International Symposium on

Energy Co-operation in Northeast Asia

7-8 June 2001

Sheraton Walker Hill Hotel, Seoul, Korea

Organized by

Korea Energy Economics Institute

Institute of Energy Economics, Japan

United Nations Economic and Social Commission for Asia and the Pacific

Sponsered by

Ministry of Commerce, Industry and Energy, Korea

Korea Gas Corporation

Korea National Oil Corporation

에너지경제연구원
KOREA ENERGY ECONOMICS INSTITUTE

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International Symposium on

Energy Co-operation in Northeast Asia

7-8 June 2001. Sherton Walker Hill Hotel, Seoul, Korea

Symposium Program

Agenda

Thursday, June 07, 2001

Registration: *08:10 – 09:00* ***(Room – Mugunghwa Ballroom I, Convention Center)***

Opening Session

09:00 – 09:10	**Welcome and Introduction**	*Dr. Hyun-Joon Chang,President, KEEI*
09:10 – 09:30	**Keynote Speech:**	*Mr. Hak-Soo Kim, Executive Secretary, UN/ESCAP*

Session 1: Energy Profile, Outlook and Perspectives on Regional Co-operation in Northeast Asia

Chair: Dr. Bong Suh Lee, Former Minister of Energy and Resources, Korea

09:30 – 09:50	**Overview of Energy Issues in Northeast Asia**	*Dr. R. Wahnschafft, UN/ESCAP*
	Energy Profile, Outlook and Perspectives on Regional Co-operation	
09:50 – 10:10	• China	*Dr. D. Zhou, President, ERI, China*
10:10 – 10:30	• Japan	*Mr. Y. Sakamoto, President, IEEJ, Japan*
10:30 – 11:00	***Coffee Break***	
11:00 – 11:20	• The Republic of Korea	*Dr. Hyun-Joon Chang, President, KEEI*
11:20 – 11:40	• Russia	*Prof. S. Zhiznin, Senior Counsellor, Ministry of Foreign Affairs*
11:40 – 12:00	• *Mongolia*	*Mr. L. Bold, Chairman Committee on the Promotion of Foreign Investment, Mongolia*

12:00 – 12:20	• The Democratic People's Republic of Korea	*Mr. Kyoung Sool Kim* *Research Fellow, KEEI*
12:20 – 12:40	***Floor Discussion***	

Lunch: 12:40 - 14:30, Mugungwha Ballroom II, Convention Center

Luncheon Speech : H.E. Dr. Che-Shik Chang, Minister of Commerce, Industry and Energy, Republic of Korea

Session 2: Future Challenges in the Energy Sector in Northeast Asia

Chair: Dr. Young Sik Jang, Former President of KEPCO

14:30 – 15:00	**Energy Security and Northeast Asian Petroleum Market**	*Mr. M. Soga, Senior Economist, IEEJ* *Dr. S. Kaku, Economist, IEEJ* *Mr. Jung Hwan Choi, Economist, IEEJ*
15:00 – 15:30	**Power Interconnection Network in Northeast Asia**	*Dr. S. Popov,* *Head of Laboratory, ESI, Russia*
15:30 – 16:00	**Natural Gas Infrastructure Development in Northeast Asia**	*Mr. Sunwoo Hyun Bum,* *Advisor to the President, NAGPF*
16:00 – 16:30	***Coffee Break***	
16:30 – 17:00	**Energy-Environment Issues and Implication of the CDM for Northeast Asia**	*Dr. G. Timilsina,* *Senior Researcher, CEERD,AIT*
17:00 – 17:40	***Floor Discussion***	

Reception : 18:00 – 20:00. Mugungwha Ballroom II, Convention Center

Hosted by Korea Gas Corporation

Friday, June 08, 2001

Session 3: Perspectives of Energy Co-operation in Northeast Asia

Chair: Prof. Eui Soon Shin, Yonsei Univ.

09:00 – 09:30	**Energy Co-operation between two Koreas**	*Mr. Woo Jin Chung, KEEI*
09:30 – 10:00	**Lesson from Energy Co-operation in Europe and its Implications for Northeast Asia**	*Mr. E. Ulfstedt, Director, Energy Charter Secretariat*
10:00 – 10:30	***Floor Discussion***	
10:30 – 11:00	***Coffee Break***	
11:00 – 11:30	**Financing Energy Infrastructures in Northeast Asia**	*Mr. M. Farhandi, Energy and Mining Sector, World Bank*
11:30 – 12:00	**Energy Co-operation between Northeast Asia and the Middle East** – *Commentator: Dr. G. H. Hassantash* *President, Institute for International Energy Studies, Iran*	*Dr. A. M. Al-Ghamdi, Economic Advisor to the Minister of Petroleum, Saudi Arabia*
12:00 – 12:30	***Floor Discussion***	

Lunch: 12:30 - 14:00, Mugunghwa Ballroom II, Convention Center
Luncheon Speech: Mr. Soo Yong Lee, President of Korea National Oil Corporation

Session 4: Implementation of Energy Co-operation in Northeast Asia

Chair: Dr. Hyun-Joon Chang, President, KEEI

14:00 – 15:30 **Roundtable discussion for energy co-operation in Northeast Asia**

- Panel:
- Country representatives: Korea, China, Japan, Russia, Mongolia
- International Organisation: UN/ESCAP, Energy Charter Secretariat, World Bank, AIT

15:30 – 16:00 **Wrap-up**

16:00 **Closing**

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International Symposium on

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Opening Session

Welcome and Introduction

Dr. Hyun-Joon Chang,President, KEEI

Keynote Speech

H. E. Dr. Che-Shik Chang,
Minister of Commerce, Industry and Energy, Korea

Mr. Hak-Soo Kim, Executive Secretary, UN/ESCAP

Welcome and Introduction

Dr. Hyun-Joon Chang,
President
Korea Energy Economics Institute

Ladies and gentlemen

It is my great privilege to greet you all, the honorable guests who participate in the International Symposium on Energy Cooperation in Northeast Asia. This Symposium, I believe, will be a great stepping stone for opening a new and prosperous era. Especially I would like to express my deep appreciation to Dr. Zhou, the President of Energy Research Institute of China, Mr. Sakamoto of Institute of Energy Economics of Japan, Mr. Bold, the Chairman of Committee on the Promotion of Foreign Investment of Mongolia, and Mr. Sooyong Lee, the President of Korea National Oil Corporation. Another deep thanks are due to Dr. Bongsuh Lee, the Former Minister of Energy and Resources of Korea, Dr. Youngsik Chang, the Former President of KEPCO, and Professor Euisoon Shin of Yonsei University for their willingness to accept chairmanships. Finally I wish to express my deep gratitude to Minister of Commerce, Industry and Energy, UN-ESCAP, Institute of Energy Economics of Japan, Korea National Oil Corporation, and Korea Gas Union for their thoughtful and wonderful support in preparing for this symposium.

Up to now Northeast Asian countries have experienced some kind of troubles in the mutual economic cooperation because there has been the serious historical, political, and economical differences even though they have shared common cultural heritage. Still the reconciliation of political and economical dissimilarities has a long way to go. Recently new trend to narrow those differences has evolved because each country's economic environment becomes more interrelated.

Now it's time to find out what is best way to speed up this trend toward more productive and rewarding circumstance. The energy cooperation could be the truly key play to accelerate this trend since we witnessed that European countries had similar experiences after World War II.

World War II made European countries feel deep hatred and distrust toward

each other. Also they strongly felt that a new economic and political framework was needed if future conflict was to be avoided. As a beginning of new framework, European Coal and Steel Community was founded in 1952. Even though the beginning of ECSC was not smooth, ECSC have played a main role in the gradual integrating of European economy and produced a strong, positive feeling about the benefits from economic cooperation. The same rule can be applied to energy cooperation among the Northeast Asian countries. Mutual benefit from energy cooperation can provide a momentum to promote our economic cooperation. The role of coal and steel in regional integration can be replicated in the energy cooperation in Northeast Asian Countries.

Northeast Asia is not only a huge energy consumption region, which is close to main supplier like the Middle East, Siberia, and Southeast Asia, but also currently its energy consumption accounts for 17% of the world consumption. Furthermore since within next 10 years the energy consumption will sharply increase at the rate of more than 50%, the securing of reliable energy *sources* will be a core factor in the future economic growth. However, since Northeast Asia countries have had the closed and isolated energy supply network, every energy crisis has enforced each country to depend on its own limited and myopic energy policy. Transportation through marine route has been main transit method of energy resources transporting. This marine transportation is vulnerable to the unpredictable instability of energy supply and has a potential danger of disastrous environmental pollution. If Northeast Asian countries are successful in energy cooperation, these problems can be avoided and furthermore the dependable and inexpensive energy will be supplied. The efficient energy supply will raise the competitiveness of each country and successfully contribute to the prosperity of all Northeast Asian countries. It is no doubtful that security of energy supply is one of most important factor in sustainable economic growth. The effort to secure efficient energy supply will make us to be leading actors in the prosperous 21st century.

I hope this symposium will not be the just distribution of energy-related knowledge, but a chance to exchange mutual trust and understanding and found common ground for us. I wish this event will be a great opportunity not just for energy cooperation for Northeast Asian countries, but also for economic integration of these countries. Today we will be sure that continuing co-prosperity of Northeast Asian countries lies in the mutual economic cooperation, the initiative of which must be in the energy cooperation.

Thank you very much.

Keynote Speech:

Vision of Energy Cooperation in Northeast Asia

H.E. Dr. Che-Shik Chang
Minister of Commerce, Industry and Energy
Republic of Korea

Distinguished guests and energy experts, ladies and gentlemen

Today, I am very pleased to address the First International Symposium on Energy Cooperation in Northeast Asia, which is jointly organized by the Korea Energy Economics Institute, the Institute of Energy Economics Japan, and the UN ESCAP.

New Trends in the 21st Century and Northeast Asia

As we enter the 21st century, the world is now transforming itself into the knowledge-base economy, complexly driven by new technologies, such as information technology(IT) and bio-technology(BT) as well as by extensive use of the internet and digitalization (information networking) of conventional industries. For this reason, significant changes in industrial structure and people's life style are taking place, and economic globalization is accelerating through borderless business activities and exchange of information and human capital.

Also, as we have seen, especially in Europe and North America, growing economic regionalization, which deepens cooperation among the nations in a particular region.

However, in Northeast Asia, the promotion of regional cooperation is proceeding at a relatively slower pace, compared with the other regions, despite its enormous potential benefits. This is due mainly to past historical rivalries and conflicts and to the differences in economic levels among the countries in the region.

In Particular, energy cooperation for development of energy resources and construction of energy related infrastructures in Northeast Asia, which usually requires a large amount of capital investment, has shown little progress up to now, because this requires substantial mutual trust and cooperation among the countries involved.

In this respect, we can see that President Kim Dae-jung's visit to Pyungyang in North Korea last year helped relieve tension on the Korean peninsular and nurtured a peaceful climate for mutual cooperation between two Koreas. Furthermore, I believe that this movement toward peace on the Korean peninsular will eventually contribute to eliminating obstacles in promoting cooperation in Northeast Asia by ending political

and military tension in the region.

