seen edging up in 2006

The oil consumption in Korea is projected to rise this year as economic growth accelerates, the government said on January 26.
The Ministry of Commerce, Industry and Energy expects petroleum consumption this year to continue its increase by 1.1 percent to total 769 million barrels from a year ago. The comparable figure for 2005 was a 1.2 percent increase totaling 761 million barrels compared to 2004.
Naphtha and airline fuel are expected to lead the demand, while consumption of gasoline, kerosene and diesel are forecast to drop because of high oil prices.
The government predicts that consumption for naphtha will rise 4.4 percent year-on-year on expectations of an improvement in the petrochemical industry. Airline fuel consumption is expected to expand 9.7 percent because of strong exports and an increase in demand for overseas travel and overseas study programs, the government said.
Exports, which account for about 40 percent of the economy, are expected to grow 11.7 percent this year after a 12.2 percent gain last year. Asia's fourth-largest economy is heading toward a broad recovery powered by robust exports and an improvement in private consumption, which was lethargic for more than two years in the aftermath of a credit binge.
The Commerce Ministry highlighted that liquefied petroleum gas will see a 0.4 percent increase this year, as more consumers shift to the more affordable butane gas amid globally changing energy consumption trends as well.
Demand for bunker C oil is forecast to climb 0.7 percent with ships expected to guzzle more fuel, it said.
With the ongoing high oil prices, consumption of gasoline will drop 1.5 percent, while use of kerosene will drop 15.9 percent. Diesel consumption is expected to fall 1.1 percent from a year ago due to a price increase, the government said.
Despite all the threats of high-flying oil prices, the Finance Ministry expects the economy to expand 5 percent this year, compared to last year's 4 percent gain, based on resilient exports and improving domestic demand.

The refining capacity in China is expected to grow only 2.5 percent in 2006

Chinese industries and consumers increase their energy consumption but no major downstream facilities expected to be completed this year.
The Energy Information Administration, the U.S. government's energy statistician, also predicts the world's daily oil demand will increase by 1.94 million barrels in 2006, compared to 1.2 million barrels last year.
In 2005, the Chinese government began to put the brakes on skyrocketing crude consumption, and drivers in major oil importing nations tightened their purse strings at gas pumps.
When oil supply crunches across southern China last summer threatened industries and caused widespread public anxiety, Beijing implemented price caps and energy-saving policies.
But experts anticipate the Chinese government will loosen the constraints this year under mounting pressure from consumers and industries.
Since world's second largest crude consumer still doesn't have enough refining capacity for its own use, they said a softening of Beijing's position will drive up energy demands across the Asia-Pacific region.
"The refining capacity in the region is expected to grow 2.5 percent in 2006, well below the anticipated 3.4 percent growth in the region's oil demand," said an analyst at Meritz Securties Co. "Since it takes a long time, more than three years, to establish a new facility, the industry cannot easily boost its capacity to meet the needs of the growing market," he added. ▣

Issue & Focus

The Latest Development of China Power Industry and Environmental Protection

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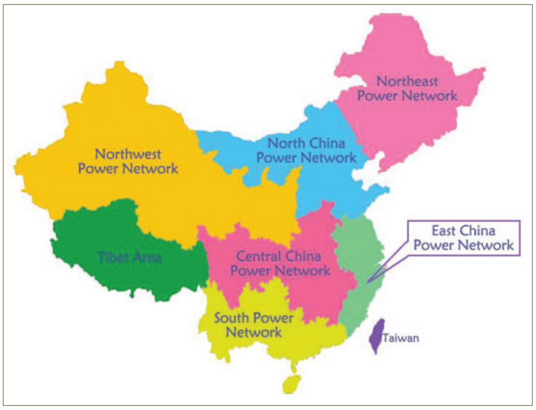
Abstract: Based on the introduction of the power grids in China, the current electric power situation has been expatiated as well as the prospects in 2010 and 2020. In the meantime, the energy distribution in China has been given so to attain the comparison with the average level in the world including coal, nuclear, oil & gas and the other clean energies. Coal proportion in all the energies is much higher than the average level, and the clean energy should be developed fast in China. Combined the power situation with the energy situation, the power industry environmental protection situation in China has been described as well as the power industry environmental protection aims in 2020. On the precondition of all the analysis, the investment and the power market in China for foreigner have been drawn.

The Current Status of China's Power Grids

China's power industry has entered into the era of large power networks, and power transmission technologies have also upgraded greatly with the recent rapid development and construction of these power networks. At present, there are 6 inter-provincial power grids (East China, Northeast, Central China, North China, Northwest and South China— which covers Yunnan, Guizhou, Guangxi, Hainan and Guangdong) and 1 independent provincial power networks (Xizang (Tibet)) operating in mainland China. Large power grids now serve all cities and most villages throughout China, as can be seen in Figure 1.

Figure 1. China's Power Grids



China's power generation and consumption rank both in second position all over the world. The total generating capacity in China was 440.7 GW (gigawatts) and the total electricity generated was 2,187,000 GWh (gigawatt-hours) in 2004. However power supply is still poor in China and power industry will develop faster in order to comply with requirement of economic development. China's electricity is mainly from coal-fired power plants. China's reliance on coal-fired power has caused serious environmental problems. Acid rain area in China is one of most serious acid rain areas in the world. Acid rain pollution causes damage over 110 billion Yuan RMB every year in China. How to realize sustainable and fast development for power industry is a critical question to be worth of deep study.

Energy Resource Distribution in China

On basis of the data of 2003, Coal resources account for 67.1% of all the energy resources in China, and coal resources account for 26.5% in the world. Comparatively, the coal proportion in China is 40.6% higher than the average level 26.5% in the world. Oil resources account for 22.7% in all the energy in China, and the corresponding proportion is about 37.3% in the world. The oil energy proportion in China is lower 14.6% than the level in the world. In the same way, the gas proportion in China, which is 2.8%, is 21.1% much lower than the average level in the world. And the other clean energy including hydro, nuclear and the others account for about 7.4% in China; relatively, the average value is 12.3% in the world (as shown in Table 1).

Table 1. Comparison of Energy Resource Distribution in China with the World

Area	Resource percentage (%)			
	Coal	Oil	Gas	Hydro and Others
China	67.1	22.7	2.8	7.4
World	26.5	37.3	23.9	12.3

Note: the data is based on 2003.

Chinese coal resources are mainly distributed in northern China. Coal resources in northern China account for 64% of all of China's coal resources. Shanxi province and the western part of Inner Mongolia have the richest coal resources in northern China. The second richest regions are the northwest and southwest areas, respectively, accounting for 12% and 10.7% of total coal resources. All the proportion of energy resources to the total amount is seen as Table 2. China's petroleum and natural gas resources are distributed mainly in the northeast and north parts of the country, which account, respectively

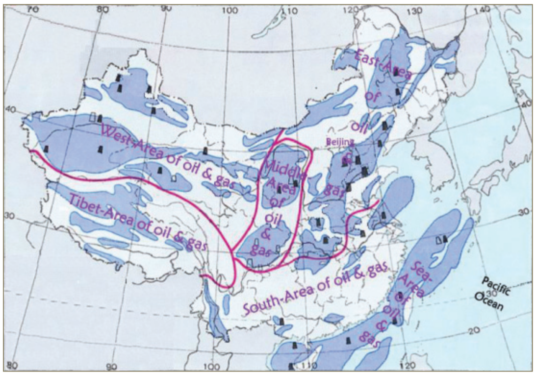
Table 2. Distribution of Energy Resources in China

Region	Fraction of energy resource (percent)			
	coal	hydro	Petroleum & natural gas	total
North	64.0	1.8	14.4	43.9
Northeast	3.1	1.8	48.3	3.8
East	6.5	4.4	18.2	6.0
South & central	3.7	9.5	2.5	5.6
Southwest	10.7	70.0	2.5	28.6
Northwest	12.0	12.5	14.1	12.1

Note: North includes Beijing, Tianjing, Hebei, Shanxi (N), Inner Mongolia.
Northeast includes Liaoning, Jilin, Heilongjiang.
East includes Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong.
South and Central includes Hebei, Hubei, Hunan, Guangdong, Guangxi, Hainan.
Southwest includes Chongqing, Sichuan, Guizhou, Yunnan, Tibet.
Northwest includes Shanxi (NW), Gansu, Qinghai, Ningxia, Xinjiang.

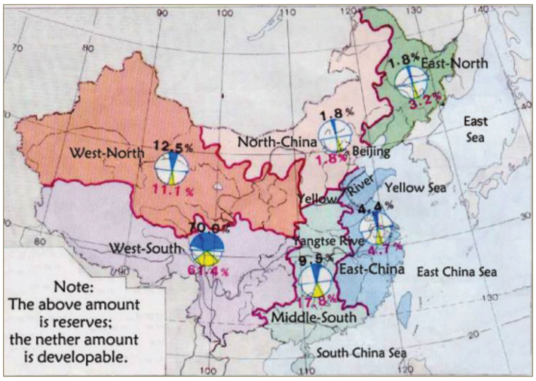
for 48.3% and 18.2% of the total. Petroleum and natural gas are cleaner energy for electricity generation than coal. Unfortunately, the availability of these resources is relatively poor in China, so it is impossible for China to use largely petroleum and natural gas for electricity generation. The distribution of petroleum and natural gas resources is seen as Figure 2.

Figure 2. Distribution of China's oil and gas resources



Hydro energy resources are distributed preliminarily in Southwest China, which accounts for 70% of all hydro energy resources. Hydro energy availability in the Northwest region is second in importance, comprising 12.5% of the national total. As a result, China's hydro energy resources are centralized in the western part of the country, which is too far away to transport power to dominant consumers in the eastern marine areas. The detailed distribution of hydroelectricity resources is seen as Figure 3 as well as the developable hydro.

Figure 3. Distribution of China's hydro resources



Current Status of China's Power Industry

The recent situation of China's power industry

By the end of 2005, the total generating capacity in China was 508.41 GW (gigawatts), of which hydroelectric capacity (totaling 116.52 GW) accounted for 22.9%, thermal power (384.13GW) accounted for 75.56%, and nuclear and other types of generation (at 7.76 GW or so) accounted for 1.5%. This division of capacity is shown in Table 3. The total electricity generated in 2004 was 2,474,700 GWh (gigawatt-hours), of which thermal power supplied 2,018,000 GWh, accounting for 81.5% of total generation (as shown in Table 3). Of thermal generation, 95% was from coal-fired power plants.

Table 3. Structure of generation capacity and electricity generation in China in 2004

Type	Capacity		Electricity	
	Value (GW)	Percentage	Percentage	Value (GWh)
Thermal	384.13	75.56%	81.5%	2,018,000
Hydro	116.52	22.9%	15.97%	395,200
Nuclear and others	7.76	2.0%	2.49%	61,500
Total	508.41	100%	100%	2,474,700

Compared with 2002 and 2003, the total generating capacity of 2004 has increased by 84.1GW and 56.7GW respectively, and the latter exceeds any levels in past years; accordingly, the electricity generation has increased by 532,800GW.h and 279,000GW.h. From the detailed structure of power industry of 2004, the coal power is still the emphasis despite that the proportion has decreased a little from 74.4% to 73.7%. The hydro power and nuclear power have developed and increased although they are slow. The detailed information is seen in Table 4.

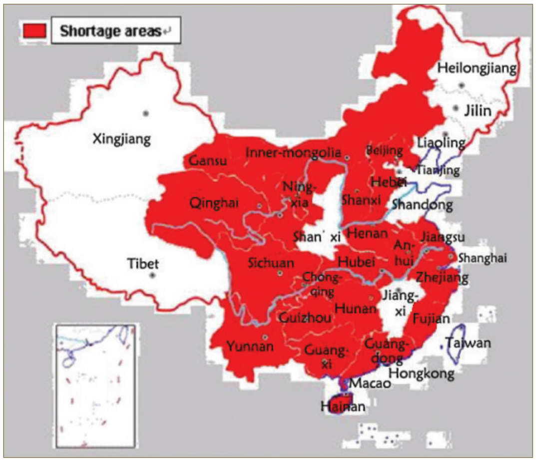
Table 4. Current Status of China's Power Industry in 2002, 2003 and 2004

Type	Year	Generating Capacity		Electricity Generation	
		GW	%	GWh	%
Thermal	2002	265.5	74.5	1,352,200	81.7
	2003	285.6	74.4	1,580,000	82.8
	2004	324.9	73.7	1,807,300	82.6
Hydro	2002	86.1	24.1	274,600	16.6
	2003	92.2	24.0	283,000	14.8
	2004	108.3	24.6	328,000	15.0
Nuclear and others	2002	4.5	1.3	26,500	1.6
	2003	6.2	1.6	43,700	2.4
	2004	7.5	1.7	51,700	2.4
Total	2002	356.6	100	1,654,200	100
	2003	384.0	100	1,908,000	100
	2004	440.7	100	2,187,000	100

Both of capacity and electricity increases are fastest in 2004. But there are 24 provinces with shortage of power supply in 2004, which is 19 provinces in 2003, especially in Zhejiang, Jiangsu and Fujian. The largest gap has reached 30GW in 2004, which is about up to

6.8% of the total generation capacity of the year. The power contradiction between supply and demand should be relaxed a little in 2005, and the gap should reach 25GW or so. The areas are concentrated on the seashore and the Middle-China. All these shortage areas are seen in Fig. 4.

Figure 4. Shortage Areas in 2004 in China



The current status of China's nuclear power

Up to now, 11 nuclear power units have been put into commission. All the total generation capacity has reached 6850MW, accounting for 1.35% in 2005. Significantly, in Zhejiang province and in Guangdong province, the ratio of nuclear power has been to 13%, which is equal to the modern level of world. 8 nuclear power units are being under construction. The total reaches 16000MW for 19 units. Mostly, the nuclear power stations are distributed in Guangdong Daya Bay, Zhejiang Qinshan and Jiangsu Tian Bay.

In the world, to June of 2004, the average proportion of NP is about 16.1% in world. 17 countries have exceeded 25% in the field of NP. The maxim proportion of nuclear power has reached 77.6%, which is France, and the others countries with high level are most between 20% and 30%. In China, the most advanced area concentrates on Zhejiang province and Guangdong province, whose proportion has reached 13%, and the average proportion in China in 2004 is very low, which is 1.6%.