Vision and Challenges in Northeast Asia

The Northeast Asian region at present accounts for 24 per cent of the total world population, and about 19 per cent of total world GDP. Northeast Asia is experiencing the faster economic growth than any other regions in the world, and it is expected to emerge as a center of the world economy in the 21st century.

Thanks to continuous high growth in China, robust economic growth in Korea and economic recovery in Japan, Northeast Asia is believed to have a great potential for increasing energy demand in the future. The share of this region in world energy consumption is expected to increase to 23 per cent in 2010 from the current 19 per cent.

Korea and Japan totally depend on imports for their oil supply, and China is expected to significantly increase oil imports in the future. Accordingly, the region's dependence on the Middle East for oil imports is expected to increase to 90 per cent in 2010 from the current level of 75 per cent. This outlook clearly indicates that regional energy security could be threatened in the event of an oil crisis in the future.

Moreover, since increases in energy consumption usually result in environmental pollution, the countries in the region need to make joint efforts to establish a more environmentally friendly energy system in the region.

Perspectives on Energy Cooperation in Northeast Asia

In order to enhance the stability of the energy demand and supply structure in Northeast Asia in the future, we need to develop energy resources, such as natural gas, coal and hydro power reserves in this region including East Siberia, and to construct energy infrastructures to transport the energy from remote areas.

Also, to meet the continuously increasing demand for electricity resulting from economic growth in Northeast Asia and to develop an efficient power supply-demand system, there is a need to promote, in the long term, a cross-border interconnected power grid system.

In addition to measures on the supply side, we need to facilitate mutual regional cooperation for facilitating energy conservation and technology development for new and renewable energy to jointly tackle common global problems such as climate change.

Thus, the promotion of energy cooperation in Northeast Asia will not only contributes to solving the problem faced by the region but will also promote clean

environment and the regional prosperity for future generations.

As you are aware, Europe has already created the regional energy cooperative body based on the European Energy Charter, and the United States, as announced in its New Energy Policy last month, emphasizes the importance of regional energy cooperation, particularly with its neighboring countries. Thus, strengthening regional energy cooperation is a common phenomenon in other regions in the world.

Northeast Asia has a large potential for mutually complementary energy cooperation structure in that there are major energy consuming countries, Japan, China and Korea, and the countries with large energy reserve areas, such as East Siberia, Sakhalin, and Central Asia.

I am convinced that the climate for active promotion of energy cooperation in Northeast Asia has been created.

Proposal for Creation of Working Committee for Energy Cooperation in Northeast Asia

Since the inauguration of President Kim's administration, the Korean government has been implementing reforms in the four major economic sectors : namely, the corporate, financial, labor, and public sectors. Yet, while it is true that there are many issues to be resolved, Korea has successfully recovered from the financial crisis which severely hit our economy in 1998 and has achieved a great deal of success in its reforms.

In Particular, reform of the energy sector is well recognised as the most successful case among the public sector reforms. The energy industry in Korea, re-born as a more efficient industry, is well prepared to play an active role in energy cooperation in Northeast Asia.

As the Energy Minister of Korea, I have no doubt that energy cooperation in Northeast Asia will be a 'Win-Win' business proposition, beneficial for all the countries in the region.

Thus, I would like to propose, on this important occasion, to create a " Working Committee for Energy Cooperation in Northeast Asia" this year, including China, Japan, Mongolia and Russia. The initial task of the proposed Committee is to develop a policy agenda to promote regional energy cooperation, which heretofore has been discussed at the private-sector or industrial levels, at the government level.

I am confident that such a government cooperative body, through collaboration with the related research institutes and industry, can produce very productive results such as realistic proposals for financing large scale energy projects for energy development and infrastructure building, which require enormous amounts of investment.

Concluding Remarks

I believe that this Symposium will provide us with an excellent opportunity to facilitate exchange of expertise and ideas among energy experts on energy cooperation in Northeast Asia. And, the outcomes and suggestions from this Symposium will, I believe, have a positive impact on policy making in the countries in the region.

The Korean Government is committed to provide financial and administrative support for the follow-up activities of this Symposium.

In conclusion, I would like to thank the organizers of this Symposium for their hard work and offer my best wishes for a highly successful and productive conference.

Thank you very much.

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Session I

Chair: Dr. Bong Suh Lee, Former Minister of Energy and Resources, Korea

Energy Profile, Outlook and Perspectives on Regional Co-operation in Northeast Asia

Overview of Energy Issues in Northeast Asia — *Dr. R. Wahnschafft, UN/ESCAP*

Energy Profile, Outlook and Perspectives on Regional Co-operation

- China — *Dr. D. Zhou, President, ERI, China*
- Japan — *Mr. Y. Sakamoto, President, IEEJ, Japan*
- The Republic of Korea — *Dr. Hyun-Joon Chang, President, KEEI*
- Russia — *Prof. S. Zhiznin, Senior Counsellor, Ministry of Foreign Affairs*
- *Mongolia* — *Mr. L. Bold, Chairman Committee on the Promotion of Foreign Investment, Mongolia*
- The Democratic People's Republic of Korea — *Mr. Kyoung Sool Kim Research Fellow, KEEI*

Issues and Perspectives on Energy Development and Cooperation in North-East Asia : An Introductory Overview

Ralph Wahnschafft
Energy Resources Sections
United Nations Economic and Social Commission
for Asia and the Pacific

Structure of Presentation

Part One : Economic and Energy Indicators: An Overview
- Geography, Population and Economy
- Energy Production and Consumption: Structure and Trends
- Long-term Outlook for Energy Development

Part Two : Possibilities and Problems for Multilateral Energy Cooperation in North-East Asia
- Overview of Proposed Projects in Gas, Oil and Electricity
- Problems and Issues to be Addressed

Part Three : Summary Profile of United Nations ESCAP
- Mandate, Vision and Organizational Structure
- ESCAP Activities on Energy in North-East Asia

Economic and Energy Indicators of Countries in North-East Asia

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North-East Asia : Population and Geography at a Glance

	Population (mid 2000)	Area ('000 km²)	Population Density (pers / km²)	Population Growth (in % /year)	Urban Population (in % of total)
China [1]	1,271.9 Million	9,326.4	133	0.8%	32%
- NE China [2]	209.7 Million	2,203.6	95		
Japan	126.9 Million	377.8	336	0.2%	79%
Republic of Korea	47.4 Million	98.5	470	0.9%	82%
DPR Korea	21.7 Million	120.5	192	1.3%	60%
Russia Federation	146.9 Million	16,995.8	9	-0.2%	78%
- Russia Far East [3]	7.3 Million	6,200.0			
Mongolia	2.6 Million	1,556.5	1.4	1.6%	69%

- Includes Hong Kong SAR and Macao SAR
- Includes Beijing and Tianjin Cities and Provinces of Hebei, Heilongjiang, Jilin, Liaoning, and Nei Mangol

3) Republic of Sakha (Yakutiya), Jewish Autonomous Territory, Chukotka Autonomous Territory, Territories of Primorskij, Khabarovsk, Amursk, Kamchatka, Magadan, Sakhalin territories

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North-East Asia : Main Economic Indicators at a Glance

	1999 per capita GDP in US $ (actual exchange rates)	1999 per capita GDP (in PPP-US $)	(PPP Factor)[4]	Estimated Economic Growth 1999	2000	2001
China	784 [1]	1,662	(2.12)	7.2%	8%	7.5%
Japan	23,100 [2]	24,717	(1.07)	0.8%	1.7%	1.5%
Republic of Korea	8,659 [3]	9,698	(1.12)	10.9%	8.8%	3.7%
DPR Korea	1,000 [2]	-	-	6.2%[5]	2.4%[7]	2.7%
Russian Federation	4,000 [2]	8,400 [2] 4,810 [3]	(2.10)	3.2%	7.7%	4.0%
Mongolia	2,250 [2]	-	-	3.2%[6]	4.0%	-

Footnotes :
1. National data 2. Source : CIA data book 3. EIU data
4. The Economist 's Big Mac Index (19 April 2001) : Purchasing Power Parity: US commodity price (Hamburgers) in US$ divided by local community prices (in US$) (Hamburgers)
5. Estimate of Central Bank, Republic of Korea
6. International Monetary Fund 7. Statement of DPR Korea Finance Minister

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Energy Intensities North-East Asia

	Total Primary Energy Supply (TPES) / Gross Domestic Product (GDP) (in toe per 1000 1990 US$)		
	1988	1993	1998
China	2.07	1.63	1.16
Japan	0.15	0.15	0.15
Republic of Korea	0.34	0.41	0.42
DPR Korea	0.26	0.21	0.14
Russian Federation	-	1.73	1.74
Mongolia	-	-	-

Source : International Energy Agency (IEA)

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Self-sufficiency in Energy in North-East Asia

	Domestic Energy Production / Total Production of Energy Supply (in %)		
	1988	1993	1998
China	**1.01**	**0.99**	**0.97**
Japan	**0.18**	**0.19**	**0.22**
Republic of Korea	**0.29**	**0.16**	**0.17**
DPR Korea	**0.89**	**0.92**	**0.92**
Russian Federation	-	**1.41**	**1.60**
Mongolia	-	-	-

Source : International Energy Agency (IEA)

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China: Energy Balance 1999

	(in million tonnes of oil equivalent)					
	Oil	Gas	Coal	Electricity	Other	Total
Primary Supply						
Production	159	22	512	59[a]	210	962
Imports	63	0	1	0[a]	0	64
Exports	-14	-3	-21	-2[a]	0	-40
Stock changes	-1	0	19	0	0	18
Total	**207**	**19**	**511**	**57[a]**	**210**	**1,004**
Processing & transformation						
Losses & inputs to refining & transformation	-210	-10	-261	21	0	-285
Transformation	1,705	0	105	0	280	n/a
Total	**-40**	**-5**	**-261**	**21**	**0**	**-285**
Final consumption						
Transport fuels	66	0	5	1[b]	0	72
Industrial fuels	24	7	175	52[b]	0	258
Residential etc	37	3	60	25[b]	210	335
Non-energy uses	40	4	10	0	0	54
Total	**167**	**14**	**250**	**78[b]**	**210**	**719**

Source : Energy Data Associates.

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Japan: Energy Balance 2000

(in million tonnes of oil equivalent)

	Oil	Gas	Coal	Electricity	Other	Total
Primary Supply						
Production	0.7	2.2	1.7	94.2[a]	7.0	105.8
Imports	273.5	65.0	95.5	0.0	0.0	433.5
Exports	-4.2	0.0	-1.5	0.0	0.0	5.7
Stock changes	0.0	0.0	0.0	0.0	0.0	0.0
Total	**270.0**	**67.2**	**95.2**	**94.2[a]** **36.3[b]**	**7.0**	**533.6** **475.7[c]**
Processing & transformation						
Input to refining	-217.0	0.0	0.0	0.0	0.0	-217.0
Input to transformation	-34.0	-53.5	-54.0	94.2[a]	-3.7	-239.4
Refining/transformation output	217.0	11.0	0.0	91.5[b]	0.0	319.5
Energy industry fuel/loss	-15.0	-0.8	-3.2	-9.8	0.0	-28.8
Final consumption						
Transport fuels	97.5	0.0	0.0	1.9[b]	0.0	99.4
Industrial fuels	34.5	9.3	37.0	36.0[b]	1.8	118.6
Residential etc	45.5	14.6	1.0	43.8[b]	1.5	106.4
Non-energy uses	43.5	0.0	0.0	0.0	0.0	43.5
Total	**221.0**	**23.91**	**38.0**	**81.7[b]**	**3.3**	**367.9**

Source : Energy Data Associates.

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(Average Annual) Growth of Economy and Primary Commercial Energy Consumption (in percent)

		GDP	Oil	Coal	Gas	Nuclear	Hydro	Total Primary Energy
China	**Historical (1980-1995)**	10.2	4.9	5.4	1.4	173.4	7.9	5.1
	Forecast (1995-2020)	6.9	4.4	2.8	9.2	14.1	4.4	3.6
Japan	**Historical (1980-1995)**	3.3	0.8	2.7	5.9	7.5	0.9	2.2
	Forecast (1995-2020)	2.3	0.4	2.1	4.3	2.4	4.0	1.7
Republic of Korea	**Historical (1980-1995)**	8.7	9.5	4.9	67.2	22.4	5.3	8.5
	Forecast (1995-2020)	5.4	2.4	2.5	7.2	5.8	0.8	3.4

Source: F. Fesharaki, S. Banaszak, Wu Kang: The Outlook for Energy Supply and Demand in North-East Asia, University of California, Institute of Global Conflict and Cooperation, Policy Paper No.36 (1996)

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Summary Conclusions

The developing countries of North-East Asia (China, Republic of Korea, DPR Korea, Mongolia):

- have all growing populations and are expected to expand their economies. This will result in rapid energy demand growth and growing net energy import requirements;
- face challenging tasks to mobilize domestic and international financing for their energy sector development;
- would benefit from a sub-regional coordination mechanisms and from an agreed regional framework for energy sector investments;
- will produce growing emissions as their energy consumption increases.

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Overview on Perspectives for Multilateral Cooperation in North-East Asia's Energy Sector

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Qualitative Comparison of Resource Endowment

	Oil and Gas	Coal and Mineral	Labour	Capital	Technology	Managerial Expertise
China	Rich	Very Rich	Very Rich	Very Poor	Short	Short
Japan	Very Poor	Short	Short	Very Rich	Very Rich	Very Rich
Republic of Korea	Absent	Short	Short	Rich	Rich	Rich
DPR Korea	Absent	Rich	Rich	Very Poor	Very Poor	Very Poor
Russian Federation	Very Rich	Very Rich	Very Poor	Very Poor	Short	Short
Mongolia	Short	Rich	Short	Very Poor	Very Poor	Short

Source: Park, Keun Wooh 1995, Gas and Oil in North-East Asia, Royal Institute of International Affairs

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Overview of Proposed Projects for Multilateral Cooperation and Energy Sector Development

Natural Gas (alternative projects; alternative routes)

- **Asia-Pacific Energy Community (promoted by Japan)**
- **Vostok Plan (promoted by Russian Federation, 1991)**
- **Energy Silk Road Project (China, Japan, Turkmenistan**
- **Irkutsk Region Gas Project (Russia, China, Republic of Korea) (under negotiation)**
- **Trans-Asian Gas Pipeline Network**

Oil

- **Off-shore Oil Fields 1,2,3,4 etc (Production started)**

Electricity

- **2,600 km. - 3 GW Power Transmission line) (Bratsk-Beijing / Shenyang) (under negotiation)**
- **Power Transmission Primorskaya to Republic of Korea (via DPR Korea)**
- **Power Transmission Sakhalin to Hokkaido (Japan)**

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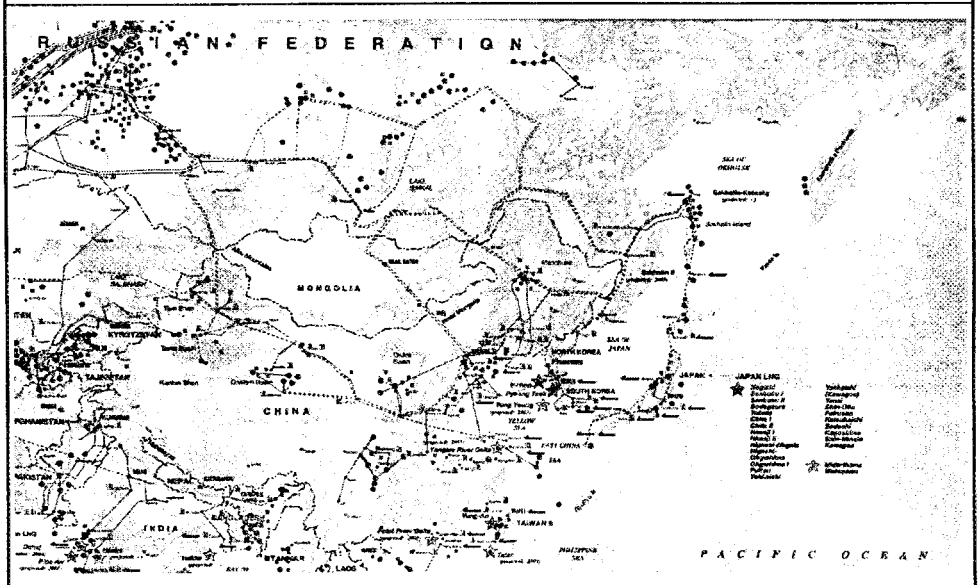
Energy Map of the World (2000): North-East Asia



Source:Petroleum Economist (2000)
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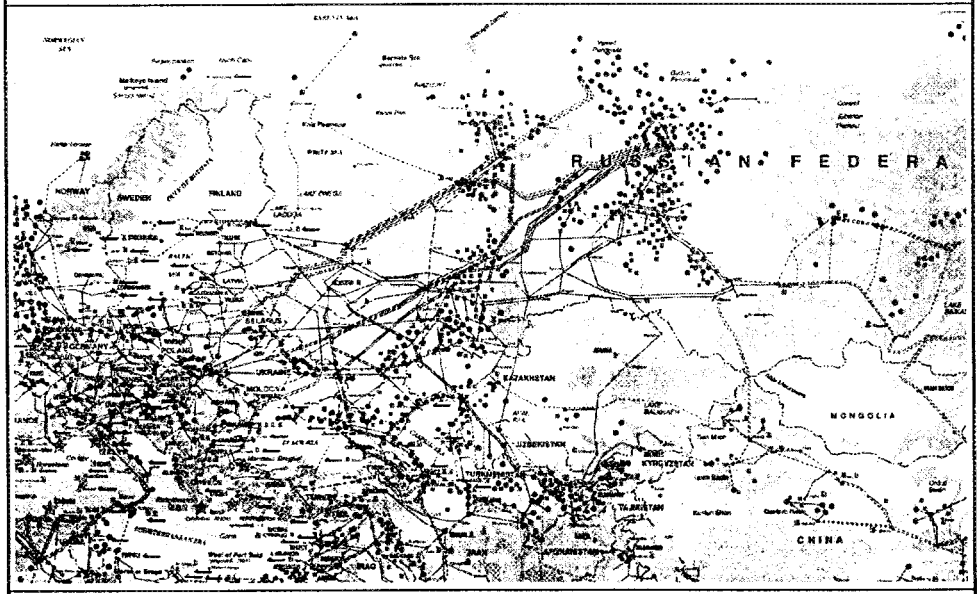
Energy Map of the World (2000) : Europe-Asia



Source: Petroleum Economist 2000
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Obstacles to Trans-boundary Energy Sector Development

Political	• Unsettled political questions are obstacles to bi-lateral co-operation; • Lack of agreed framework / common energy development strategy; • Lack of institutionalized framework for multi-lateral co-operation; • Sustainability of (positive) political development trends (?)
Economic and financial	• High investment costs and long amortization periods; • "high risk" investment leads to high capital costs; • non-market pricing / non-payment crisis in some countries; • high taxation, duties and lack of transparency for investors;
Environmental	• insufficienct enforcement of environmental standards; • Lack of compensation for local communities;

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Summary Conclusions

- **In both, Russian Far East and China, considerable natural gas and hydrocarbon reserves are available for development to meet the growing future energy needs of the North-East Asia sub-region;**
- **Due to large geographical distances between sources of supply and centers of consumption and lack of infrastructure, project development requires large amounts of long-term investment finance;**
- **Productive and mutually beneficial energy sector development cooperation will be a cornerstone for long-term economic cooperation, energy security and peace.**

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Summary Profile of United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP)

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ESCAP Profile

- **Regional inter-governmental parliamentary organization for Asia and the Pacific under the United Nations System;**
- founded in 1947;
- Reporting to (Global) Economic and Social Council of United Nations (UN-ECOSOC) and United Nations General Assembly;
- Membership: 61 Member and Associate Member Countries (as of 2001)
- Main Functions - Intergovermental Parliamentary Consultations
  - Annual Sessions of the Commission and its Subsidiary Committees,
  - Operational activities (background reports; publications; group training; advisory services)

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International Symposium on Energy Co-operation in North-East Asia
Seoul, Republic of Korea, 7-8 June 2001

ESCAP Profile (cont'd)

- Mandate: Promote regional cooperation among member countries and associate member countries;
- Vision: Focus of Programme Activities on
  - Poverty alleviation and pro-poor policies;
    (United Nations Millenium Declaration)
  - Managing globalization;
    (international Conventions and Treaties)
  - Emerging Social Issues (HIV-Aids; Aging; etc)

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ESCAP Profile (cont'd)

- Structure: Intergovernmental Subsidiary Committees;
  Committee on Poverty Alleviation;
  Committee on Regional Economic Cooperation;
  Committee on Environment and Natural Resources Development;
  Committee on Transport and Communications;
  Committee on Statistics;
- Staff resources at ESCAP Secretariat: ~ 200 professional posts
  ~ 270 GS Posts
- Budgetary Resources (Biennium) :

Regular UN Budget	57.0 Mio US$	(mainly staff costs)
Extra-budgetary Contributions	16.8 Mio US$	(donations)

- Secretariat: Division on Environment and Natural Resources Development
  - **Environment** **Energy** **Water& Minerals** **Space technology**

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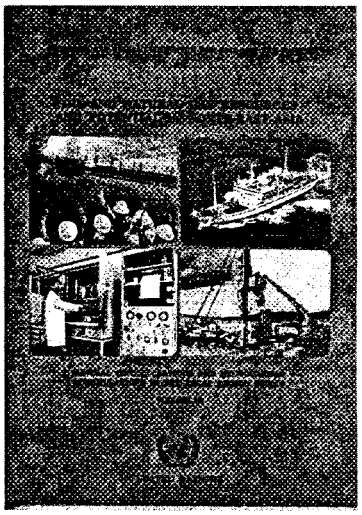
Energy Related Activities of ESCAP in North-East Asia