Table 5. Current Status of China's Power Industry in 2002, 2003 and 2004

Proportion of NP from total generation capacity (%)							
France	German	Japan	Britain	U.S.A	Russia	China	Zhejiang, Guangdong
77.6	28.1	25.0	23.7	20.0	16.5	1.6	13.0

Note: the data is based on 2004.

The Prospects of China's Power in 2010 and 2020

The general prospects of power industry

Based on various predictions, GDP will increase to 21,500 billion RMB in 2010 from 8940 billion RMB in 2000 in China. Accordingly electricity generation will increase to 3,045,000GW.h from 1,368,000 in 2000; and generation capacity will increase to 700GW or so from 319GW in 2000. In the power structure of 2010, coal power will reach 468GW, accounting for 66.8%; hydro power 165GW, 23.5%; nuclear power 12.5GW, 1.8%; other clean power 37GW, 7.9%.

Similarly, GDP will increase by 200% to 35,000 billion RMB in 2020 from 8940 billion RMB in 2000 in China. Electricity generation will increase to 4,500,000 GWh from 1,368,000 in 2000. Generation capacity will increase to 950GW from 319GW in 2000. In the power structure of 2020, coal power will reach 605GW, accounting for 64%; hydro power 230GW, 24%; gas power 60GW, 6%; nuclear power 36GW, 4%; new energy power 20GW, 2%.

Based on Guide List of Foreign Enterprise Investment Industry (2004 revision), large gas turbine unit equipment and over 600MW nuclear power unit manufacture (limited for joint venture and co-operation) are encouraged by the Chinese government. So the prospects of nuclear power and gas power (LNG) projects are to be introduced as follows.

The prospects of nuclear power projects

In China, the nuclear power generation capacity shall reach 36GW to 40GW in 2020, and the increased ratio will up to 2000MW or so for each year before 2020. Guangdong Yangjiang nuclear power station and Zhejiang Sanmen nuclear power station have been approved to develop as another NP foundations. Hubei has selected nuclear power site; Hunan nuclear power construction plan has been approved; Chongqing has submitted the report; Sichuan is preparing. In addition in Shandong, Fujian, Liaonig and Jiangsu etc. provinces, the nuclear power station plans are being considered.

The prospects of LNG projects

The LNG projects are booming in China, and many foreigner investment groups have entered into the market such as Singapore, Russia and so on. The LNG projects involve mainly the receive stations, the transmission tubes, the LNG transportation, the LNG power stations and so on. All the large-scale LNG projects concentrate mainly on the seashore areas. And the LNG future must be bright. The detailed distribution of LNG projects plan is seen as Figure 5.

Figure 5. Distribution of China's LNG Projects Plan

Table 6. Detailed Information of LNG Projects

	Site	Schedule	Investment (million RMB)	The foreign cooperation partner
1	Shenzhen, Guangdong	Being constructed	7200	BP; Australia ALNG
2	Fujian	Being constructed	24000	Indonesia
3	Shanghai	Being constructed	4590	——
4	Ningbo, Zhejiang	Approved	14200	——
5	Hebei	To be approved	13600	Not decided
6	Hainan	To be approved	8378	Seeking
7	Wenzhou, Zhejiang	To be approved	4000—5000	Seeking
8	Liaoning	To be approved	5000	——
9	Jiangsu	To be approved	15000	Not decided
10	Guangdong	To be approved	15000	——
11	Jiangsu	Approved	15000	Singapore
12	Hebei	To be approved	10000	Not decided
13	Dalian, Liaoning	To be approved	6800	Not decided
14	Guangxi	To be approved	5200	——
15	Qingdao, Shandong	Approved	4500	Indonesia, Russia; Iran
16	Jiangsu	To be approved	5000	——
17	Tianjin	To be considered	——	——
18	Zhuhai, Guangdong	Being constructed	6000	Not decided
19	Henan	Finished	——	——
20	Xinjiang	Finished	——	——
21	Guangdong	To be approved	——	Iran
22	Jiangsu	Approved	6016	Singapore

And the detailed information including the project site, the plan schedule, the project investment and the foreign cooperation partner are seen in Table 6.

Environmental Impacts of China's Power Industry

Environmental impacts of power generation

Power demand all over the world currently relies preliminarily on fossil fuel combustion (thermal power), as well as hydro and nuclear. The amount of electricity generated from wind, solar, tidal and geothermal energy accounts for a very small percentage of the current total global generation. There is no doubt that large-scale power generation inevitably causes environmental impacts of varying levels of severity.

In Table 7 shows a subjective environmental ranking of various power-generation technologies. Power-generation from solar energy, wind energy, tidal energy and biomass is renewable and sustainable. The environmental impacts of these generation technologies are relatively light.

Table 7. Environmental Ranking of Various Power-Generation Technologies

Environmental rank (impact from least to most)	Remark
Solar energy	Renewable and sustainable
Wind energy	
Tidal energy	
Biomass	
Hydro	Renewable and potentially sustainable
Geothermal	
Natural gas	Non-renewable and unsustainable
Oil	
Coal	
Nuclear	

Hydroelectric generation is or should be renewable as it burns no fuel and is powered by solar energy via the hydrologic cycle. Prevention of sedimentation in hydroelectric is essential if generation capacity is to be maintained. Reservoir development in which the areas flooded contain considerable biomass (forests or peat, for example), however, can lead to significant greenhouse gas emissions (methane and carbon dioxide from decaying biomass).

The environmental impacts of geothermal power systems are generally easily managed (for example, through re-injection of condensates once heat has been extracted), so it makes sense to utilize this resource where it is available.

Utilization of all fossil fuels is unsustainable by definition. The combustion of fossil fuels, especially coal, can produce heavy environmental impacts. Coal combustion produces smoke dust (particulate matter), sulfur dioxide, NOX, and CO_2 emissions. In addition, some wastewater, as well as and fly ash and bottom ash, are also produced by coal-fired power plants. Generators can use advanced technologies and equipment to reduce dust, SO_2 and NO_x emissions from fossil fuel-fired power plants to minimum levels, but these technologies are generally are not widely used in China today. So far, however, power generation equipment cannot use coal without excessive CO_2 production. If coal technology improves such that CO_2 emissions can practically and economically be largely eliminated, or CO_2 from coal-fired generation can be collected and adequately disposed of, prospects for future development of coal-fired power would improve.

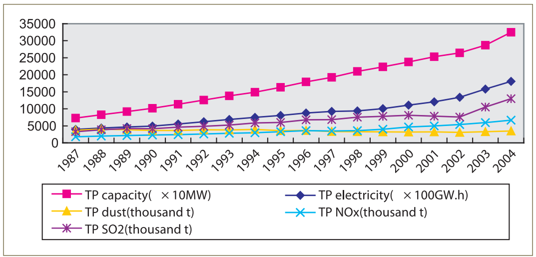
Nuclear power plants do not emit many air pollutants, but their operation results in the production of radioactive wastes, and pose safety problems. If the radioactive waste storage problem in China (or regionally) is solved, and if in addition "inherently" safe reactor designs are achieved, uranium mining impacts are reduced, nuclear weapons proliferation issues are fully addressed, and shipment of radioactive materials becomes safe, then prospects for future deployment of nuclear power generation would improve.

As mentioned above, about 80% electricity is from coal-fired power plants in China. So environmental impacts caused by thermal power generation in China is to be described in detail.

Environmental impacts caused by China's thermal power plants

The key environmental impacts caused by China's power industry are the results of air pollutant emissions from coal-fired power generation. Figure 6 shows the trends of national SO_2, NO_x and dust emissions from thermal power plant operation compared with the development of the power industry (electricity generation and capacity) and with total nationwide SO_2 emissions over the past two decades.

Figure 6. SO_2, NO_x and Dust Emitted from Thermal Power Plants (TP) in China

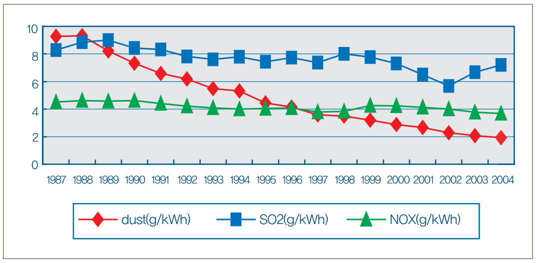


As shown in Figure 8, with the increase of thermal power electricity over the past twenty years, the emission of SO_2 and NO_x has increased gradually. At present, about 10 million tons of SO_2 emitted from coal-fired power plants each year, which accounts for about 50% of total industrial SO_2 emissions in China. The 3.5 million tons or so of dust emitted from coal-fired power plants each year amounts to about one-third of total industrial dust (particulate matter) emissions. In China about over 6 million tons per year of NO_x is emitted to the air from fossil-fueled power generation.

Principle environmental protection achievements for electric power industry

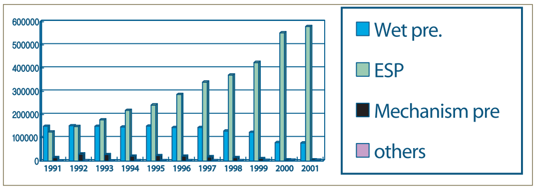
SO_2 Control Some measures have been adopted to control SO_2 emission from coal-fired power plants such as shutdown of small & old units, reduction of sulfur content in coal and installation of FGD. But with the operation of newly-constructed power plants, SO_2 emission has increased again from 2003, especially in 2004. But NO_x and dust emission per kilowatt hour electricity generation is decreased gradually. It is seen as in Figure 7.

Figure 7. Pollutant Emissions per Kilowatt Hour Electricity Generation



Dust Control Total dust emission amount from coal-fired power plants decreased gradually from 1997 to 2002, and increased in 2003, 2004, which is seen as in Figure 8. Dust emission per kilowatt hour electricity generation decreased obviously after 1988, which is seen in Figure 9. Adopted measures are installation electro statistic precipitator instead of wet precipitator and mechanism precipitator. In the past 10 years the ratio of boiler capacity with electro statistic precipitator increased yearly (Figure 8). It is up to 88% now. In recent years fabric filter has been used in large coal-fired power plants in China such as Fengtai Power-generating Ltd, Co. 2X200MW units in Inner Mongolia.

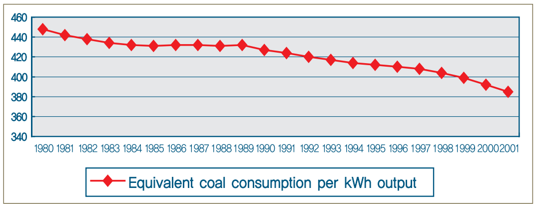
Figure 8. Distribution of Various Precipitator Types



NO_x Control To use De-NO_x combustion technologies to control NO_x emission from coal-fired power plants is from 80's of last century. Now main technologies to control NO_x emission are still De- NO_x combustion technologies. Only few power plants have been installed flue gas de-nitrogen instruments. Total NO_x emission amount from coal-fired power plants in China is still going up yearly. However emission level per kilowatt hour electricity is decreasing gradually.

Energy Saving Coal consumption per kilowatt hour electricity output reduced yearly. For example, it is 412g/kWh in 1995 and reduced to 392g/kWh in 2000 (as shown in Figure 9). The main measures are as follows. First of all, to retrofit existing units is to upgrade their efficiency. Secondly to construct large capacity, high parameter and low pollution units replace low efficiency and heavy pollution small units. Thirdly to shutdown some small and old thermal units has also contribution to energy saving.

Figure 9. Equivalent Coal Consumption per kWh Output in Past 20 Years



Prospect of environmental protection aims

The average of SO_2 emission level per kilowatt hour electricity will be 3 g/kWh or so in 2020 in China. It was 8 g/kWh for thermal power plants in 2000 in China. The averages in USA, British England, Germany and Japan in 1999 were 4.6, 5.4, 2.3 and 0.24 g/kWh respectively.

The average of NO_x emission level per kilowatt hour electricity is to be around 2.9 g/kWh in 2020 in China. It was 4.3 g/kWh for thermal power plants in 2000 in China. The averages in USA, British England, Germany and Japan in 1985 were 3.34, 3.45, 3.13 and 0.59 g/kWh respectively. And in 1999 they were down to 2.2, 2.9, 0.9, 0.29 g/kWh respectively.

The average of dust emission per kilowatt hour electricity will be only 0.7g/kWh. It is 50% much less that current level.

Investment Opportunities for Foreign Enterprises

According to the above analysis and prediction, linked with the average economic parameter, all the investment in power industry can be given, which is as the follows.

Power construction field: In the following 5 years, total investment 1000billion RMB just for the net capacity increase, and 2830billion RMB to 2020.

Power environmental protection field: At present, FGD is the main investment in power environmental protection industry. Up to 2004, the contract is 15billion RMB. The market will be 40billion or so.

Power environmental protection field: In the near future, flue gas de-nitrogenation will be the investment focus as well as technology development.

LNG projects field: About the LNG projects, much broader and brighter must exist, total potential opportunity at least 200billionRMB in the next 10 years. In meantime, the technology development is important.

Nuclear power field: To 2020, more 30 nuclear stations will be finished, total investment 400billionRMB.

Wind power field: To 2020, the aim will reach 20000MW, total investment 200billion RMB. Potential is huge.

Hydro power field: China policy supports hydro power development very much. World Bank makes sure that foreign capital has prepared well into China hydro market. The investment will reach 300billion RMB to 2020.

Solar energy field: In the following 5 years, the investment market about 10billion. American and Japan Company have entered into China market.