Technical Publications:

Oil and Gas Resources and
Potential in North East Asia (1999)

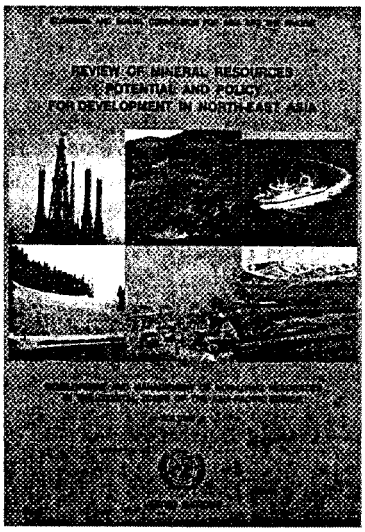


Inquiries and orders:
<kadushkin.unescap@un.org>

Energy Related Activities of ESCAP in North-East Asia

Technical Publications:

Review of Mineral Resources
Potential and Policy for Development
in North East Asia (1997)

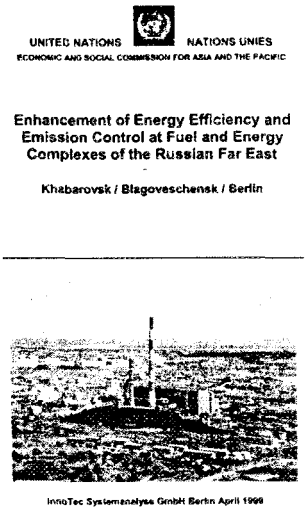


Inquiries and orders:
<kadushkin.unescap@un.org>

Energy Related Activities of ESCAP in North-East Asia

Technical Advisory Services

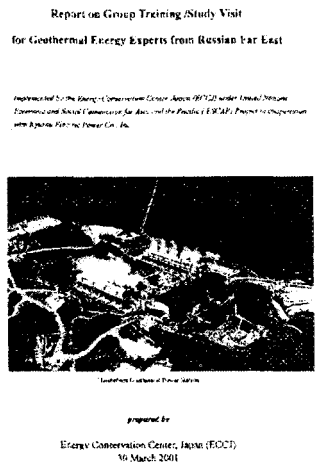
- Preliminary Energy Audit in Oil Refinery, Angarsk Refinery (Irkutsk, Russia, 1998)
- Pre-Feasibility Study on Energy Efficiency in Cement Industry (Darhan, Mongolia, 1999)
- Measurement of Power Station Emissions Blagoveschensk BTEZ, Russian Far East (1999)
- Study on Institution Building (Energy Center) Khabarovsk LERS, Russian Far East (2000)
- Pre-Feasibility Study on Hydro-Power Station Rehabilitation Mirim SHP, Pyongyang, DPR Korea (Planned)



Energy Related Activities of ESCAP in North-East Asia

Capacity Building / Group Training

- International Seminar on Energy Efficiency in Fuel and Energy Complex of Russian Far East (Khabarovsk, 2 Phases; 1999)
- Group Training on Geothermal Energy Russian experts visit Japan (March, 2001)
- North-East Asia Forum an Effective Consumer Information for Sustainable Energy Use (Beijing, China, March 2001)
- North-East Asia Expert Group Meeting on Cooperation in Energy and Energy Efficiency (Khabarovsk, Russian Far East, provisional dates: 2-4 October 2001)



Environment Related Activities in North-East Asia

- **North-East Asia Sub-Regional Programme for Environmental Cooperation (NEASPEC)**
  - Intergovernmental Meetings of Senior Officials
  (6 Meetings since 1993; Meeting No. 7, July 2001)

- **Asian Development Bank/UNDP "ALGAS Project"**
  - National Report of DPR Korea on Asian Least Cost Greenhouse Gas Abatement Strategy
  (Study commissioned through ESCAP, Report 2000)

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Thank You for Your Attention

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International Symposium on Energy Co-operation in North-East Asia
Seoul, Republic of Korea, 7-8 June 2001

Energy Future for China

Zhou Dadi
Energy Research Institute
State Development Planning Commission

June 2001

Energy Research Institute (ERI)

- Unique national energy policy study Institute
- Under the State Development Planning Commission
- Founded in 1980 under the request of State Council
- Involved in energy planning and policy development ;

Energy Research Institute (ERI)

- Covers important policy fields:
- Energy forecasting and balance analysis
- Medium and long term energy strategy
- Energy conservation and efficiency
- Environmental consideration in energy policy
- Supporting group for climate change
- Renewable energy policy

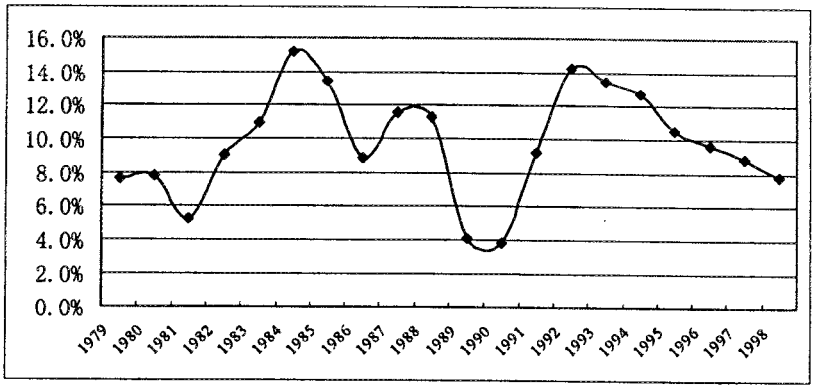
Key elements for future energy of China

- Economic growth rate;
- Urbanization and industrialization progress;
- Development of domestic demand;
- Infrastructure development of energy system;
- Environmental consideration;
- International energy market;

Economic Growth Rate Keeps High

- Average GDP growth rate for last 5 years (1996-2000) achieved 8.3% ;
- GDP growth rate of 2000 is 7.2%;
- Many economists believe that the momentum of higher economic growth has resumed;
- Targeted GDP growth rate for next 5 years (2001-2005) is 7%, higher rate will be possible;
- 7% or higher growth rate for next 20 years is expected;

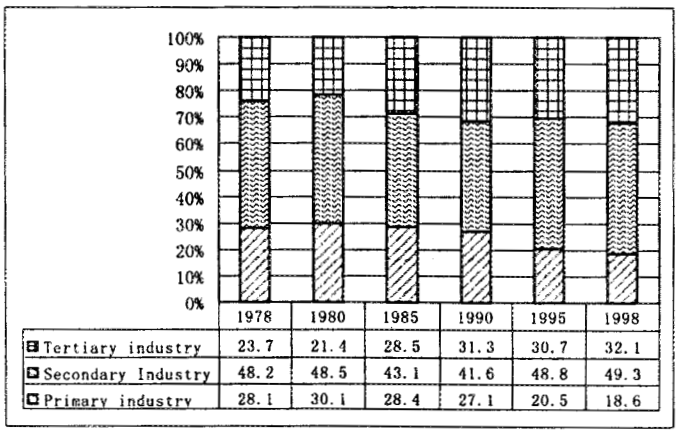
GDP Growth Rate in China (1979-1998)



Urbanization will be accelerated

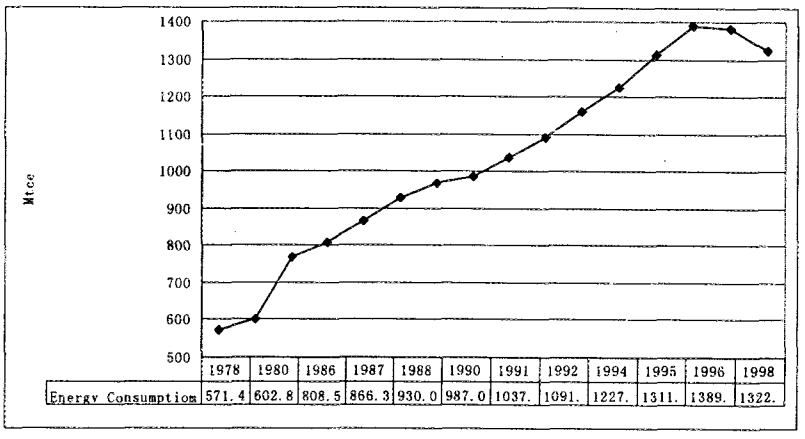
- Urbanization will be associated with the improved agriculture productivity and quicker industrialization progress;
- Additional 40 million non-agriculture jobs will be created in the next 5 years;
- Experts estimated 1% of population will immigrate from rural area into cities annually in the coming decades

Industrial Structure Change in China (1978-1998)



	1978	1980	1985	1990	1995	1998
Tertiary industry	23.7	21.4	28.5	31.3	30.7	32.1
Secondary Industry	48.2	48.5	43.1	41.6	48.8	49.3
Primary industry	28.1	30.1	28.4	27.1	20.5	18.6

Historical Energy Consumption in China

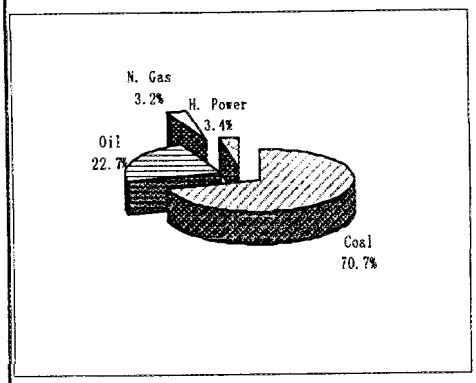


	1978	1980	1986	1987	1988	1990	1991	1992	1994	1995	1996	1998
Energy Consumption	571.4	602.8	808.5	866.3	930.0	987.0	1037.	1091.	1227.	1311.	1389.	1322.