Conclusions

- With the fast economic development, China's electric power industry has achieved great progress since 1980's. Total power-generating capacity was up to 440.7 GW in 2004, of which thermal power 324.9 GW accounted for 74.5%. And 82.8% of total electricity was from thermal power plants in which 95% of capacity is coal-fired. However power supply is still poor.
- The energy resources (hydro and coal) centralized in West China and power consuming area in East China. LNG development is booming. Nuclear energy is developed fast.
- A lot of coal fired for electricity in China has produced serious environmental problems. SO_2 from coal-fired power plants has reached around 13 million tons in 2004. And NO_x has reached about 6 million tons.
- Electricity demand in China will continue to increase dramatically in the future due to the rapid pace of economic development in the country. By the year 2020, China's GDP is expected to increase by 200% over that of 2000 and is up to 35,000 billion RMB. Total generating capacity will reach about 960 GW and total electricity demand is estimated to 4,500 billion kWh or so in 2020. At that time most of electricity will come still from coal-fired power plants.
- In 2020 SO_2, NO_x and dust emission per kilowatt hour electricity are estimated respectively around 3, 2.9 and 0.7g / kWh.
- Investment market is vast in power industry including power construction, power environmental protection, LNG, nuclear power, wind power, hydro power, solar energy and other clear energies. ▣

Japanese Trunkline and its Impact on Northeast Asian Gas Trade

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Background—Japanese Gas Market

Kyoto Protocol came into force in February 2005, in which Japan was included in the so-called Annex 1 countries that have the duty of reduction of CO_2 emission towards the first commitment period of 2008-2012. Therefore massive fuel conversion from coal or oil to natural gas is strongly expected. Moreover Japanese METI also plans to promote the environmentally friendly and efficient use of natural gas not only for the attainment of the Kyoto Protocol target of CO_2 reduction but also for reducing too much dependence of energy on Middle East and its oil. Despite these policy goals, Japanese gas market has a lot of problems. Due to the lack of trunkline network, Japanese gas market is composed of lots of small and disconnected gas markets. Indigenous gas is quite few and the others are imported LNG. LNG import has been conducted by such regional monopoly businesses as electric companies and larger city gas companies. Unlike Korea Gas Corporation in Korea, Chinese Petroleum Corporation in Taiwan and China National Petroleum Corporation in China, there are no such nationwide import and wholesalers in Japan. Consequently there has been no substantial competition among city gas companies because of no interconnecting pipelines. The results are the extremely high price structure and regional big price gaps among them.

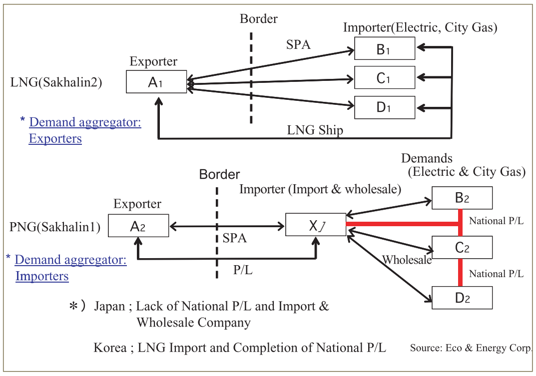
Since 15 big regional monopoly companies have been importing LNG by their own needs, there has been no necessity to establish a large-scale nationwide company for gas import & wholesale.

But this situation was forced to change rapidly by Sakhalin gas reserves in the close proximity of Hokkaido in northern Japan, which have the great possibility to be imported through international pipelines. In fact, Sakhalin 1 group have tried to transport Sakhalin gas via international pipelines, while Sakhalin 2 tried to transport Sakhalin gas by traditional LNG ship. At this moment, it seems that Sakhalin 1 gas pipeline plan has fallen in failure and Sakhalin 2 LNG plan has shown a remarkable progress. Why? It is an interesting question for planning effective and timely introduction of LNG or PNG (Pipeline Natural Gas) in Northeast Asian regions.

Japan has begun to introduce deregulations in gas retail business in spite of no nationwide trunkline network. Most of the advanced countries have started deregulation after completion of related infrastructures including trunkline network. Japan's case was the reverse of them. As a result, effects of deregulation are quite limited within no integrated gas markets and each gas importer has not enough bargaining power to buy cheaper gas.

The point is how to install a sort of aggregation tools of disconnected gas demands even after introduction of deregulation in the Japanese market. Because the effect of deregulation should be realized only together with the large, integrated and open gas market. In other words, Sakhalin 2 LNG trade would go well even in the scattered gas markets, while Sakhalin 1 PNG trade would only require a big and integrated market at the time when deregulation process of gas market already begins. Simply saying, unfortunately Japan has not yet enough gas infrastructures, that is, trunkline network to make a PNG deal with Sakhalin. That is the fundamental reason for the Sakhalin 2 LNG marketing success and Sakhalin 1 PNG marketing failure, based upon the observations of existing Japanese gas infrastructures.

Figure 1. LNG & PNG Trade



It is not exact to say that there exist no more gas demands in Japan, but precisely speaking, there are not enough tools for gas demand aggregation in Japan in spite of the huge potential and disconnected gas demands which would be realized by fuel conversion through more competitive and cheaper gas.

Construction of Japanese Trunkline

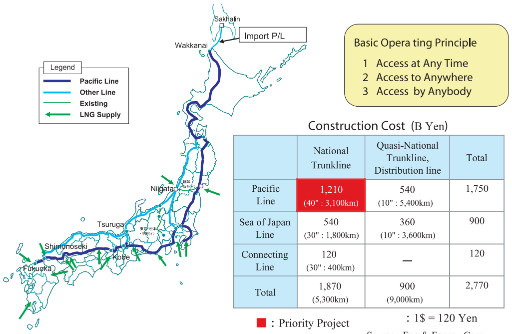
The construction of Japanese Trunkline is now a critical issue for making a PNG deal with Sakhalin as well as improvement of high price structure. In Sakhalin oil and gas developments, worldwide famous oil majors have participated including those of Russia, India, US, EU and Japan, focusing on the China, Korea and Japan as well as North American markets. It looks like a symbolic 'Gas War' on the Russian gas resources. In terms of the Japanese players, every investor for Sakhalin oil & gas developments is not an operator and gas importers are also independent electric companies and larger city gas companies, which is a quite different situation from China and Korea. Those countries have a nationwide gas import & wholesale company respectively, but Japan has not yet such kind of companies. This is a fatal fault in gas industry structure of Japan for making a PNG deal as well as even LNG deal, not gaining a strong bargaining power by the closely divided market size.

Therefore it is also an urgent task for Japan to set up a few of nationwide gas import & wholesale companies together with construction of the Japanese Trunkline under the steady promotion of deregulation in electric and gas supply. To do so, Japan could possibly make a necessary coordination with fatally important supplied gases from Sakhalin 1, Sakhalin 2 and subsequent gas development projects, for example, Sakhalin 3 and 5, without losing invested governmental & private money.

As for the basic characteristic of the Japanese Trunkline, it should be operated as an open access transportation pipeline from its starting, since Japan already has a lot of LNG importers with very limited supply areas and direct electricity generation use. On the other hand, they could be easily getting into a nationwide wholesale business together with completion of the Trunkline, making a new PNG deal with Sakhalin gas producers in addition to existing LNG deals. The ordinary way of constructing trunkline network is first setting up a state-owned gas import & wholesale industry which is in charge of completion of the nationwide trunkline network and after a while its company would be privatized and also divided into gas transportation industry and gas wholesale industry due to the liberalization, which will be taken in China & Korea. But this orthodox process could not be adopted in Japan's case due to the difficulties of coordination among the nationwide import & wholesale company and existing LNG importers.

As is quite well known, Japan has very few trunklines with around 2,000 km in length. Therefore master plan for the Japanese Trunkline should connect almost all the demand areas with PNG and LNG supply sources, as shown in Figure 2.

Figure 2. Japanese Trunkline



Construction Cost (B Yen)

	National Trunkline	Quasi-National Trunkline, Distribution line	Total
Pacific Line	1,210 (40" : 3,100km)	540 (10" : 5,400km)	1,750
Sea of Japan Line	540 (30" : 1,800km)	360 (10" : 3,600km)	900
Connecting Line	120 (30" : 400km)	–	120
Total	1,870 (5,300km)	900 (9,000km)	2,770

■ : Priority Project

: 1$ = 120 Yen

Source : Eco & Energy Corp.

Its total length is about 5,300 km in which 3,100km is the urgently required Pacific Coast Line which runs through the Japanese Archipelago along the Pacific Coastal regions, covering more than 80 percent of potential gas demands of the country and also interconnecting the existing gas distribution network of the city gas companies and indigenous gas companies. Its design pressure is 7 Mpa and its diameter is around 40 inches. The rough estimated construction cost will be around 1,210 billion yen (10 billion US dollars) for the Pacific Coast Line with 1,870 billion yen (16 billion US dollars) for the total Trunkline. Because Japan has very serious issues for the right of the way, the Trunklines would be properly buried under the redundant public spaces of the national highway site by special approval of the Government. As to this issue, the undersea pipeline option as a part of the Trunkline should be eliminated because no potential gas demands exist offshore. However, an international import pipeline between Sakhalin and Hokkaido (Northern Japan), or Korea and Kyushu (Western Japan) would have to be constructed offshore as a matter of course. Its operation would be very similar to the UK national grid operation system by the National Grid Transco as a gas transportation industry. Prior to, or in tandem with the completion of the Trunkline, setting of a new legal framework would be required for defining the governmental financial support to its construction and the guarantee of fair and transparent use of it. The expected completion year should be before 2012 just within the first commitment period of Kyoto Protocol of 2008-2012.

Here, targeted potential gas demands are not for domestic use by city gas companies but massive fuel conversion to gas in about 1,600 industrial complexes along the Pacific Coast Line since industrial gas use accounts for only 6 percent of the total industrial energy consumption in 2002 due to the high prices of gas and limited supply areas. The estimated industrial fuel conversion along it will amount to 15 BCM (10 million tons-LNG equivalent) of gas at starting year of operation, caused by the reduced gas price of industrial use. This figure seems to be quite large, taking the necessary gas demands of 8 BCM for Sakhalin 1 start-up into consideration. And the share of gas in the total primary energy supply will increase from 13 percent in 2002 to 16 percent.

Most significant effects of the Trunkline are those of gas price reduction and reduction of CO_2 emission. The former consumer benefit is estimated as about 1 trillion yen per year even if the CIF prices of gas import are assumed the same before and after the Project. The latter effect would be enough to pave the way for attaining the CO_2 reduction target of 6 percent by the Kyoto Protocol without depending too much upon the CO_2 absorption of forests.

According to the Japanese Government's policy for the public infrastructure development, the private sector should implement what it could do. Therefore the implementing body of the Trunkline construction would not be a governmental corporation, but an ordinary commercial corporation which could be exclusively receiving governmental financial supports by special legal designation, since the cost benefit ratio (B/C) of this project is far larger than 2.0 which could justify the public financial support in terms of national economy. Thus also massive direct or indirect investments from domestic or foreign private sources would be quite welcome up to the two thirds of the total equity of the Trunkline Company, while the governmental share of the equity would be probably not more than one third, observing the recent examples of privatization of such public corporations as Japan Highway Authority, Metropolitan Highway Authority and so on. The debt portion for financing the project would be partially guaranteed by the Government, or covered by low-interest loans from public banks. In this financial scheme, big Sakhalin gas exporters are strongly expected to make a relatively large direct or indirect investment and in return they would be able to enjoy high return on equity (ROE), which is estimated as more than 10 percent at this moment, and also secure a sort of their Sakhalin gas share in the integrated Japanese gas market through the Trunkline, which will expand double in volume towards 2020. The latter deal would be made between Sakhalin gas exporters and the newly emerging import & wholesale companies of Japan. Thus construction of the Trunkline might inevitably lead to the restructuring of Japanese gas industries including some electric and oil companies.

Now the time has come for Japan to construct the Trunkline and open its competitive market for every gas supplier, whatever form it will be.

Impacts on Northeast Asian Gas Trade

Integrated and liberalized gas market of Japan would surely cause a lot of remarkable changes in Northeast Asia.

First, around the Japanese market both onshore and offshore competition would be introduced and Japanese gas consumer prices could be drastically reduced. It means that the market will expand in volume and money term, which might attract many gas suppliers from all over the world including Sakhalin. Conflicts and competition between Japan and neighboring gas consuming counties such as China and Korea might occur more frequently. Then some kind of coordination dialogues among these countries and gas supply countries should be established through existing international organizations or other channels.

Second, reflecting these market changes of Japan, terms and conditions of gas sales & purchase contracts for both LNG and PNG, and possibly CNG(Compressed Natural Gas) in the future will be forced to change more flexibly which would contribute to promote gas utilization in Northeast Asia as a whole. And in addition to existing LNG import, PNG import route to Japan will be diversified such as Sakhalin to Hokkaido, Sakhalin to South Korea and extensively Japan through North Korea, Central Asian Republics to China and extensively Japan through East China Sea and so on. These would be contributing to make a trigger for constructing Northeast Asian international pipeline network and also set a practical basis for establishing 'Northeast Asian Energy Community'.

Third, liberalized gas market in Japan would facilitate the spread of many kind of distributed and efficient energy systems using fuel cell and micro gas turbines. These new technologies should be transferred to China and Korea. Thus as a whole, efficient use of gas and expansion of gas supply would contribute to reduce CO2 emission. And then an international CO2 emission trading market in addition to the international gas trading market might be established in Northeast Asia with its market hub in the near future.

Conclusion

For Japan, introduction of Sakhalin gas has been a too long project for more than 30 years. However its importance has not diminished, but gradually increased. Moreover Japan has already invested too much in Sakhalin 1 and Sakhalin 2 projects. Japan has to accomplish both Projects successfully. For this purpose, construction of the Japanese Trunkline is crucially required in parallel with the establishment of a few of new nationwide import & wholesale companies of gas which would be working as counterparts for Sakhalin gas exporters. This means that some kind of restructuring of gas industries would not be avoided. When the Japanese Trunkline is announced to be completed in around 2010, many related foreign or Japanese companies which involve Sakhalin gas exporters, domestic wholesale businesses etc. would begin to make a positive larger investment in order to secure their business domains. Especially foreign investments will be quite welcome, since there are not any big appropriate players in Japan which are in charge of the construction of the nationwide Trunkline and its related facilities. These investments will also contribute to the revitalization of Japanese economy.

For the rapid and smooth construction of the Trunkline, strong and unchanging will of the Japanese Government is especially needed.

At the same time, reduction plan of CO_2 emission of Japan would become easier and more reliable to attain its target due to the massive fuel conversion to natural gas. It will be a minimum duty of Japan as an advocate of the Kyoto Protocol.

And energy cooperation among Northeast Asian countries will be realized, involving the movements for bilateral or multilateral FTA in energy. Ultimately Northeast Asia will be covered by Asia Pacific LNG market including North America and Northeast Asian PNG market, including very local CNG markets. As a result this would surely strengthen energy security in this region. At the G8 summit in St. Petersburg of Russia next July, these issues should be fully discussed. ▣

Current Status and Prospect of Nuclear Energy in Northeast Asia

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Introduction

With fast growing economy of China and scarcity of natural resources in Republic of Korea (ROK) and Japan, Northeast Asia is the most active region in the world where nuclear energy development is growing significantly. As of the end of 2004, Northeast Asia, composed of ROK, Japan, China and Taiwan, consumed over 2 billion-ton oil equivalent of energy, more than 20% of world energy consumption. Energy consumption of China will continue its rapid growth with high economic growth in the coming decade. ROK, Japan and probably Taiwan would moderate in increase of their energy consumptions in near future, but still mostly depend on imported energy resources. Therefore, nuclear energy would be one of main energy sources in Northeast Asia for some decades.

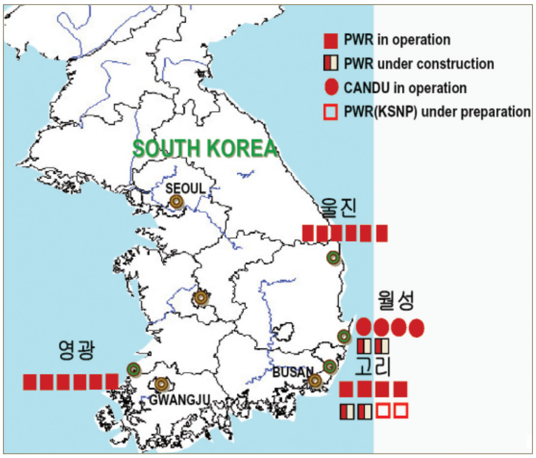
ROK

Since the first commercial nuclear power plant (NPP) operation in 1978, a total of 20 NPPs, i.e., 16 pressurized water reactors (PWRs) and 4 CANDU reactors with an electric power capacity of 17.7 GWe are in operation, as of the end of 2005. Eight PWRs are planned to be deployed by 2015, according to a long-term nuclear power supply plan of ROK. Current status and long-term nuclear power supply plan in ROK through the year 2015 is given in Table 1. As of end of 2004, nuclear power was 28% of total electricity generation capacity and supplying 39% of total electricity generation. Nuclear power is expected to grow to 26.6 GWe and to supply 47% of total electricity generation in 2015. Figure 1 shows locations and current status of operation and construction of NPPs in ROK as of Jan. 2006.

Table 1. Current status and long-term nuclear power supply plan in ROK

Site	Unit	Type	Capacity (MWe)	Operation
Kori	Kori-1	PWR	587	Apr. 1978
	Kori-2	PWR	650	Jul. 1983
	Kori-3	PWR	950	Sept. 1985
	Kori-4	PWR	950	Apr. 1986
	Sinkori-1	PWR	1000	Oct. 2010
	Sinkori-2	PWR	1000	Oct. 2011
	Sinkori-3	PWR	1400	Jun. 2012
	Sinkori-4	PWR	1400	Jun. 2013
Yonggwang	Yonggwang-1	PWR	950	Aug. 1986
	Yonggwang-2	PWR	950	Jun. 1987
	Yonggwang-3	PWR	1000	Mar. 1995
	Yonggwang-4	PWR	1000	Jan. 1996
	Yonggwang-5	PWR	1000	Apr. 2002
	Yonggwang-6	PWR	1000	Oct. 2002
Ulchin	Ulchin-1	PWR	950	Sept. 1988
	Ulchin-2	PWR	950	Sept. 1989
	Ulchin-3	PWR	1000	Aug. 1998
	Ulchin-4	PWR	1000	Dec. 1999
	Ulchin-5	PWR	1000	Jul. 2004
	Ulchin-6	PWR	1000	Jun. 2005
	Sinulchin-1	PWR	1400	Jun. 2014
	Sinulchin-2	PWR	1400	Jun. 2015
Wolsong	Wolsong-1	CANDU	679	Apr. 1983
	Wolsong-2	CANDU	700	Jul. 1997
	Wolsong-3	CANDU	700	Jul. 1998
	Wolsong-4	CANDU	700	Oct. 1999
Wolsong	Sinwolsong-1	PWR	1000	Mar. 2011
	Sinwolsong-2	PWR	1000	Mar. 2012

Figure 1. Current status of operation and construction of NPPs in ROK



Japan

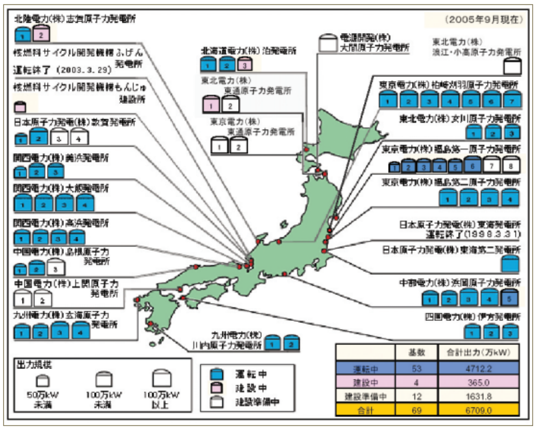
Since the first commercial nuclear power plant operation in 1966, a total of 53 NPPs, i.e., 30 boiling water reactors (BWRs) and 23 PWRs with an electric power capacity of 47 GWe are in operation and are supplying over 30% of total electricity generation, as of the end of August

Table 2. Current status and long-term nuclear power supply plan in Japan

Site	Unit	Type	Capacity(MWe)	Utility	Operation
Tomari	Tomari-1 Tomari-2 Tomari-3	PWR PWR PWR	550 550 866	Hokkaido	Jun. 1989 Apr. 1991 Under const.
Onagawa	Onagawa-1 Onagawa-2 Onagawa-3	BWR BWR BWR	498 796 798	Tohoku	Jun. 1984 Jul. 1995 Jan. 2002
Higashidori	Higashidori-1 Higashidori-2	BWR ABWR	1067 1385	Tohoku	Under const. 2016 (planned)
Namie-odaka	Namie-odaka-1	BWR	1385	Tohoku	2016 (planned)
Higashidori	Higashidori-1 Higashidori-2	ABWR ABWR	1385 1385	TEPCO	2013 (planned) 2015 (planned)
Fukushima Ⅰ	Fukushima Ⅰ-1 Fukushima Ⅰ-2 Fukushima Ⅰ-3 Fukushima Ⅰ-4 Fukushima Ⅰ-5 Fukushima Ⅰ-6 Fukushima Ⅰ-7 Fukushima Ⅰ-8	BWR BWR BWR BWR BWR BWR ABWR ABWR	439 760 760 760 760 1067 1380 1383	TEPCO	Mar. 1971 Jul. 1974 Mar. 1976 Oct. 1978 Apr. 1979 Oct. 1979 2011 (planned) 2012 (planned)
Fukushima Ⅱ	Fukushima Ⅰ-1 Fukushima Ⅰ-2 Fukushima Ⅰ-3 Fukushima Ⅰ-4	BWR BWR BWR BWR	1067 1067 1067 1067	TEPCO	Apr. 1982 Feb. 1984 Jun. 1985 Aug. 1987
Kashiwazaki-Kariwa	K-K-1 K-K-2 K-K-3 K-K-4 K-K-5 K-K-6 K-K-7	BWR BWR BWR BWR BWR ABWR ABWR	1067 1067 1067 1067 1067 1315 1315	TEPCO	Sept. 1985 Sept. 1990 Aug. 1993 Aug. 1994 Apr. 1995 Nov. 1996 Jul. 1997
Hamaoka	Hamaoka-1 Hamaoka-2 Hamaoka-3 Hamaoka-4 Hamaoka-5	BWR BWR BWR BWR ABWR	515 806 1056 1092 1380	Chubu	Mar. 1976 Nov. 1978 Aug. 1987 Sept. 1993 Jan. 2005
Shika	Shika-1 Shika-2	BWR BWR	505 1358	Chubu	Jul. 1993 Under const.
Mihama	Mihama-1 Mihama-2 Mihama-3	PWR PWR PWR	320 470 780	Kansai	Nov. 1970 Jul. 1972 Dec. 1976
Takahama	Takahama-1 Takahama-2 Takahama-3 Takahama-4	PWR PWR PWR PWR	780 780 830 830	Kansai	Nov. 1974 Nov. 1975 Jan. 1985 Jun. 1985
Ohi	Ohi-1 Ohi-2 Ohi-3 Ohi-4	PWR PWR PWR PWR	1120 1120 1127 1127	Kansai	Mar. 1979 Dec. 1979 Dec. 1991 Feb. 1993
Shimane	Shimane-1 Shimane-2 Shimane-3	BWR BWR ABWR	439 789 1375	Chugoku	Mar. 1974 Feb. 1989 Under const.
Kaminoseki	Kaminoseki-1 Kaminoseki-2	ABWR ABWR	1373 1373	Chugoku	2014 (planned) 2017 (planned)
Itaka	Itaka-1 Itaka-2 Itaka-3	PWR PWR PWR	538 538 846	Shikoku	Sept. 1977 Mar. 1982 Dec. 1994
Genkai	Genkai-1 Genkai-2 Genkai-3 Genkai-4	PWR PWR PWR PWR	529 529 1127 1127	Kyushu	Oct. 1975 Mar. 1981 Mar. 1994 Jul. 1997
Sendai	Sendai-1 Sendai-2	PWR PWR	846 846	Kyushu	Jul. 1984 Nov. 1985
Tsuruga	Tsuruga-1 Tsuruga-2 Tsuruga-3 Tsuruga-4	BWR PWR APWR APWR	341 1115 1538 1538	JAPC	Mar. 1970 Feb. 1987 2014 (planned) 2015 (planned)
Tokai	Tokai-2	BWR	1056	JAPC	Nov. 1978
Ohma	Ohma	ABWR	1383	EPDC	2012 (planned)
Monju	Monju	Prototype FBR	246	JAEA	Operated 1994-95, awaiting restart

2005. Table 2 gives current status and long-term nuclear power supply plan in Japan through the year 2016. Locations and current status of operation and construction of NPPs in ROK as of Sept. 2005 are given in Figure 2.
According to a "Framework for Nuclear Energy Policy" of Japan, published by Japan Atomic Energy Commission in October 2005, Japan would aim at maintaining or increasing the current level of nuclear power generation (30 to 40% of the total electricity generation) even after 2030, including replacement of current NPPs with advanced light water reactors. Commercial fast breeder reactors would not be introduced until about 2050.

Figure 2. Current status of operation and construction of NPPs in Japan



China

Since the first commercial nuclear power plant operation in 1970, a total of 9 NPPs, i.e., 7 PWRs and 2 pressurized heavy water reactors (PHWR), with an electric power capacity of 6.6 GWe are in operation, as of the end of 2005. Nuclear power supplied 2.2% of total electricity generation, as of the end of 2003. Table 3 gives current status and near-term nuclear power supply plan in China. China has a plan to increase its nuclear capacity to 36-40 GWe by 2020. Locations and current status of operation and construction of NPPs in China as of the end

Table 3. Status and near-term nuclear power supply plan in China

Site	Unit	Type	Capacity (MWe)	Operation
Daya Bay	Daya Bay-1 Daya Bay-2	PWR PWR	944 944	1994 1994
Qinshan	Qinshan-1 Qinshan-2 Qinshan-3 Qinshan-4 Qinshan-5 Qinshan-6 Qinshan-7	PWR PWR PWR PHWR PHWR ? ?	279 610 610 665 665 1000 1000	Apr. 1994 2002 2004 2002 2003 being proposed being proposed
Lingao	Lingao-1 Lingao-2	PWR PWR	935 935	2002 2003
Tianwan	Tianwan-1 Tianwan-2	VVER VVER	950 950	2006 2006
Haiyang	Tianwan-1 Tianwan-2	? ?	1000 1000	being proposed being proposed
Hui An	Hui An-1 Hui An-2	? ?	1000 1000	being proposed being proposed
Sanmen	Sanmen-1 Sanmen-2	? ?	1000 1000	being proposed being proposed
Yangjiang	Yangjiang-1 Yangjiang-2 Yangjiang-3 Yangjiang-4 Yangjiang-5 Yangjiang-6	? ? ? ? ? ?	1000 1000 1000 1000 1000 1000	being proposed being proposed being proposed being proposed being proposed being proposed

of 2005 are given in Figure 3.

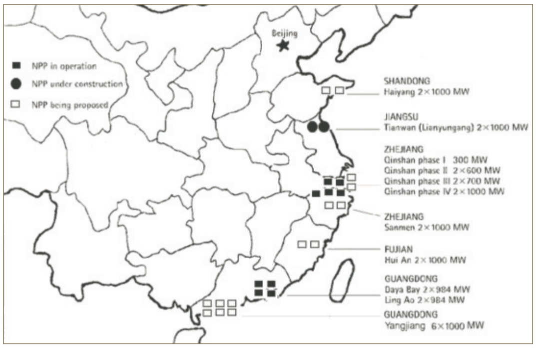


Figure 3. Current status of operation and construction of NPPs in China

Taiwan

Like ROK and Japan, Taiwan has few energy resources and has to import more than 90% of its energy. Since the first commercial nuclear power plant operation in 1978, a total of 6 NPPs, i.e., 4 BWRs and 2 PWRs, with an electric power capacity of 4.9 GWe are in operation and two advanced BWR are under construction, as of end of 2005.

Table 4. Status and near-term nuclear power supply plan in Taiwan

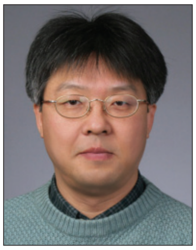
Site	Unit	Type	Capacity (MWe)	Operation
Chinshan	Chinshan-1 Chinshan-2	BWR BWR	604 604	1978 1979
Kuosheng	Kuosheng-1 Kuosheng-2	BWR BWR	948 948	1981 1983
Maanshan	Maanshan-1 Maanshan-2	PWR PWR	890 890	1984 1985
Lungmen (near Taipei)	Lungmen-1 Lungmen-2	ABWR ABWR	1350 1350	under const. under const.