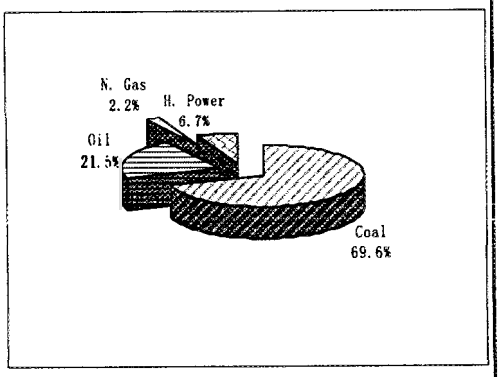
Energy Consumption Change in Recent Years

- By statistics, energy consumption has decreased since 1997;
- Coal production and consumption decreased significantly;
- Oil and natural gas consumption increased;
- Natural gas production increases rapidly;
- Import of oil increased significantly; 70 million tones of crude oil imported last year;

Change of Primary Energy Mix

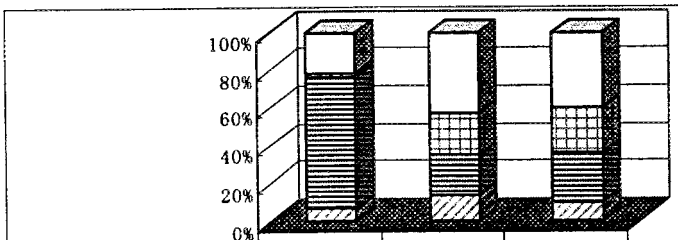


（ 1978年 ）



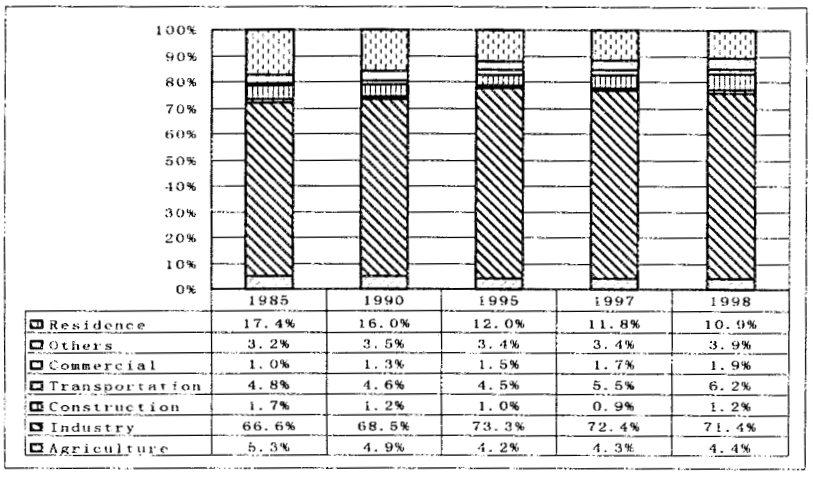
（ 1998年 ）

Comparison of the Energy Mix



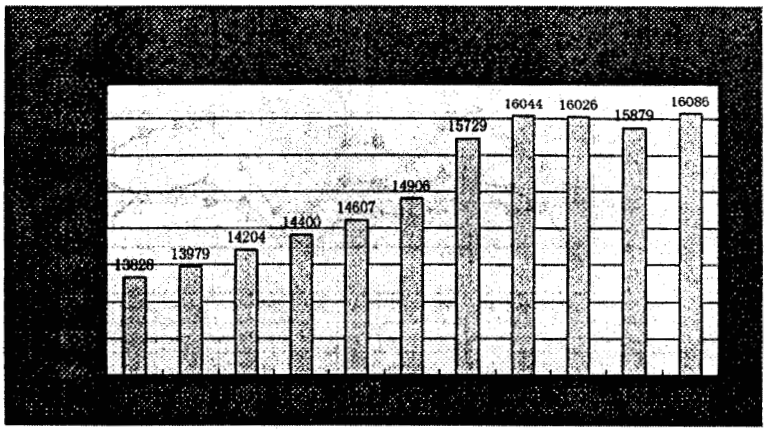
	China	OECD	World
Oil	21.5%	43.0%	39.9%
Natural Gas	2.2%	22.3%	23.8%
Coal	69.6%	21.3%	26.2%
Electricity	6.7%	13.4%	10.1%

Energy Consumption by Sectors

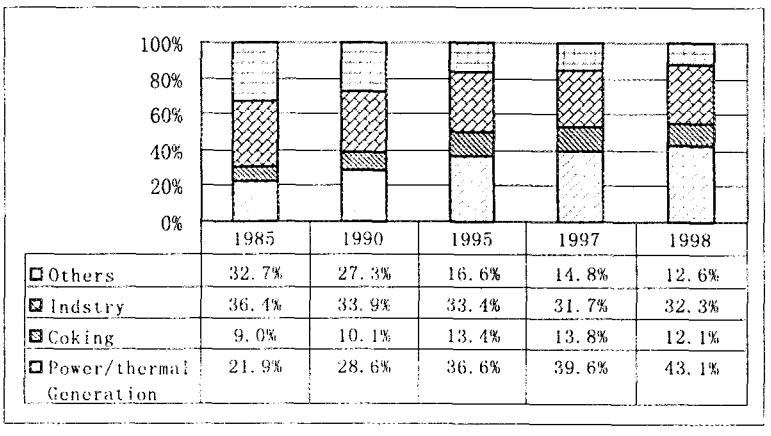


	1985	1990	1995	1997	1998
Residence	17.4%	16.0%	12.0%	11.8%	10.9%
Others	3.2%	3.5%	3.4%	3.4%	3.9%
Commercial	1.0%	1.3%	1.5%	1.7%	1.9%
Transportation	4.8%	4.6%	4.5%	5.5%	6.2%
Construction	1.7%	1.2%	1.0%	0.9%	1.2%
Industry	66.6%	68.5%	73.3%	72.4%	71.4%
Agriculture	5.3%	4.9%	4.2%	4.3%	4.4%

Oil Production in China

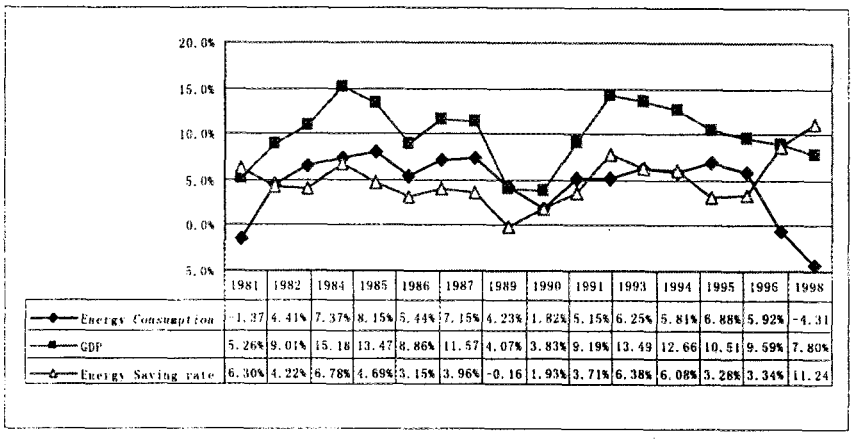


Consumption Structure of Coal in China



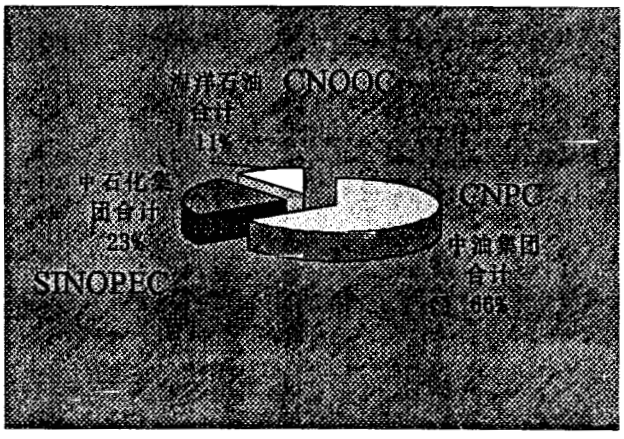
	1985	1990	1995	1997	1998
Others	32.7%	27.3%	16.6%	14.8%	12.6%
Indstry	36.4%	33.9%	33.4%	31.7%	32.3%
Coking	9.0%	10.1%	13.4%	13.8%	12.1%
Power/thermal Generation	21.9%	28.6%	36.6%	39.6%	43.1%

Energy Efficiency Improvement



	1981	1982	1984	1985	1986	1987	1989	1990	1991	1993	1994	1995	1996	1998
Energy Consumption	1.37%	4.41%	7.37%	8.15%	5.44%	7.15%	4.23%	1.82%	5.15%	6.25%	5.81%	6.88%	5.92%	-4.31
GDP	5.26%	9.01%	15.18	13.47	8.86%	11.57	4.07%	3.83%	9.19%	13.49	12.66	10.51	9.59%	7.80%
Energy Saving rate	6.30%	4.22%	6.78%	4.69%	3.15%	3.96%	-0.16	1.93%	3.71%	6.38%	6.08%	3.28%	3.34%	11.24

Oil Production by Producers



Oil Import of China

	1993	1994	1995	1996	1997	1998	1999
Import crude	1567	1235	1709	2262	3547	2732	3661
Refined	1729	1289	1440	1582	2379	2174	2082
Export crude	1943	1849	1885	2033	1983	1560	717
Refined	372	379	414	418	559	436	645
Net Import Crude	-376	-614	-176	229	1564	1172	2945
Refined	1357	910	1026	1164	1820	1738	1437

注：(1) 成品油中除汽油、石脑油、煤油、柴油和燃料油外，还包括液体石蜡和润滑油脂。

(2) "-"表示净出口量，"+" 表示净进口量。

Energy Demand Forecast

- Great challenge to energy demand forecast;
- Previous forecasts failed for real energy consumption of recent years;
- Coal consumption decrease is still a mystery;
- Long term energy demand forecasts sustain;
- Energy consumption will increase significantly in the future;

Total energy consumption in 2010

- No specific targets in the 10th Five Years' Plan;
- Annual growth rate around 3% estimated by experts;
- More studies on oil, gas and electricity demand forecasting;
- Demand for natural gas and electricity may increase quicker than others;

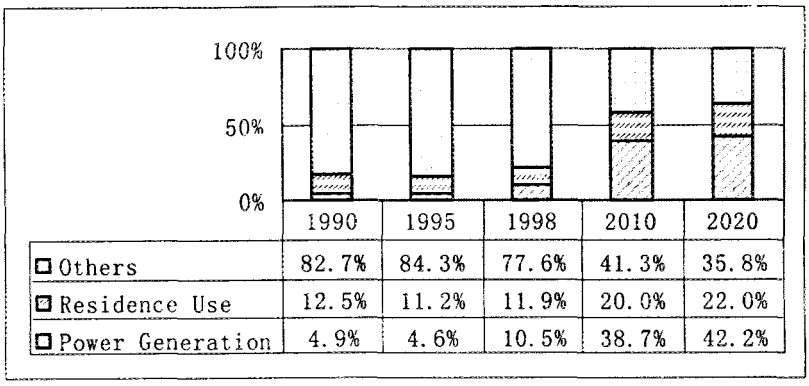
Oil demand and import in the future (million tones)

	2000	2005	2010
Oil demand	220	265~285	300~340
Domestic production	160	170~180	180~200
Net import	59	85~115	100~160
Self reliance rate	73%	63%	60%

Natural gas demand forecast in billion cubic meters

year	2000	2005	2010	2015
Demand estimated	27	50~60	90~120	130~170
Need for import		4~6	20~25	30~40

Natural Gas Consumption Structure Estimation

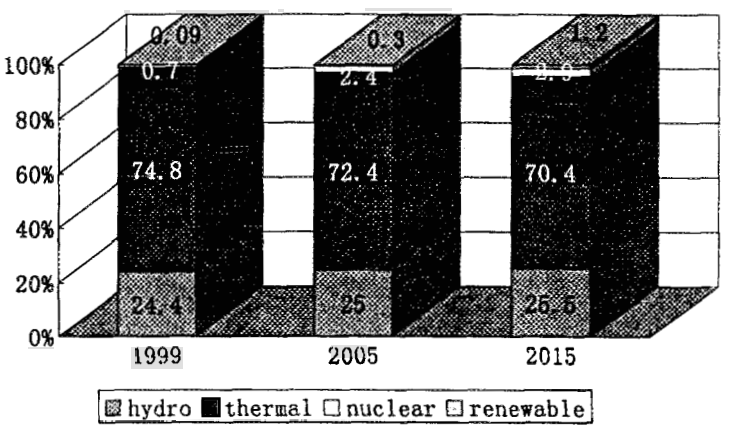


	1990	1995	1998	2010	2020
Others	82.7%	84.3%	77.6%	41.3%	35.8%
Residence Use	12.5%	11.2%	11.9%	20.0%	22.0%
Power Generation	4.9%	4.6%	10.5%	38.7%	42.2%

Power Generation Capacity Forecast

（10MW）	1999	2005	2015
Total installed	29880	38000	55000
Hydro	7297	9500	14000
Thermal	22350	27512	38740
Nuclear	210	870	1600
Renewables	27	118	660

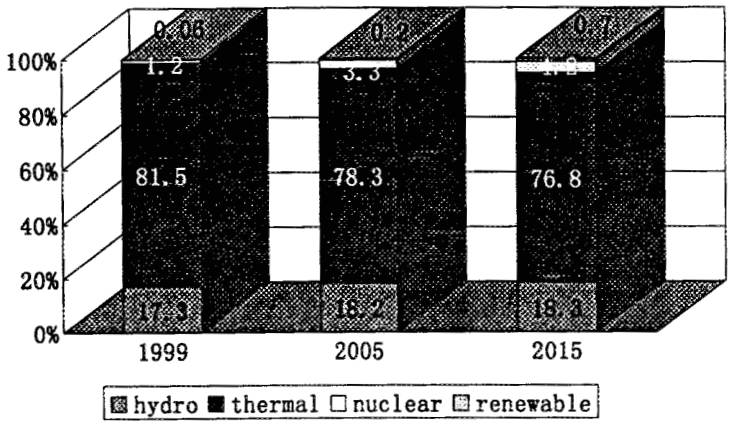
Power Generation Capacity



Power Generation Forecast

(unit =100 million kwh)	1999	2005	2015
Total	12331	17000	24800
Hydro	2129	3100	4550
Thermal	10047	13304	19045
Nuclear	148	566	1040
Renewables	7	30	165

Power Generation Structure



Key elements in the energy sector

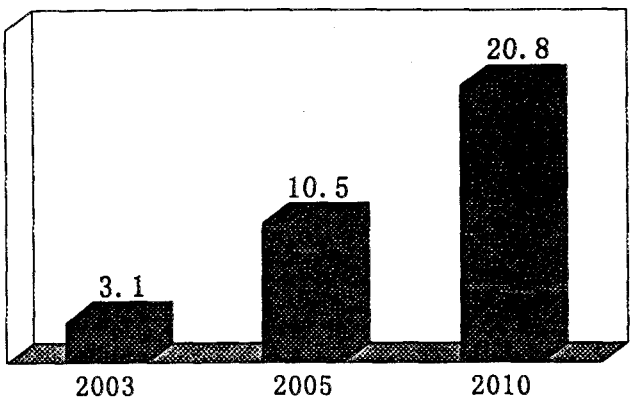
- Focus has been changed from quantitative expansion;
- Coal is still considered as a basic primary energy; clean coal approaches and technology;
- Market demand will become major driving force;
- Environmental consideration will play more important role;

Improvement of energy structure

- Attach priority to oil and gas exploration and exploitation;
- Speed up the natural gas development, including gas production, transmission, and downstream utilization;
- Pay attention on energy security and safety, (strategic storage and others);
- Diversify supply sources of oil and gas; (domestic and abroad)
- Implement "West Gas to East" project;
- Coal bed methane development;

In 2001, the construction of the pipeline will be started. In 2003, the pipeline will be completed, and the natural gas will be transported to delta of Yangtze River.

TOTAL DEMAND OF GAS IN SHANHAI, ZHEJIANG, JIANSHU, HENAN AND AN HUI PROVINCES



International Cooperation

- ✓ 1.Foreign investors are encouraged and welcome to invest in upstream, midstream and downstream of the project.
- ✓ 2. Foreign investors may become holding companies in pipeline projects.
- ✓ 3. Flexible approaches for international cooperation: both equity joint venture and contracted joint venture can be approached.

Power sector reform and innovation

- Power system reform: grid and generation separating, monopoly breaking;
- Higher priority to hydro and large scale pit mouth power plants;
- Improve the fuel efficiency of power generation; (replacement of small scale generators)
- West power to East transmission projects

West Power Transmit to East

- 10 GW power transmitted into Guangdong province from Southwest China by the end of next 5 years;
- Mainly hydro power and pit mouth power plants。
- 5 main transmission lines to be constructed with total capacity of 10GW;
- Further improve transmission capacity from Northwest China to Beijing and Tianjin regions;

Energy efficiency and renewables

- Efficiency improvement based on market mechanism;
- Government intervention necessary;
- New approaches are under development;
- Renewables face challenges;
- Small and mini hydro, wind power;

Develop the Oil Strategy of China

- Further identify the importance of oil in energy strategy;
- More study on oil demand of long term future;
- Analysis on international oil supplier and market;
- Regional and international oil security and safety;

Cooperation in North-East Asia

- Group oil and energy security
- Strategic oil storage and regional cooperation;
- Cooperation on oil and natural gas exploration and exploitation;
- Group efforts in Russia, Middle Asia, Middle east, South-East Asia, and other potential supply sources;
- Natural gas development;

"Common approach to common interests"

Mr. Yoshihiro Sakamoto
President
The Institute of Energy Economics, Japan
JAPAN

Ladies and gentlemen, it is my great honor and pleasure to have been invited to this symposium and given this opportunity to speak before you this morning.

- I wish to extend my congratulations and pay respects to Dr. Chang, KEEI for having offered a special occasion to discuss the energy situation in Northeast Asia and policy options to be taken for the future.

Because, firstly, the northeast Asian region is expected to show the highest economic growth potential in the world in the near future; secondly, the world's energy-related parties are hence expressing great interest in the magnitude and structure of energy supply and demand as well as a pace at which energy demand is growing in this region; and thirdly, many people in and outside the region are keenly interested in knowing what roles the main players in this region such as China, ROK and Japan will assume and whether intra-regional cooperation among them is possible.

- In referring to issues confronting the energy field in this region and options to be exercised in the future, I would like to mention the fundamental condition of the utmost importance.

That can be summed up as follows: any subject in energy area can never be solved by one country alone, given the geographical and geopolitical characteristics intrinsically possessed by energy. So, a regional approach is needed and it is especially necessary for

the main players in the region to jointly address problems common to them. Though it may be a matter to be pursued in the distant future, I am personally dreaming a "Common Energy Market for Northeast Asia," in which member countries' interests are adjusted so that the market can be integrated and the region can become a most economically efficient market, thus formulating an effective power to encounter the outside.

It should be noted that Europe needed forty years to integrate its market as the unified common market. It is necessary for us to follow a number of steps over the period to eventually materialize our common market concept, too. Now is the time for us to take a first step to lay the foundation for our descendants to enjoy prosperity from such a common market.

▪ Yesterday, I participated in the "East-West Asian Energy Dialogue," initiated by KEEI. I wish to take this opportunity to welcome the commencement of such a forum, in which major players in the Asian energy field, including major energy-consuming countries in Northeast Asia, India, and leading oil-producing countries – major oil-supplier countries in West Asia – met together to jointly discuss energy-related matters to be addressed with the common understanding. It is essential to begin with a "dialogue," with participants frankly exchanging views on such issues as the supply security on the demand side and the demand security on the supply side.

Moreover, Japan will host a dialogue between oil-producing and oil-consuming countries ("International Energy Forum") next year. At the IEA-sponsored "Millennium Symposium" held the other day, a U.K. representative extended his congratulations to Japan, expressing his expectations that Japan should host the conference taking into account the northeastern Asian countries' interests in the future.

The world has changed. In the energy area time of confrontation between IEA and

OPEC came to an end with the termination of the cold war, and the season of the dialogue has come. In coming new world the northeast Asian region is urged to take some initiative as important players.

▪ Next, I want to list below several questions that confront the northeast Asian countries for some time to come.

The first is a question related to oil. The most remarkable feature is that the rapid progress in motorization in China will raise demand for oil dramatically in this region. In case China's oil imports increase at a rapid pace, the region's reliance on the Middle Eastern oil will rise further, which may have a considerably adverse effect on the stability of oil supply and demand and prices, I am afraid. As for natural gas, to lesser extent, there is the similar condition.

The second question concerns the position of coal relative to other energy sources in the northeast Asian energy market in the future.

Here, again, China's move in the future should be watched carefully. It is being contended loudly that use of coal should be limited from the standpoint of preventing global warming. What will happen, however, if all power plants cease to burn coal and switch fuel to natural gas? The "energy crisis" that has happened in the U.S. suffices to show what will be possible to happen in other areas. The "Dash for gas" suddenly has caused the price of natural gas to skyrocket to as high as $10/million Btu at one time. The U.S. new administration has decided to lift restrictions on CO_2 emissions from coal-fired power plants. As to the extent to which and the speed at which the world moves to prevent the global warming in the future, we have to watch the outcome of the meeting of environment ministers to be held again in July to discuss how to follow the Kyoto Protocol. In an effort to minimize the cost of burning coal and real-

ize the internationally fair sharing of the burden, the Asian countries are requested to positively participate in the program to develop an international framework of the Kyoto mechanism, including that of trading the emissions right.

At any rate, the option of using coal as a means of keeping prices of other energy sources from soaring should not be abandoned, while taking necessary measures to counter the environmental problems such as acid rain and the global warming that accompany the burning of coal.

The third subject is the development of new technology. Northeast Asia is not endowed with much nature resources, but human resources are abundant. As the technological development will continue to play an important role in the solution of energy problems, the northeast Asian nations have a wide spectrum of joint technological development projects to be undertaken on a joint basis, and in fact some projects have already been launched in this area. We should lose no time to extend our all-out support to such joint efforts.

Thank you.