Conclusions

In Northeast Asia (ROK, Japan, China and Taiwan), there are currently 88 NPPs operating, 12 under construction and plans to build 29 within a decade. Nuclear energy capacity of Northeast Asia would share greater than one fourth of the world capacity in a decade. Rapid expansion of nuclear energy in Northeast Asia would be continuing after then, mainly driven by high economic growth of China. In contrast to China, nuclear energy of ROK, Japan and Taiwan would be moderate in the long-term because of siting problem due to strong oppositions by local communities. ▣

Figure 4. Sites of NPPs in Taiwan

Energy Information & Technical Cooperation for Northeast Asia Energy Community



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Introduction

Northeast Asia region has shown the most vigorous economic growth in the world since 1970. Currently, Northeast Asia emerges as one of the most important regions in the world economy, but at the same time, it is also perceived to be one of the greatest threats to international security. Especially, energy demand in this region is on the rise because of China's rapid and sustained economic growth. Such phenomenon raises not only importance of energy security of its neighbor countries but also importance of other energy issues such as Asia premium oil price, high dependency on imported fossil energy from Middle East, joint oil stockpiling, Siberia oil and gas pipeline development project etc. To discuss these matters, the creation of Energy Community for Northeast Asia countries was proposed. However, until now, the detail road map for the foundation of Energy Community hasn't been clear although discussion and research have progressed steadily.

To realize Energy Community in Northeast Asia, the mutual confidence and the common vision for Northeastern Asian countries are the most important precondition. However, it has some difficulty to organize the regional energy community such as the diversified political point of view and the difference of economic level. Therefore, as the first stage to promote regional energy cooperation, the building confidence and developing common vision among the energy opinion leaders in this region through the exchange of geological, technical, institutional and market information of energy or energy expert exchange program should settle down as early as possible.

This article focuses mainly to present the necessity and importance of fundamental programs such as energy information, technology and personal exchange. Therefore, in this article, the benefits and obstacles related to the creation of Northeast Asia Energy Community were gone over. Then, as the example, the pass of EU energy cooperation was reviewed. Through this article, the schemes of energy information, technology and capacity building programs for the creation of Northeast Asia energy community were proposed.

The Problems & the Necessity of Northeast Asia Energy Cooperation

Many energy experts through their research works in recent years have emphasized the necessity and the benefit of Northeast Asia energy cooperation. Expected benefit from regional energy cooperation can be classified in two main categories; economical benefit, environmental & social benefit. First, the expected economical benefit can be summarized as follows;

- ▶ Reducing the wasting expenditure to avoid over competition among regional energy importing countries (China, Japan, Korea)
- ▶ Improving the regional energy security through the increasing the supply of primary energy sources in Northeast Asian region.
- ▶ Reducing the oil import expenditure from Middle East through the reducing of difference of east-west oil price
- ▶ Improving the energy security and management cost from the joint energy network (electricity network, gas & oil pipe line or joint oil stockpiling)
- ▶ Assisting the establishment of FTA, or transportation, traffics, distribution internal network among Northeast Asian countries through unified energy market

And, as the environmental & social benefit, the followings would be pointed out;
- ▶ Technical transfer related to new, renewable and clean energy and improvement of energy efficiency
- ▶ Helping to establish the collaborative economic or political goals among Northeast Asian countries
- ▶ Easing of the political conflict through increasing the reliance of each countries

For the realization of these positive expectations, in 2001, South Korea Government proposed organization of SOM(Senior Official Meetings on Energy Cooperation in Northeast Asia) as the preparatory stage of regional energy community, then there was some progress such as adoption of "Khavarovsk Communique". However, the progress to form the regional energy community was delaying as the such problem ; the various interest among Northeast Asian countries, the difference of political position concerning to the North Korea nuclear weapon, and complication between China and Japan who play the leading role in Northeast Asia etc.

The Progress for Organizing EC Energy Community

The energy cooperation of Europe was started, with forming the "European Coal and Steel Community : ECSC ", in 1952. In 1958, "The European Atomic Energy Community : Euratom" was organized, and <Treaty of Rome> was adopted. For a background of these works, EEC(The European Economic Community) could be founded, and Single European Act(1987), the Treaty of European Union(1993) were adopted.

In case of Europe, although the creating the regional community could be started from energy sector, as the most member countries would not want to be infringed their own energy sovereignty, practical outcomes from the cooperation of energy sector were delayed for a long time. Therefore, the visible agreement in energy sector could be accomplished in 1988, after adopting European Commission, applying the single EU energy market concept and competition rule in electric and gas market. For the reason why not to attract the practical result from energy sector at first stage, many research works indicated that cooperative agendas were initiated by the public sector. After 1980's, as regional energy cooperation was leaded by private sector under the market principles, the visible progress could be shown in European energy market. And to induce the successful result for energy market unification, leading by private sector, the following assumptions are also required :
- ▶ Guarantee for the dialectical process to find a common denominator among composed members
- ▶ Offering the regional energy market, policy, technical information to build the mutual confidence

For instance, sufficient understanding for energy market of member countries can help to make their own strategies and to make decision of participation for energy community.

The Energy Information and R&D Cooperation Program in Europe

In order to create energy community in Europe, initiated by private sector, the role of public sector have to be concentrated on making the base of energy cooperation. The representative works are to operate the regional energy information network and the cooperative energy R&D program.

EU Energy Information Providing Program

For supporting the unified energy community, as European Commission operates the energy database, provides information on various energy related EU countries through the WEB. The provided information is as follows :

Table 1. Energy Market Information Available Through the WEB

Coal	EC Coal Market, Pricing Information, State aid, Environmental legislation, Clean coal Tech. Agenda of ECSC Treaty
Oil	Oil Strategy, Price, market statistics, Technology, internal market, Upstream licensing, security stock, legislation,
Gas	Legislation, market statistics, Agenda of each forum(European Regulators Group, Madrid Forum etc.), Infrastructure
Electricity	Legislation, market statistics, Agenda of each forum(European Regulators Group, Florence Forum etc.), Infrastructure
Nuclear	Safety, Radioactive Waste, Nuclear Installation, Radiation Protection, Transport of Radioactive Material, Safe Guards, Euratom Supply Agency
New & Renewable Energies	R&D of Each Renewable Energy Sector, Partnership, Industry/Polygeneration, Official Document and Action Plan, Events

· Energy Market information on each energy sources (Coal, Oil, Gas, Electricity, Nuclear, New & Renewable Energy)
· Energy Demand Management Information
· Energy Transport Information
· Legislation on Energy Industry
· Energy Meeting & Forum Information

EU Energy R&D Program

Developing sustainable energy systems and services for Europe is the strategic goal of EU energy research programs. In addition, the aim is to contribute to a more sustainable development worldwide. This strategy will lead to an increased security and diversity of energy supply, and will provide Europe with:
· High-quality, low-cost energy services
· Improved industrial competitiveness
· Reduced environmental impact
· A better quality of life for all Europeans

The European Union promotes research cooperation between partners from different countries through a series of successive Framework programs. However, making the most of the huge research potential in Europe requires more than financial support for these cooperative activities.

How energy research policy is decided and then implemented is outlined in the following principles ;

▶ Energy research is carried out under the terms of the European Treaties. In this treaty, research and technological development (RTD) is highlighted as one of the EU's objectives (Title XVIII, Articles 163 to 173).
▶ The European institutions together decide on the Framework programs for research and technological development (RTD) as set out in the European Treaties.
▶ Energy research is part of the thematic area 'sustainable development, global change and ecosystems' in the current research and technological development (RTD) program.

Energy Information & Technical Cooperation for Northeast Asia Energy Community

The instructions through understanding the European experience for founding the energy community, the proper role of public sector is, not to precede the cooperation, just to create the affirmative social environment or to

Table 2. The Difference Between Europe and Northeast Asia Formulating the Regional Energy Community

Different Condition	Countermeasures
The existence of huge energy supplier(Russia, China)	· Constructing the regional geology & resources information D/B for excavating the new energy project · technical cooperation for joint energy development
Continues increasing of primary energy demand (China)	· Finding the agenda to extend the energy supply · Technical cooperation for improvement energy efficiency and environment
Difference of economic development level	· Operating the capacity building program · Making the support program for under-developed countries
Lack of regional energy infrastructure	· Inducing the international financing organization (World Bank, ADB etc)
Existence of political conflict	· Discriminate between political and economical affairs
No common standard and format on energy statistics, and D/B network	· Creating the Energy D/B Working Group for operating the information network

operate the basic support programs inducing the private sectors to the cooperative energy project. The specific roles of public sectors can be summarized :

▶ Operating the joint energy information system in capable of accessing the various kind of energy information of member countries
▶ Operating the joint energy R&D programs for extending energy development project, infrastructures, improving energy efficiency and preserving regional environment
▶ Operating the joint capacity building program improving mutual understanding and confidence among energy expert
▶ Financial preparation or building the joint fund to activate these basic support programs for regional energy cooperation.

However, the some basic condition between Europe and Northeast Asia, to formulate the regional energy community is little bit different. The differences between Europe and Northeast Asia formulating the regional energy community were summarized in Table 2. Table of contents, especially, the existence of political conflict and the difference of economic development stage among the member countries can be pointed out as the structural differentiations to case of Europe. It means, in Northeast Asia, the realization energy cooperation should be more difficult and the role of public sector has to be done more wide work scope. In this situation, not to share the mutual confidence or a common vision, the existence of practical energy cooperation can not be expected, basic cooperative work for energy, such as the construction of information network, R&D exchange or capacity building capacity programs has the more importance. And existence of Russia who has greatest hydrocarbon resources, exposed that, in energy cooperative program, the subjects for fossil fuels have to be the major and essential fields. ▣

Opinion

Opportunities and Risks of Northeast Asian Energy Cooperation

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Introduction

Unlike North America or Europe, Northeast Asia appears to lack in substantive regional economic cooperation. Energy sector is not an exception. This may result from our unhappy historical relations and confrontations in ideology in the region. However, in reality, exchanges of goods and services, flows of information and human contacts are more frequent than we might be able to imagine in this region. It would make our life much happier if we could realise many gains arising from regional cooperation in Northeast Asia. In the subsequent sections, I would like to illustrate potential benefits of our regional cooperation in energy field and our respective roles to play. In this paper, the term "Northeast Asia" covers the geographic area composed of Continental China, Chinese Taipei, Korean Peninsula, Japanese Archipelago and Russian Far East. This paper relies on several earlier studies of the Asia Pacific Energy Research Centre, which the author served as President between mid-1996 and mid-2001, on regional gas and power grid connections and oil emergency stocks as well as my recent contribution to a book on energy and security published in the US.

Many Common Challenges

It is important to understand that we, Northeast Asians are now facing many challenges in common. There are three major challenges commonly facing us.

First, we share the question of how to balance energy demand and supply without sacrificing our environment and at affordable prices. Asian energy demand will clearly expand over several coming decades and, consequently, be met in many instances, by supplies coming from sources outside their borders, considering limited indigenous resources. Japan, Korea and Chines Taipei are poor in indigenous fossil fuel resources. Although China is endowed with abundant coal resources, her oil consumption has already exceeded her domestic production. Her gas consumptioon is almost equal to her production and will exceed her domestic supplies soon. Although Russia as a whole is a net exporter of oil and gas, their poor delivery system and production in Russia Far East prevents residents in this region from enjoying sufficient energy supplies. Thus, Northeast Asia as a whole depends on energy imports. However, any attempt to secure these external supplies exclusively for any single consuming nation will be not only counterproductive in the sense that will induce others to take similar measures, but also, in many instances, unpractical. For example, the quality of oil thus procured may not match the needs of the importing party's market requirements, such as resulting product mixes and environmental standards. Thus, swapping arrangements and other adjustments will be necessary. In essence, any attempt for energy self-sufficiency without cooperation with other consumers will not achieve the desired objective. Moreover, the present-day level of global integration of oil markets is sufficient enough to adjust demand and supply imbalances with corresponding price changes.

Second, many energy and environmental issues have regional and international implications. For example, oil and gas markets are globally linked. Significant demand and supply imbalances in oil and gas in national and regional markets could raise their prices globally. This is evidenced by the recent IEA coordinated responses to the oil product supply shortfalls caused by the Hurricanes Katrina in North America. On the environment, acid rains are one of the most evident cases of cross-border environmental hazards. Pollution abatements in China will bring us so many environmental benefits that regional cooperation in reducing pollutants from coal fired power stations in China will be well justified.

Third, Northeast Asia is distinct in its poor energy delivery networks. Both North America and Europe have already developed cobweb like regional networks of energy delivery, such as oil and gas pipelines and power grids. ASEAN countries have drafted their master plans for such infrastructure connections. Creation of Northeast Asian energy delivery networks or regional energy grids will not only alleviate many economic, energy and environmental problems described above, but also foster a sense of community among those living in the region and facilitate confidence building among them. Potential gains in economic, energy and environmental aspects will be discussed in the subsequent paragraphs.

Potential Economic, Energy and Environmental Gains of Regional Energy Grids

The existence of regional energy delivery networks could enable Asian energy consumers to choose the most economic supply sources through expanded supply options. For example, if a regional trans-boundary gas pipeline network is constructed, it will offer an alternative gas supply option to liquefied natural gas (LNG), which is at present the only available gas supply form for many Northeast Asian gas consumers. Then, competition between piped gas and LNG could lower natural gas prices to them. Further, through the link inside Russia, European gas markets and Asian gas markets will be connected and prices in gas will be globally adjusted, which means price disparity between regions to be reduced, if not eliminated. Similar economic gains could be expected for oil and electricity. Oil pipelines from Russia to Japan, Korea and China will not only offer an alternative to supplies from Middle East but also reduce, if not eliminate, what we call "the Asian premium" again through Russian oil pipeline links with Europe. Power grids in this region will offer similar gains to Asian consumers. For example, Japanese power consumers can benefit from lower priced supplies from the Continent through grid connections, as her expensive power rates are well known and as the scope of lower cost alternative domestic supply would be limited with her prospective enhanced competition in power sector due to many high cost factors.