Energy in Korea, 2001

Hyunjoon Chang

Korea Energy Economics Institute

Republic of Korea

Korea at a Glance(2000)

- Land Area:
  - 99,392㎢ (S. Korea)
- Population:
  - 47.2 million persons
- GDP(1995 const.):
  - US$ 476 billion(2000E)
  - US$ 10,074 per capita
- Real GDP growth rate
  - 1999: 10.8%
  - 2000E: 8.8%

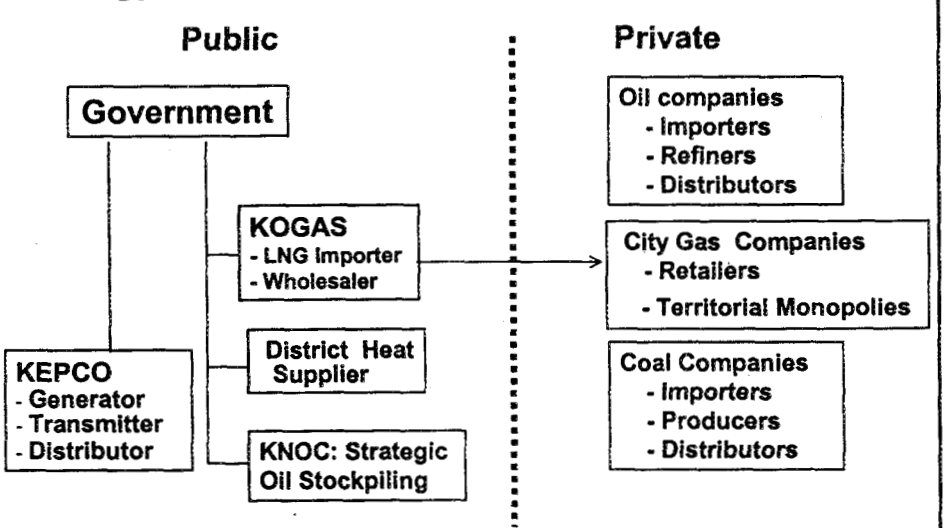
Republic of Korea

Energy Overview(2000)

- **Total Energy Consumption**
  - 192 million TOE(97.3 % imported)
  - 51.9% depend on petroleum
- **Oil consumption**
  - 2.0 million Bbl per day(all imported)
  - 76.8% depend on Middle East
- **Natural gas consumption**
  - 14.5 million ton per year
  - all LNG
- **Sectoral share of energy consumption**
  - Industrial 55.8%
  - Transportation 19.7%
  - Residential/Commercial 22.7%
- **Korea ranks**
  - No. 3 in oil imports
  - No. 2 in coal & LNG imports

Republic of Korea

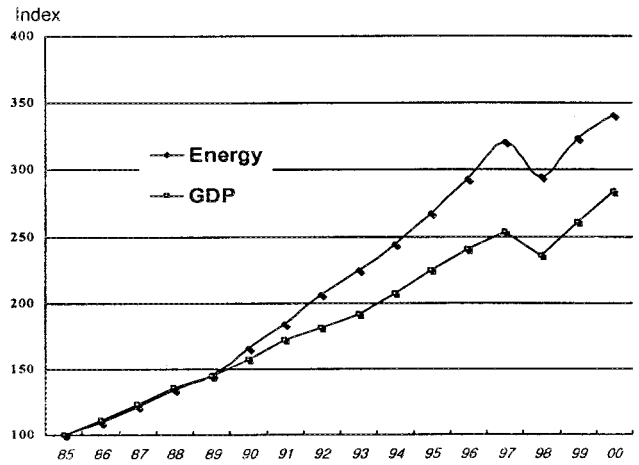
Energy Industry Structure



- **Restructuring of power industry is under way**

Republic of Korea

Energy Consumption & Economic Growth



(1985=100)

Energy/GDP elasticity

- 85 - 90 : 1.16
- 91 - 00 : 1.32

Growth (1985 - 2000)

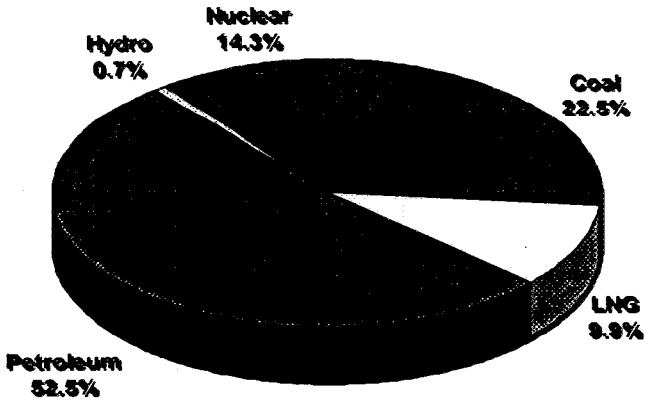
Steel: 9 → 25 MMT

Cement: 21 → 51 MMT

Cars: 1.1 → 12.0 mill

Republic of Korea

Energy Consumption by Source (2000)



	Petroleum	Coal	Nuclear	LNG	Hydro
1990	53.8%	26.1%	14.2%	3.2%	1.7%

Republic of Korea

Shadows of the Success

- **Overseas Dependence increased**
  - 74 per cent in 1980 → 97 per cent in 2000
- **Energy Intensity increased**
  - 0.35 TOE/million Won in 1990 → 0.40 in 2000
- **Environmental Backwardness**
  - CO_2 emission: 65 million TC in 1990 → 121 million TC in 2000
  - Siting problems, in particular, for nuclear power plants
- **Weak Market Mechanisms**
  - Reform of energy pricing and privatization of large state-owned enterprises to improve market efficiency

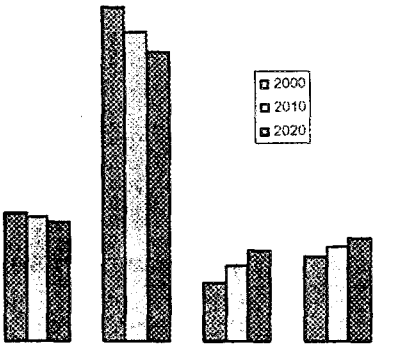
Energy Outlook in Korea

Republic of Korea

- **Primary Energy Demand**

Unit: Million TOE

Unit: %



Source: KEEI, May 2001

Energy Outlook in Korea

Republic of Korea

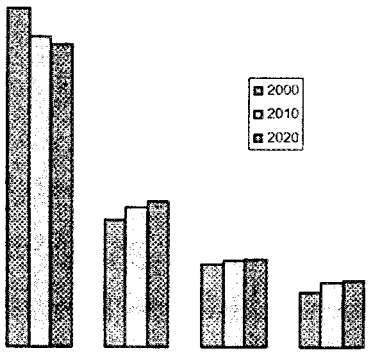
• Final Energy Demand

Unit: Million TOE

	2000	2010	2020
Industry	84	105	123
Transport	31	47	59
Residential	20	29	35
Commercial	13	22	27
Others	2	4	4
Total	153	209	250

Source: KEEI, May 2001

Unit: %



Energy Outlook in Korea

Republic of Korea

• Energy and GHG Indicators

[illegible]	MTC	111.3	146.4	170.6	198.8	225.3
Per capita CO_2	TC	2.38	2.98	3.37	3.84	3.92
[illegible]	TC/yr	0.25	0.24	0.21	[illegible]	[illegible]
[illegible]	TC/TOE	0.67	0.62	0.62	[illegible]	[illegible]

Source: KEEI, May 2001

Republic of Korea

Primary Objectives and Measures for Korea's Energy Future

Objectives

- Strengthen Market Mechanism
- Establish Environmentally Friendly Energy Systems
- Maintain Stable Energy Supply

Measures

- Remove price controls
- Reform tax system for fair competition and inducement to low pollutant energy use
- Privatize public utilities
- Encourage energy efficiency technologies and new & renewable energy developments
- Seek to cooperate with Northeast Asian countries

Republic of Korea

Issues to be Addressed - Asian Energy Market in transition

Past	Future
• Government lead system	• Market lead system
• Monopolistic structure	• Competitive structure
• Closed & isolated market	• Open & connected market
• Growth-oriented policy aims	• Aim at sustainable development

What Is needed for sustainability at all?

Chances for a new era

- **North-South Korea talks resume**
  - **From cold war to cooperative games**
  - **Major obstacle for a complete connection of Asian energy network could be removed**
- **East and West Asia are mutually interdependent**
  - **Heavy reliance on the West Asia**
    - Korea 76%(2000), China 62%(1998), Japan 82%(1999)
  - **Rapid growth of East Asia's oil demand**
    - 50% demand increase is expected during the next decade

Energy challenges Facing the Asia - In Korea's perspective

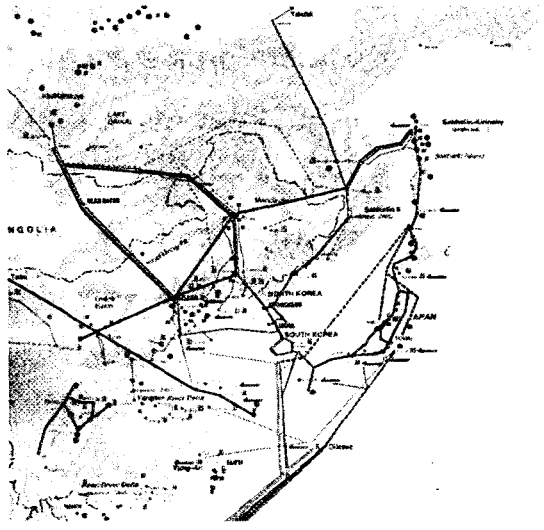
Two paths are ahead: Conflict one, Cooperative one

Cooperative future ensures mutual benefits

Energy importers	Energy exporters
• Ensure stable energy supply	• Secure stable energy demand
• Strengthen bargaining power	• Increase of foreign investment in an upstream sector
• Reduce the energy cost	

Possible Areas

- Power interconnections
- Natural gas pipeline networks
- Joint oil stockpiling



ENERGY PROFILE OF RUSSIA: OUTLOOK PERSPECTIVES FOR REGIONAL COOPERATION IN NORTH-EAST ASIA

Dr. Stanislav Zhiznin, Senior Counsellor,
Department of Economic Cooperation
of the Ministry of Foreign Affairs
of the Russian Federation

1. General issues

Russia's Fuel and Energy complex is a backbone of the country's economy. It is well known that the Russian Federation is completely self sufficient in energy resources. According to different estimates, Russia has the world's largest natural gas reserves (35-38%), second largest coal reserves (23-24%), sixth-eight of the world oil reserves (10-13%) and 14% of the world uranium-ore reserves.

The Russian energy producing, processing and transporting infrastructure is well developed, equipped and managed despite the economic crisis in the country. It is noteworthy that a substantial intellectual and technological potential of the Fuel and Energy complex of Russia is not used in full.

Russia is second after the USA world's largest energy producer accounting for over 10-11% of the world primary energy production. Since beginning of the XX century the country is one of the leading energy exporters. For the period up to 1990 it exported substantial volumes of energy equipment and services.

After the well known political changes in 1991 Russia's economy as well as transitional economies of other CIS countries is undergoing serious difficulties that led to substantial fall in energy production. Without presentation of detailed facts and figures on macroeconomic and financial dimensions of the crisis of the Russian economy, I will only mention that a GDP fell for the period of 1991 - 1998 nearly by 40%. In 1998 spillover from ongoing East Asian financial and economic crisis as well as oil and gas sharp fall in prices (the source of almost 50% of Russia's hard currency earnings and export revenues) have, among other factors, led to increased pressure on the country currency, the ruble, further drop of the GDP and almost destroying the new born banking system . But Russia managed to avoid panic and the near havoc in Russia's economy, to preserve the several years old market economy's sprouts and to continue economic reforms. Now it is obvious that the crisis of 1998 is over.