Besides these economic benefits, more macro-economic gains could be expected through such regional energy delivery infrastructure, as its construction and operation will generate local income and employment, for example, in Russia and China. Similarly, energy production facilities, such as oil and gas production wells and hydro, nuclear and gas power stations could be built or expanded, which will also generate local employment and income.

The development of regional energy delivery networks will also enhance energy supply security. The emergence of a wider scope of supply options in itself means the greater availability of alternative supply routes in case of disruptions in one or a few supply channels. For example, even if oil tanker delivery from the Middle East sources is disturbed, oil transported by pipelines on land could offset the lost supply. Not only diversified oil supply sources but also diversified supply routes or channels will offer oil supply security. The same logic will hold for gas and electricity grid expansion. But in the case of oil, its supply security could be further augmented, if oil pipeline network expansion plans are combined with such a scheme as the location of joint stockholding facilities in adjacent areas. As shown in the case of the recent Hurricanes Katrina in the US, supply disruptions could be caused by domestic incidents inside consuming countries. In order to respond to such cases, the release of oil stocks from sources nearby the pipeline network will become a readily available remedy.

Somewhat related to economic gains arising from regional energy delivery networks, such networks could also contribute to environmental gains. First, the capacity utilisation of energy production facilities such as power plants and oil refineries could be increased, thus reducing additional capacity expansion needs. Further, more environmentally friendly energy supply sources could be better exploited. Particularly, in the case of power grid connections, wind power and other renewable energy based power generation as well as nuclear and gas fired power generation could be chosen before coal fired power generation. Thus, for example, China could import hydro, gas based or other environmentally benign electricity from Russia through the grid instead of domestically generating from coal. Similarly, Japan could import electricity generated from Korean nuclear power plants through grids instead of operating domestic fossil-fired stations. With or without the Clean Development Mechanism under the Kyoto Protocol, Japan could increase her power consumption without increasing carbon dioxide emissions.

Thus, the development of regional energy delivery infrastructure will offer potential economic, energy securing and environmental gains in Northeast Asia. The presence of physical regional energy delivery infrastructure will further help us, Northeast Asians, realise how much we depend on energy demand and supply and how much we need each other.The sense of “living in a common world, or community” will result among us.

Potential Geopolitical Risks?

While the development of regional energy delivery networks described above may attract some interests of policy makers, there also exist those who express some concerns and scepticism over an idea of building essential energy supply routes crossing countries and economies which may be conceived as actually or potentially hostile each other. Their reasoning is based on their perceived risk of arbitrary supply interruptions by a producing or transit party. The recent natural gas supply stoppage by Russia to Ukraine can be cited as an example of such a case. Because of their historical and political relations, it appears difficult to judge whether this is the case. But it is clear that Russia has lost her credibility to her European customers and will have to pay high prices for that European customers have alternative supply sources including their own North Sea gas fields and North African sources. Russia’s interests in Northeast Asian gas pipeline network arise partly from her wish to find alternative Asian customers to Europeans which could dictate terms in their Russian deal.

Before this incidence, the long standing Russian gas supplies to Europe which could date from the Soviet Union era were regarded as one of the evidence that potentially hostile suppliers could honour their commitments so long as they serve their long term interests. When Western Europe planned to import gas from West Siberia and to build pipelines in early 1980’s, the US was opposed to the European plan and even ordered a US firm to have its European subsidiaries and licensees producing steel tubes stop exporting them to the USSR. France had them honour the contract. It was said later that the US and Europeans tacitly agreed the share of USSR gas supplies in Europe to remain below 30%. However, despite the economic turmoil in Russia following the collapse of the USSR, gas supplies were said to be maintained.

A similar discussion was made to the plan transporting natural gas from Iran through pipelines crossing Pakistan to India several years ago. An Indian friend of mine told me that there was a similar concern in India on relying on Pakistan for gas supply crossing her, but he also pointed that the river water sharing arrangement between two nations were honoured even during their hostilities. Some years ago, I heard that some basic understanding of this project was made among Iran, India and Pakistan.

My personal feeling is that a kind of geopolitical risk would be lower. For one thing, technical and economic penalty of arbitrary supply disruptions would be high for suppliers. At the time of the first Oil Crisis in 1973, some of my Japanese friends told me that Arab LNG supplies would not be curtailed as such supply reductions in LNG plants would be technically very difficult and economically damaging suppliers. Even on oil, many Arab oil experts now acknowledge that an oil embargo was a mistake.

Another cause for my relative confidence of supply security is that former USSR states and European countries (and Japan) have signed an Energy Charter Treaty which spells out the rights and obligations of transit countries and other parties. Although this Treaty has already entered into force, Russia still fails to ratify it and joins the Treaty on provisional basis. I think that this Treaty or another similar arrangement could apply to the future regional energy delivery network in Northeast Asia.

Remaining Issues

As described above, I express my optimistic view on the development of regional energy delivery infrastructure in Northeast Asia. However, my optimism is largely based on qualitative and notional assessments of such a scheme. To make this more concrete and realistic, many remaining issues should be carefully examined. In other words, while I am very optimistic on such a prospect, nothing could be produced automatically from an optimistic wish. However, in this short paper, any detailed description of remaining issues is not possible. Below I will list some of those which may not be exhaustive.

First, economic and financial aspects of regional energy delivery infrastructure should be quantitatively assessed. Several alternative options on throughput volumes, routes, and technologies to be used should be developed. At the same time, ambitious and selfish expectations for potential gains such as transit fees should be restrained to make those projects more feasible. Actually several simulations and analytical studies have been conducted by interested researchers, some of which are referred to in the APERC papers.

Second, multinational legal, institutional and contractual arrangements over construction and operations of transborder infrastructure should be developed to ensure equitable interests among parties concerned. The application of the Energy Charter Treaty or a similar international agreement should be examined in this context. Russia's early ratification would benefit both Russia and other interested parties.

Third, linkage with internal energy delivery and supply infrastructure should be also considered. In this context, Japan lacks in any major oil or gas trunk pipeline network at home. Japan should consider how to overcome her disadvantage at her earliest possible date.

Fourth, as suggested above, linkage with other infrastructure such as oil stockpiling facilities could be also examined. Naturally, together with pipeline networks, rail and road network connections could be examined. In this connection, under the circumstances that North Korea is accepted as a credible and appropriate partner, a KEDO nuclear project will be able to be examined for its value as one of power supply sources in the region.

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Main Driving Forces Of Energy Cooperation In NEA

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Main Driving Forces of Energy Cooperation in NEA

The North East Asia is the region with the land of 9 million square km, and population of 300 million people, and it is one of regions in the world, which has enormous potentials for cooperation, integration and development for prosperity. This region constitutes a quarter of the world's population, approximately one fifth of world GDP, nearly a fifth of global CO_2 emissions and one quarter of global energy consumption.

For long period this region was a region of intense geopolitics, and interdependency was a main feature of relations between countries in the region. Since 1990s the countries of the region made a lot of efforts to promote regional cooperation, integration and mutual understanding.

This region is already developing regional arteries of interstate transport, telecommunications, tourism and services, and it has even more opportunities for regional cooperation in developing interstate pipelines, power links[1]. This region offers opportunities for regional cooperation, which might grow to the level of existing economic integration unions, such as ASEAN, EU, NAFTA etc. This region is moving from interdependent to integrated co-existence.

The North East Asia countries' strong economic growth require increasing demand for energy resources, and the region needs to secure more reliable, diverse and energy resources for sustainable development.

What are the issues, or driving forces, that will shape the energy cooperation in North East Asia over the next decades?

Most basic issue for energy in this region likewise on any market is the supply and demand of energy resources, and related issue of energy security. Although some countries of the region had stagnant demand for growth, in overall, the countries of the North East region is characterized by dynamic economic activities which will require increasing demand for energy resources, such as oil, gas, power.

Most countries of the region are dependent on Middle East oil supply, and projections show that the dependence will grow, and with instable situation in Middle East there is a need to diversify energy supply.

The failure of countries of the region to secure energy resources in sustainable manner by taking concerted efforts will negatively affect economic development and will lead to insecurity of energy supply and high prices, and will decrease overall competitiveness of the region.

The next important issue is the financing of regional energy projects and risks associated with actual implementation of regional projects. These risks include differences in legal and institutional structures of the countries, complicated political issues, mutual trust between nations due to historical issues etc. Because of historical tensions and the lack of trust between nations, some countries pay excessive prices for securing energy sources. As we see from recent developments in ongoing and developing projects, there are issues related to the costs of the project, and political issues which needs to be tackled on the Government level.

The other important issue is the environmental issue. Dependency on coal and increasing

1. *Source*: A Grand Design for Stability and Prosperity of Northeast Asia, Mr.Hajime Koizumi, KRI International, Japan

pollution require more concerted efforts to reduce an impact to the environment. High economic growth and improving living standards of countries cause increased pollution of the environment, increased CO_2 emissions. Since the nations of the region share one earth, one commonplace, environmental issue should be considered in comprehensive manner.

Supply & Demand Issue, and related Energy Security

Asia shares 30% (3.0/9.4 billion TOE) of the world primary energy (TPE) consumption (2002), and energy consumption in North East Asia exceeds that of EU 15 countries[2], and demand for energy resources in NEA region grows at much higher than the world average. Energy demand growth projections show that by 2020 the energy demand of North East Asia region will reach 3515 million TOE[3], which will account 26.7% share from the world total energy demand.

The situation with the oil supply is desperate. This region includes countries, which are among the world top 10 oil consumers, such as China, Japan and Republic of Korea. The countries of the region are vulnerable by depending on certain region of supply, the Middle East oil, and the projections for supply show that dependency on Middle East oil supply will even increase by 2020. With the instable situation in the Middle East region and increasing oil prices, the countries need to secure as diverse as possible energy sources. Recent developments with ongoing projects in East Siberia and Russian Far East show that there is little evidence that there will be significant oil exploration, development and export to the countries of North East Asia comparable to current supply from Middle East.

And with the increasing demand and mismatch between demand and production[4] capacities the countries concerned with energy security issue as never before. By 2030 the North East Asia will consume 20% of the world oil, and, especially, in China the gap between oil demand and production will grow. Although the increasing oil prices would help to justify economical feasibility of expensive regional projects, there might be political influence to the development of future projects using energy resources as a policy tool.

And recent developments with oil related projects present an evidence that the among the countries there will be quite stiff competition to secure energy resources and to get access to resources as much as possible bypassing neighbors and using bilateral types of agreements.

Due to historical issues between nations, disputes for certain territories, and differences in political and structural the countries of the region are still reluctant to cooperate in multilateral projects, and besides bilateral projects the opportunities for successful multilateral cooperation are enormous.

The countries of the region, such as Japan, South Korea, China, are among the largest in the world in terms of energy consumption. Demand for energy in North Asia will increase by 1.7 times by the year 2020.

The 70% of total regional increases will be contributed by China alone. As of 2003 China is the second largest energy consumer accounted for 10.6% of the world total[5]. The China's crude oil import increased significantly to 91.13 million tons, up to 31.3% compared to previous years[6]. The China's petroleum

2. *Source*: Kensuke Kanekiyo, Managing Director, the Institute of Energy Economics of Japan (IEEJ), Diversifying Energy Resources in North East Asia, The 8th International Conference on North East Asian Natural Gas Pipeline, March 8, 2004, Shanghai, China
3. *Source*: North East region energy demand in 2001 was 2332 million TOE, which was the 25.4% of total world share, KEEI, 2004
4. *Source*: Oil Security and Collaboration in Northeast Asia, Norio Ehara, Head of Non-Member Division, Asia/Pacific and Latin American Countries, International Energy Agency (IEA), Seoul, Korea, 16-17 March, 2004
5. *Source*: BP Statistics
6. *Source*: Survey on the Development of Liberalization of the Oil Market in Northeast Asia and its influence. Youichi Odawara, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry, Japan

demand is estimated to grow by highest in the world rate of 3.3% on average up to 2020, its import reach about 10 billion B/D in 2030, equal to that at present in the United States. So, the impact of China to regional demand increase will be outstanding. China produces 30 billion m^3 of natural gas, and its consumption at 3% of total energy consumption compared to the world average of 24%. By the end of 2002, the cumulative geological reserve of proved natural gas has reached 3.46 trillion cubic meters, ranking 15th in world. The recent forecasts show that the demands for natural gas will 153.5 billion m^3 in 2015. The demand for power in China has grown by 15.6% in 2004 faster than it was predicted in the tenth five-year plan (2001 – 2005) of People's Republic of China.

These numbers for growth for energy demand show that the Chinese factor, or Chinese impact will be huge.

With the increasing demand for energy resources in North East Asia the energy security issues will include supply/demand issue, dependence on certain region (Middle East oil supply), political risks, and market power of major suppliers etc.

Financing Needs, Ongoing Projects and Obstacles for Implementation

For North East Asia the main potential energy supplier is the East Russia. Energy resources of East Russia are enormous: 14 billion tones of oil potentials in East Siberia and the Far East, hydro and tidal generation capacity of 17.2 GW, proven natural gas reserves of 5.4 tcm (12% of total Russian reserves). Russia produced 590 billion m^3 of natural gas in 2002, and production will reach up to 730 m^3 in 2020. And the natural gas sector would require up to 200 billion $US dollar investments till 2020, and East Russia would require 23-25 billion USD investments[7]. Russian Far East needs investments for explorations, production and infrastructure to export oil to countries of NEA region.

The East Siberia and Far East of Russia has a potential to export electricity up to 40 TWh by the year 2010[8].

It is estimated that by the year 2030 the world's total energy investment would need about $16 trillion, and the electricity sector would dominate the demand accounting 60% of the total world energy investment. Nearly a third of $16 trillion of energy investments will be needed for East Asia.

It is estimated that cumulative energy investments needs for China and Russia would be at about 850 billion USD by 2010, and about 3300 billion USD by 2030. For already identified projects in NEA, such as Sakhalin and Irkutsk gas projects, and Angarsk-Nakhodka (or Daqing), or Pacific oil projects the investment needs would vary from 112 to 120 billion USD.

The NEA region has been historically a place of tense geopolitics. The recent pull-out of the DPRK from the non proliferation treaty (NPT) and stagnant six party talks to produce expected results favorable for regional security will definitely influence the North East Asia (NEA) regional projects, which are under considerations or development.

In 2001, the Governments of China and Russia signed a framework agreement to build a an oil pipeline linking Angarsk in Russia to Daqing in China, but recent developments show that Japan has offered a rival 4300 km pipeline Taishet – Skovorodino – Nakhodka (Perevoznaya bay). The cost of this project may be as high as 16 billion, and if the project will realize it will pump one million barrels of oil a day by 2006, which is enough to supply one-fifth of Japan's consumption. It is evident that for this project the energy security was the first argument, and the cost was the second issue. Increasing oil

7. *Source*: "The Energy Cooperation between Russia and NEA Countries: Direction, Priority Interstate Projects, Problems of Their Implementation", B.Saneev, A.Kalmychek, International Workshop "North East Asian Natural Gas Pipeline: Multilateral Cooperation", Tokyo, December 6-7, 2004

8. *Source*: Ways of Creating International Connections in East Asia and Environmental Implications, L.S.Belyaev, N.I.Voropai, S.V.Podkovalnikov, G.V.Shutov, Energy Systems Institute, Irkutsk, Russia

prices may justify the economic feasibility, but only in the case if the proven reserves would be high.

Among advanced ongoing projects there is a project for electricity transmission from Russian Federation to the DPRK through 380 km 500 kV AC (alternating current) transmission line with load capacity up to 500 MW and up to 2.5 billion kWh per year. The total project cost is about 160-180 million USD. The power will be supplied from Primorsky Krai to the DPRK through Vladivostok, Kraskino to Chonjin. Besides of securing the project financing, the project implementation may be influenced by external political factors.

It is evident that after 9/11 the global investment environment has been shaken tremendously, and investors worldwide became very cautious in making long-term investment commitments especially in energy sector, where the success of investments depend on complex set of issues, such as political and macro economical stability, regulatory environment, investment protection and promotion policy, etc. And as a result, in estimation of return on investments the investors increase an influence of such factors, such as regional security, political stability, and country risks.

Most ongoing and developing projects have very high investment costs, and it is difficult for one country, or one investor to secure financing for these expensive projects, therefore, only joint multi-governmental efforts together with investors' consortium can share and mitigate the risks and implement these projects.

Environmental Issues & Further Actions

Significant demand increase will have a dramatic impact to the global environment. It is estimated that carbon emissions from fossil fuel burning could rise to more than 20 billion tons/year in 2100 from 6 billion tons/year in 2000. The International Panel on Climate Change (IPCC) concluded that temperatures are likely to increase another 1.4° to 5.8° C in the next 100 years (an addition to the 0.7° C increase already observed)[9].

The North East Asia region characterized by high dependency on coal in China, and high dependency of oil in Japan and Korea. The carbon dioxide emissions will grow at 3.2% in China, and at 2.0% in other North East Asia countries totaling 7967 million tons by 2020[10].

In China with the sky rocketing energy demand and improved living standards the use of coal as a primary energy source will affect the whole region along with other countries and there is a need to diversify and improve the share of other energy sources, such as oil, hydro, nuclear.

There are some encouraging trends by countries of the region to reduce impact to the environment.

China has increased Government spending on environmental protection from 0.73% of the GDP (130 billion yuan) in the Eighth Five-Year Plan to 0.93% (360 billion yuan) in the Ninth. China also have taken measures, such as upgrading the status of the State Environmental Protection Agency (SEPA), allocating more financial resources, tightening of enforcement of pollution control regulations, improving legal environment to combat and deter environmentally damaging activities, and relaxing government control over non-governmental environmental organizations, etc[11].

Japan is taking measures by promoting policies to tackle environmental issues by diversifying energy sources on supply side, encouraging energy conservation, improving energy efficiency on demand side, by taking measures

9. *Source*: Bridging the Gap between Science and Society, #32, November 2005, James A.Baker III Institute for Public Policy at Rice University

10. *Source*: Potential Benefits and Barriers in Multilateral Energy Cooperation in NEA, Dr.Ji-Chul Ryu, International Expert Workshop "Towards Multilateral Energy Cooperation in NEA", September 5, 2003, Seoul, Korea

11. *Source*: China's Green Challenges in the Twenty-first Century, Carlos Wing-Hung Lo, Shan-Shan Chung

to control the CO_2 emissions below the mandate under the Kyoto Protocol etc[12].

The projects aimed to ensure environmental sustainability in areas of energy conservation and efficiency, renewable energy, and clean development mechanisms (CDM) would be of significant importance to improve an efficient use of energy and to develop environmentally friendly technologies. The countries of the region need to take concerted efforts to promote the use of energy efficient and environmentally friendly technologies, to build capacity for sharing knowledge on new technologies and solutions.

Possible Forms of Cooperation

Although the region has opportunities for regional cooperation, the countries of the region differ significantly in terms of economic capability, size, resources and labor. Every country of the region has own distinguished features, own comparative advantages and disadvantages in promoting regional cooperation.

It is evident that there are tremendous opportunities for regional energy cooperation in all areas of energy related activities, such as power transmission, trade of oil and gas. There is growing demand for energy resources in China, and other countries, such as South Korea and Japan, and on other side we have Russia, which has enormous energy resources and needs investments and labor force.

The countries of the region made significant efforts in facilitating the regional cooperation since Khabarovsk meeting in 2001. And the countries of the region made progress by establishing Senior officials committee (SOC) at the Government level, and establishing the working groups on energy policy and planning in 2005.

It is believed that the collaboration framework on governmental level will help to exchange information, to facilitate project development between interested countries, to reduce the impact of differences in institutional and political structures, to reduce the investment risks etc.

And in a long run as a top down approach of multilateral cooperation, the countries of the NEA can work on creation of institutional framework based on best practices in other regions, such as creation of Energy Charter etc.

Conclusion

For NEA the supply and demand of energy resources, and related energy security will be a major issue for years to come, and investment needs are enormous. Financing of expensive regional energy projects and mitigation of associated risks will be a big challenge for future projects. High dependency on coal as a primary energy resource and increasing pollution require more concerted efforts to reduce an impact to the environment.

The North East Asia region has significant potentials for energy cooperation. The countries of the subregion differ significantly in terms of scale, capacity, political and institutional structure, and for successful energy cooperation it is necessary to actively work on already created institutional framework to promote regional projects. ▣

12. *Source*: Lowering Energy Intensity toward Sustainable Development, Kensuke Kanekiyo, Managing Director, the Institute of Energy Economics (IEEJ), Japan, January 2006

The Gas Dispute between Russia and Ukraine and its Implication for North East Asia

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On the first few days of this year, energy experts and consumers were taken by a surprise with a dispute between Russia and Ukraine over gas supply. Fortunately, the fiasco was not developed into a more serious energy conflict between the gas producer, Russia and the gas importer, Ukraine as the gas supply resumed in a few days. The European gas consumers who heavily rely on Russian gas and the U.S. severely complained about the Russia's suspension of gas supply. Although the dispute ended in a short time, the world economy was concerned about the possibility that the dispute might result in shaking the global balance of energy supply and demand. As the dispute took place in Europe, it doesn't seem to have a deep impact on the Asia gas supply. The geographical long distance from the Asian gas market to the European market may lead the Asian gas consumers to ignore the dispute. A proper attention, rather, should be given to it because it has a heuristic effect on future North East Asian gas supply and demand in the sense that Russia is considered one of the next gas supply sources for the region which is expected continuously to import a large amount of gas from the global gas market.

Key Features of the Russian Gas Fiasco

The starting point for understanding the Russian-Ukraine gas dispute is to analyze the negotiation between Russian and Ukraine over the gas supply price. The two countries had negotiated over the price, but did not draw any conclusion before the end of the last year. On the rupture of the price negotiation, Russia turned off the gas pipeline to Ukraine. In fact, Russia had charged about $50 per one thousand cubic meters($/㎣) on Ukraine, almost the same price of the Russia's domestic gas supply. Ukraine had enjoyed a privileged price since the Soviet Union collapse which politically disentangled Ukraine from Russia. In addition, Ukraine siphoned off the Russian gas to European countries and Russia did not take concrete action against Ukraine, only criticizing Ukraine of stealing Russian gas. According to Russia's accusation, Ukraine have stole about 35million ㎥ per day of gas which Russia intended to export to Europe via gas pipeline crossing the Ukraine territory. It is very curious that last year, the seemingly benign Russia suddenly asked Ukraine to pay the gas price as much as Germany pays to Russia. Last year, Gazprom, the Russian gas monopoly insisted that Ukraine should pay $230/㎥ on the ground that Ukraine attained a free trade country status like the Western European countries in the international trade regime, namely World Trade Organization. For Ukraine, a four-times-increased price was unacceptable and in consequence, Russia responded by stopping gas supply to pressure Ukraine to agree with Russia's offer.

Table 1.Russia's Natural Gas Pipelines to Europe and Export Volume
(as of Nov. 2005. million cubic feet per day)

Via	Ukraine	Turkey	Poland
Export	10,096	1,518	671

source: PIRA, Dec. 27, 2005

The Russia's strategy of price negotiation instantly faced a strong backfire from the Western countries. Besides Ukraine, the Western countries which heavily rely on the Russian gas were also exposed to gas supply disturbance directly caused by the gas dispute. The reduction of the gas supply to European consumers is closely linked to the Russia's gas pipeline system for providing gas to Europe. The system consists mainly of three pipelines. One is Blue Stream, newly constructed and put into operation in 2003, goes to Turkey. This line does not provide gas to the West European consumers. Another is Yamal-Europe pipeline which passed through Poland to Germany's Berlin. The other is the largest Transgas pipeline, which passes through Ukraine and branches off into two lines. One branch goes through Czech Republic and ends in Germany's Frankfurt while the other branch goes through Austria and terminates in Italy's Milan.

As Russia stopped gas supply to Ukraine, the key European economies such as Germany, Italy and Austria, being supplied with Transgas pipeline, encountered gas supply disruption. As is seen in the table above, the pipeline via Ukraine transports the largest volume of Russian gas to Europe. To make matters worse, these three pipelines are not interconnected. If one pipeline becomes inoperative, in other words, other lines cannot compensate for the loss of supply. As a consequence, Russia's stop of gas provision to Ukraine resulted in reducing Russia's gas supply to Europe without any delay. The delivery to Europe through Ukraine dropped to 30-40%, which shocked the European gas consumers and triggered a strong protest against Russia.

Along with the European protest, the U.S. also worried about the impact of Russia' gas supply disruption on the global gas supply. As Russia shut down gas pipeline to Ukraine, the consumers are very likely to go forward to the global liquefied natural gas (LNG) market to gap the shortage if it would persist for a long time. In this case, the European buyers have much stronger purchasing power for LNG and would soak up a large volume of LNG. for the conventional buyers such as Japan, Korea and the U.S. The Europeans nowadays buy the Russian gas at $6.40 per million British thermal unit(mmBTU) while the Asian LNG price is around $3-4/mmBTU. When the European consumers start an emergency LNG purchase, according to an estimate, they will absorb about half of the U.S. LNG import.[1] Russia's gas supply interruption seemed to support the U.S.'s older argument against the construction of gas pipeline from Russia to the key Western European countries in the early 1980s. At that time, the Reagan Administration, confronting the Soviet Union in the Cold War, strongly opposed the Germany's plan for the gas pipeline building because the pipeline would make the U.S. allies fall heavily back on the energy supply from the Cold War enemy.[2] Apart from the Cold War memory, in the end, the U.S. State Secretary blamed Russia right after the gas supply stop.

The gas flow restored to the normal just two days after Russia discontinued gas supply. On January 4, Russia and Ukraine made an agreement that Russia and Ukraine decided RosUkrEnergo(RUE) as an intermediary company to control the transit of Russian gas over Ukraine to Europe and in exchange, and Russia resumed gas supply to Ukraine. Although the agreement set the negotiation deadline on January 25, the two countries failed to sign the complex gas supply agreement as of the early February because they did not consent on several complex technical conditions including how to calculate Ukraine's gas consumption and Ukraine's delivered volume to Russia's European gas buyers.[3] Furthermore, the Ukraine parliament, contending that the

1. PIRA, Russian-Ukraine Gas Dispute, Dec. 27, 2005

2. For a thorough analysis of the gas pipeline construction, refer to Bruce W. Jentleson, *Pipeline Politics; the Complex Political Economy of East-West Energy Trade* (Ithaca, Cornell University Press, 1986)

3. Argus FSUE, "Russia-Ukraine gas deal flounders," Jan. 27, 2006

agreement with Russia undermine its national security, opposed it and fired the energy minister.[4]

Motivations for Russia's Action

The Russo-Ukraine gas dispute raises several questions, the most important of which is the motivation for Russia to confront its neighboring countries with gas issue. Economic factor is one explanation for the Russia's action. As briefly mentioned above, Russia has charged low rate of gas price on its former allies since the collapse of the Soviet Union. However, over the last several years, Russia changed its price policy and increased the price at an astonishing rate. In 2003, for example, Russia asked Belarus to raise the price from \$25/㎣ to \$80/㎣ and they reached \$47/㎣. For Russia, energy including gas and oil is the most viable export commodity and crucially contributes to the government revenue. From this perspective, Russia has a reason to increase export price of natural gas unilaterally.

Another motivation is closely related with Russia's foreign energy policy over its neighboring countries. In 2004 and 2005, Russia witnessed domestic political changes in several neighboring countries. The political changes such as Ukraine's Orange Revolution, Georgia's Rose Revolution and Kyrgyzstan's Lemon Revolution weakened the political relation between Russia and the countries. Despite the weakening political relations, however, Russia has dominated the energy supply to them by meeting almost all their energy demand and by controlling energy supply infrastructure including oil and gas pipelines. From a perspective of foreign relations, energy is regarded as a most effective policy instrument for fulfilling foreign policy goal. As stable energy supply is crucial for keeping economic growth and general life, energy importers which are vulnerable to energy security are very likely to subject themselves to making good relations with exporting countries. 'Russian Energy Strategy 2020' published under the Russian government auspice in 2004 follows the suit. It clearly states that energy should be strategically used for expanding Russia's international influence. According to an energy industry periodical, the Ukrainian gas dispute shows consistency with the perspective of the relations between energy and politics.[5] While Russia provides natural gas to obedient countries like Belarus at a favorable rate, it asks unfriendly countries such as Estonia and Latvia to pay as high as \$120-123/㎣. A prominent oil industry periodical criticized Russia as having willingness to use its hydrocarbon clout with former Soviet Union states.[6] In other words, Russia is reported to make a use of gas supply as a tool to prevent Ukraine and other allies from deviating from its political sphere.[7]

To reinforce economic and political interests over the neighboring regions, Russia intends to consolidate its capability to supply natural gas to the former Soviet Union countries. Russia asks for gas supplier's co-ownership of gas distributing network in importing countries. When Russia negotiated Ukraine on gas price prior to the supply interruption, Russia asked Ukraine to provide it with an ownership role in Ukraine's gas transportation and distribution network. The Russian-Ukraine gas dispute enabled Russia to reinforce its position as a gas supplier to Europe as well as Ukraine. Right

4. *Nefte Compass*, "Ukraine: Ministers Sacked over Russian Gas Deal," Jan. 26, 2006

5. The Soviet Union maintained its political influence over its allies by making use of its energy supplies to them during the Cold War. For an in-depth analysis of the relation between Soviet Union and its East European allies through several energy sources including oil and electricity, refer to William M. Reisinger, *Energy and the Soviet Bloc: Alliance Politics after Stalin* (Ithaca, Cornell University Press, 1992)

6. *Petroleum Intelligence Weekly*, "Ukraine Standoff Displays Kremlin's Gas Clout", Jan. 2, 2005

7. *The Russian Energy*, "Market Pressures: Next Year Will See Real Gas Market in Ex-USSR," December 2005

after the gas dispute, Ukraine and Turkmenistan agreed that RUE would transport Turkmenistan gas to Europe through Russia and Ukraine. With the agreement, Russia can have an influence on Turkmenistan's gas export to Europe. Russia's aspiration to take over ownership of pipeline is also observed in the Baltic states like Lithuania, Estonia and Latvia, in which Russia finally took co-ownership of gas distributing companies in each country.[8] Georgia is also concerned that Russia will stop gas supply to Georgia unless the gas pipelines are sold to Russia.[9] Securing the partial ownership of national gas distributing companies, Gazprom, the stakeholder of the partial ownership, can not strengthen its dominant role only in supplying gas supply but increase also the gas price from the preferential one to the same level of other EU states.

Natural Gas and Energy Security

The gas dispute between Russia and Ukraine has a surprising impact on energy security, in particularly natural gas security. It is general perception that natural gas has advantages over other energy sources, especially oil and moreover, natural gas transported through pipeline is more secure for several reasons. First of all, gas supply is more stable because it depends on long term supply contract. While oil is usually traded on spot market and even term oil contract is generally effective for short period like a few months or a few years, natural gas which does not have a well-developed spot market is traded on at least twenty year long term contract. Another perception is that as key natural gas producers such as Russia and Turkmenistan are not from politically unstable Middle East, natural gas is less likely to be exposed to political instability and politically motivated supply disruption. Lastly, gas through pipeline is safe in transportation because it does not depend on sea lane transportation which increasingly faces accidents such as pirate, natural disaster and territorial conflicts among littoral countries. These perceptions of natural gas are known to greatly contributing to energy security of consuming countries.

Despite the strengths of natural gas in energy security, the Russo-Ukraine gas dispute refutes the conventional wisdom of natural gas supply security. Long term contract of natural gas trade sometimes weakens consumers' status in gas price negotiation. Besides the Russo-Ukraine dispute, there have been several gas supply interruptions when gas suppliers and buyers are engaged in price negotiation. For example, Algeria stopped gas supply through an undersea Mediterranean pipeline to Italy in 1985 when the two countries failed to reach a new gas supply price. More recently, Belarus, a Russian gas buyer in Eastern Europe, went through a similar negotiation crisis when both countries talked about gas supply price. In 2003, Russia threatened Belarus to cut off gas supply if the latter did not accept Russia's new price and consequently, Belarus partly accepted Russia's offer. These imply that terms and conditions of long term gas supply are very stiff and price negotiation can easily be controversial when gas supply price should be adjusted.

Unlike oil, natural gas consumers do not have a proper policy instrument to cope with gas supply disruption. In case of oil, key oil importing countries have certain level of strategic oil reserves to make up for supply loss during a supply disruption. In addition, the international energy regime organized through International

8. *Nefte Compass*, "Showdown; Moscow Makes an Example out of Ukraine," Dec. 29, 2005

9. *FSU Oil and Gas Monitor*, "Will Georgian-Russian Gas Spat Hurt Tbilisi's Quest for Alternative Energy Supply?" Jan. 25, 2006

Energy Agency obligates members of Organization for Economic Cooperation and Development to hold oil reserves equivalent to 90days of net oil import for emergency use. On the other hand, natural gas consuming countries do not have emergency gas reserves. Two years ago, when European Union Commission proposed emergency gas reserves to the member economies, they refused it because the proposal would impose budgetary burden on the members.[10] There is no such country having emergency gas reserves in the world, without mentioning international gas regime to stipulate gas consumers to keep certain amount of emergency gas reserves which can be used when gas supply is reduced.

The inflexibility of natural gas supply system characterized with gas pipeline is very difficult diversifying gas supply sources and liberalizing gas market. As construction of gas pipeline costs much, consuming countries can't afford to have multiple gas importing pipeline and depends mainly on one supplying country. Furthermore, in European Union, it consumes much time to open Europe's gas market and create competition among suppliers for more economic price.[11] Still worse, Germany, the largest Russian gas importer in Europe, is planning to construct another line, named 'North Europe Gas Pipeline,' to import more Russian gas.[12] Even if Germany has several gas import pipelines, the gas supplier will be only Russia. It is true that a few Central Asian countries such as Azerbaijan, Turkmenistan and Kazakhstan are expected to be promising gas supply sources for Europe, transportation system based on gas pipeline is still in the strong grip of Russia.[13] Single supply source through pipeline is very hard serving the policy goal of gas supply security and market liberalization.

Concluding Remarks; Implications for Northeast Asia

The Russia-Ukraine gas wrangle appears not to have a direct impact on the balance of gas supply and demand in North East Asia. At this moment, the region is not supplied with Russian gas and no country is dependent on pipeline gas because the major gas importers such as Japan and Korea mainly rely on LNG.. Furthermore, LNG market is not so regionally integrated as the global oil market. Oil is usually traded on the regional basis in the sense that Middle East crude oil is primarily supplied to East Asian market, the U.S. is heavily dependent on Canadian, Mexico and Venezuelan crude oil and European countries imports bulk of crude oil from Africa and Middle East. In spite of the regionalized characteristics of the world crude oil market, crude oil moves between the regional markets without any institutional hindrance when the arbitrage window opens mainly because of supply disruption and inter-regional price difference. Global gas market, on the other hand, is quite different from the global oil market mechanism. Even if European gas market was faced with the short-lived supply disruption, East Asian LNG was not observed to have moved to Europe to make up for the supply shortage. Rightly to say, Northeast Asian gas consumers are not severely influenced with the Russo-Ukraine gas fiasco.

In light of the recent movement in the regional energy relations, the Russia's gas is likely to be

10. *Financial Times*, Editorial, Jan. 8, 2006
11. Loyola de Palacio, "Reforming the Gas Market," in *Energy and Security; toward a new foreign policy strategy*, edited by Jan H. Kalicki and David L. Goldwyn (Baltimore, Johns Hopkins University, 2005), pp. 175-190
12. *Weekly Petroleum Argus*, "Security Forces", Jan. 9, 2006
13. *Petroleum Intelligence Weekly*, "Gazprom's Cold War Tactics Spook Europe," Jan. 9, 2005

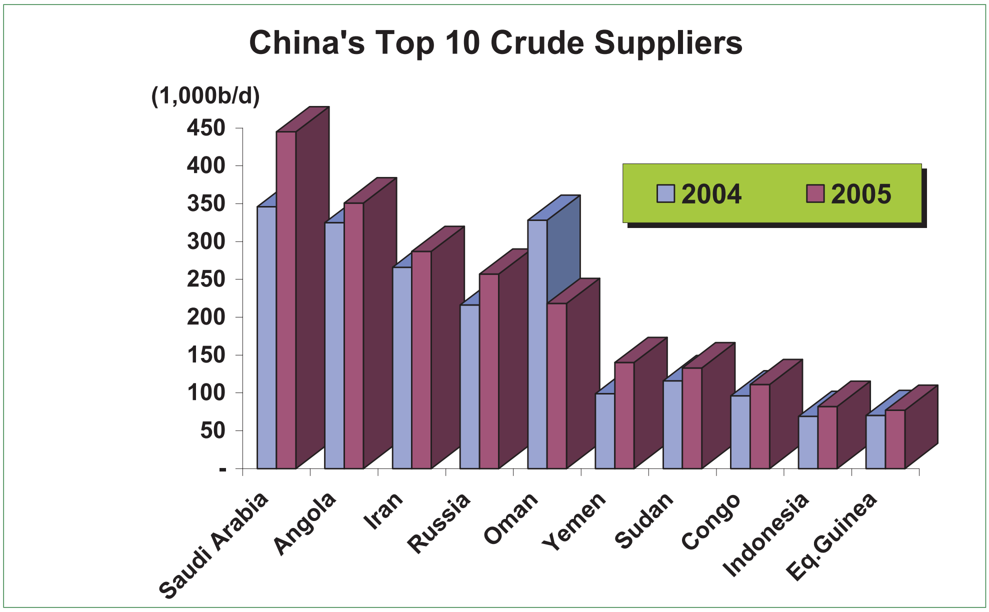
very significant for the sustainable development of North Asian economy. First of all, Russia is building a concrete plan for developing gas resource in East Siberia and North East Asia is expected to be main buyer of East Siberia gas. To facilitate gas development in Russia Far East as well as East Siberia, Russia is planning to construct gas pipeline system, so-called Unified Gas Supply System.[14] Furthermore, the negotiation among China, Korea and Russia over Kovykta gas export had seemed to realize Russian gas supply to the region. In addition, as the Sakhalin gas supply from Project-I starts sooner or later and Korea and Japan decided to import Russia's Sakhalin LNG from 2008, Russia gas is coming closer to Northeast Asian consumers. From the demand perspective, Korea and Japan import large amount of natural gas from the world LNG market and China is also to import substantial amount of LNG.. The supply push for and the demand pull of Russian gas imply, therefore, that Russia gas is a leading candidate of future supply source for Northeast Asian economy.

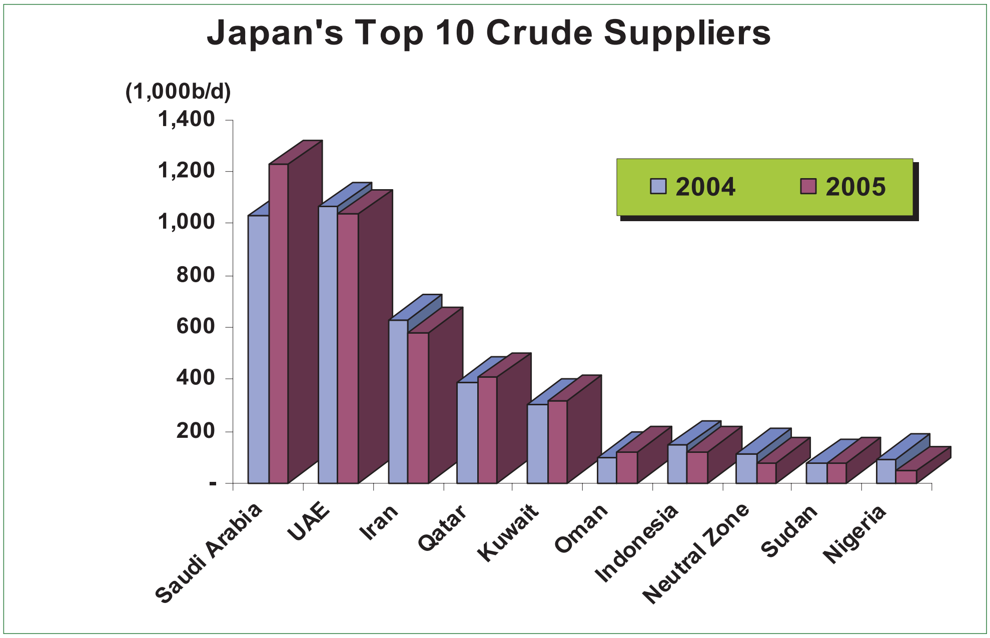
For energy cooperation and gas supply security, the Russia' gas feud with Ukraine has several strong implications. Above all, diversification of gas supply sources should be respected. At this moment, Northeast Asian countries are making effort to find additional gas supply sources and Russian gas absolutely serves to this effort. As was discussed above, the Russia-Ukraine dispute was partly due to the absence of genuine gas market in which multiple suppliers exist. In Northeast Asia, LNG and pipeline gas are very complementary in creating a regional gas market because it provides multiple choices for consumers. Second, the dispute suggests that gas price should be determined on market basis. In case of Russia-Ukraine, gas price is decided not by energy market but by complex and complicated negotiation between the seller and the buyer and the negotiation is inconclusive, controversial and quarrelsome. For an effective and transparent price decision, gas price should be linked to other competing energy products such as fuel oil products. Lastly, for emergency measure, gas consumers should give attention to emergency natural gas reserves. As Natural gas market is expected to emerge in the region where gas demand will increase continuously, it is essential to develop an emergency response instruments. Natural gas reserves will be a crucial component of gas emergency measure.[15] ▣

14. Oleg Sinyugin, "Eastern Dimension of Russia' Unified Gas Supply System," *Northeast Asia Energy Focus*, Vol. 2, No. 4, Nov. 2005, pp. 17-24

15. William F. Martin and Evan M. Harrje, "The International Energy Agency," in *Energy and Security; toward a new foreign policy strategy*, edited by Jan H. Kalicki and David L. Goldwyn (Baltimore, Johns Hopkins University, 2005), pp. 97-116

NEA Statistics





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