It is quite obvious that the energy sector of the country felt the impact of the economic depression. The total production of primary energy resources dropped from 1300 Mtoe in 1990 to somewhat 950 Mtoe in 1997. But now there is the trend of increasing of production. One can see that there is a surplus of production over consumption that accounted for about 415 Mtoe in 1990, 370 Mtoe in 1997 and 330 in 1999. Dynamics of principle indices of Russia's energy supply, range of energy demand for 2000-2010 and scenarios of primary energy supply are presented in tables 1, 2 and 3. The fall in production is accompanied by financial crisis in energy sector which is characterized by large-scale non-payments and deficit of investments. A serious problem is a non-rational energy consumption and a high energy intensity of the Russian economy. According to different estimates, the energy intensity indicator in Russia is one of the worst in the world and the annual potential of energy saving for the period 2000-2010 accounts for 150-300 Mtoe. The level of energy consumption per capita in Russia is rather high.

In spite of the total surplus of supply over demand in the country there are regions that are not sufficiently provided with energy resources and regions with substantial surplus. Share of regional primary energy and electricity demand in total energy consumption in Russia is presented in table 4. Among energy oversupplied regions there are the North of Western Siberia (oil and gas), the Central Siberia (coal provinces Kusbass and Kachinsk-Achinsk, Angar-Enisey hydropower complex), a number of territories of Eastern Siberia (oil, gas and coal), and the North of European part of Russia (oil, gas and coal).

Ecology of the Russian Energy and Fuel Complex is in the bad shape. But due to the economic depression and fall in energy production and consumption the volumes of CO_2 and other greenhouse gas emissions were substantially reduced. In 1997 the drop was by 950 mln. t (38%) as compared with 1990, and prognosis say that until the year 2010 the annual level of the emission may be lower 22-30% compared with basic 1990. The accumulating unused quantity of Russian Kyoto Protocol CO_2 quota for the period to 2010 may be at least on the level of 1.5-2 billion tons. There is a huge potential for energy savings in the Russian energy production, processing, transportation and consumption. That is why measures to improve the energy intensity in Russia financed by those countries that don't have the spare quotas may be quite profitable for them and Russia.

2. Structure of the energy consumption and energy balance of Russia

Gas occupies the leading position in the primary energy consumption in Russia (more than 50%), oil - the second (more than 21%), coal – the third (about 20%), nuclear, hydro and

others - 9% (tabl.5). According to different prognosis, by 2010 the share of gas may rise to 58%, oil - fall to 20%, coal, nuclear, hydro and others remain at the previous level.

Gas is the major fuel in the structure of power generation (42-43%), hydro - the second (22-23%), coal - the third (20%), nuclear – the fourth (12%) and oil – the last (2%). In 2010 the share of gas may rise to 48%, hydro and oil - remain at the previous level (22-23% and 2%), nuclear – rise to 15% and coal fall to 12-15%.

Natural gas. Since the collapse of the USSR, Russia's gas production has fallen from a peak of 643 bln.cub.m. in 1991 to about less then 600 in late 90-s. The main reasons are the fall of home demand, non-payments of consumers in Russia and the CIS countries. The surplus of production over consumption is about 160-180 bln.cub.m. Country's gas export were equal to about one third of its production. Almost 65% of this amount is to be supplied to Western and Eastern European markets and the remainder – to the CIS states. In spite of the crisis of the Russia's economy and energy sector there are serious plans to increase gas export to developing gas markets in European countries and to fast growing markets in Far East and East Asian countries.

Oil. The country's oil production peaked at 515 mln. t in 1990. Since then, oil output has fallen to 355 mln. t in 1993, and in 1999 amounts about 310 mln. t. There are several factors that resulted in that drop and among them insufficient investment, reservoir depletion should be mentioned. Anyway there is an essential surplus of production over consumption that leaves substantial volumes of oil for export. The main markets for Russian oil are located in Europe and the CIS though some quantities could be supplied to East Asia countries.

Coal. Coal accounts for about 20% of the country's energy supply. Coal production has fallen from 400 mln. t in 1990 to less then 250 mln. t in late 90-s. The bulk of coal production is used domestically by power sector consuming almost 50% of total production. There is some surplus of production over demand that gives the opportunity to export coal. In 1999 Russia's coal export accounted for nearly 14 mln. t or 8% of its production. Before the current financial and economic crisis the coal industry of Russia was undergoing drastic and painful changes aimed at improving its efficiency and profitability. The political and social and economic problems of Russia's major mining areas are well known. The financial crisis has aggravated the situation in the industry.

Electricity. Power generation in Russia fell from 1100 bln. kWh in 1990 to about 830-824 kWh in late 90-s. The main factors of such a drop are related to economic crisis and hence, demand reduction. Now there is a balance in supply and demand in the country though till the late 90-s there was a surplus that allowed Russia to remain a net-exporter of electricity mainly

to East European and the CIS countries. The major amount of the Russian electricity is consumed by the industry (60%) and the rest by the residential and transport sectors.

According to the Energy Strategy and the Federal Program "Fuel and Energy", there will be modernization of the power generation industry aimed at building new power plants with use of gas and 15 new nuclear plants to replace aging reactors.

3. Structure of Fuel and Energy Complex

The Ministry of Energy is responsible for energy policy making in oil, gas, coal and non-nuclear electricity. The Ministry of Atomic Energy's responsibility is to run the nuclear power generation plants. The Federal Energy Commission is responsible for heat and electricity tariffs as well as for oil and oil products transportation. The Ministry of Natural Resources has the monopoly in geological exploration. The macroeconomic and investment aspects of energy industry are covered by the Ministry of Economy and Trade, energy RDT - by the Ministry of Science and Technology. Environmental issues of energy rest with the The Ministry of Natural Resources. The international energy policy is the responsibilities of the Ministry of Energy, the Ministry of Foreign Affairs and in some cases the Ministry of Economy and Trade. Now there different approaches to restructure the Ministries including the Ministry of Energy.

Since 1992 when the reorganization and privatization processes were started, the Russian *gas sector* has been dominated by the joint stock company "Gazprom" with 35% of the state's equity. "Gazprom" controls 95% of gas production of Russia and is a leading gas company in the world both at the level of production and proved reserves. As you probably know there plans to restructure the majir gas company of Russia.

The *oil sector* is divided between partly - privatized vertically- integrated companies, a small number of regional companies, and a number of state-owned enterprises. By now 10 vertically-integrated companies had been established, namely Likoil, Yukos, Surgutneftegas, Sidanco, Tyumen Oil Company, Sibneft, Slavneft, East Oil Company, Onako and Sibero-Uralskya. The state share holdings in those companies excluding a private company Yukos range between 19% and 60%. In addition state-owned oil assets have been divested and consolidated in four Russian Federation's autonomous republics: Tatneft (Tatarstan), Basneft (Bashkortostan), Komitek (the Komi Republic), Yunko (Chechnya). Predominantly state-owned enterprises include Rosneft (100%), two midstream companies Transneft and Transnefteproduct (75-80%). There are several trading oil companies like Nafta, Alfa-Eco and others.

In the *coal industry* the state Russian coal company Rosugol played the role of the parent company to many regional coal associations and joint stock companies. According to the President's Decree of 1998 Rosugol will be reorganized. The reorganization is still under way.

The *electricity sector* of Russia is controlled by the Unified Power System of Russia (RAO EES Rossii), a joint stock company which oversees the operations of 70 semi-privatized Regional Distribution Companies such as, for example Irkutskenergo or *Dalenergo (Far East) and others.*

In the nuclear energy sector a number of joint-stock companies was organized with the Ministry of Atomic Energy retaining a 51% of controlling share. All nuclear power plants are controlled by the consortium "Rosenergoatom" created by the Minatom. The Ministry also controls all the international operations through joint-stock companies Tekhsnabexport (trade of equipment and nuclear fuel) and Atomstroyexport (nuclear power plants constructing and services)

4. The international energy policy and energy diplomacy priorities

The Russian Federation energy policy objectives are determined in the *Energy Strategy (general provisions) till 2000,* in *Doctrine of Energy Security* adopted in 1998 and in *New Energy Strategy till 2020.* It is worth mentioning that among them the stable supply of primary energy, ensuring the energy security, the improvement of situation in energy efficiency, energy saving and energy ecology, the development of export potential of the Russian fuel and energy complex and others. The energy policy of Russian Federation has federal and regional aspects. It is noteworthy that regional programs of developing energy take into consideration the possibility of cooperation with neighboring countries. The most interesting for the Asian-Pacific countries are the programs for Siberia and Far East.

In the *New Energy Strategy* there are general provisions on the international economic activity and energy diplomacy. The *Doctrine of Energy Security* contains some international points (the list of external factors that may destabilize energy security, foreign policy orientations, the importance of good relationship with neighboring countries etc). The major goals and priorities of the international energy policy of Russia are determined by mentioned documents and also by the documents that demand coordinating the foreign policy activity under Ministry of Foreign Affairs supervision.

The principle goal of Russian energy diplomacy is promoting the international coopera ed deliveries of petroleum at reasonably low price. On the other hand, as the basic currency earnings for the years immediately ahead are connected with the export of petroleum and gas,

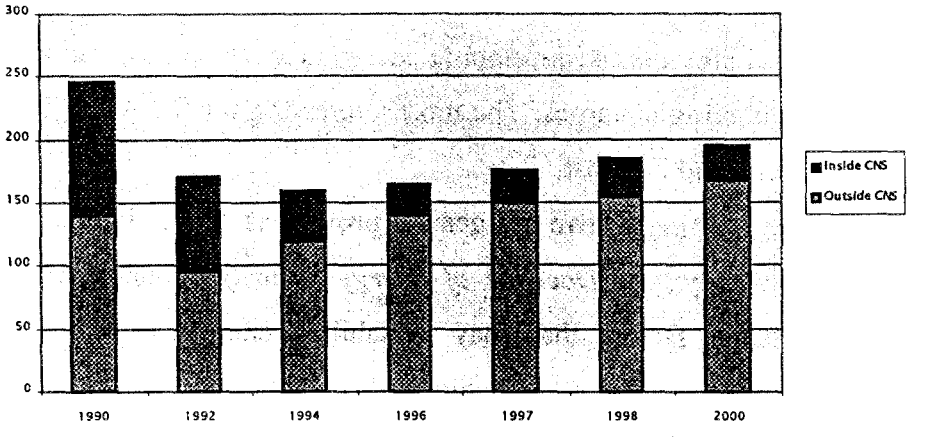
Russia is compelled to search its place among the leading exporters of these resources as well. The main objective of the exporters is to maximize the long-term returns of the sale of petroleum and to keep the price at a reasonably high level. It is with due regard for the two objectives that the Russian energy diplomacy has to find a reasonable balance between the interests of industrially developed countries, net-importers of petroleum and petroleum exporters. There are global and regional aspects of energy diplomacy of the country and also the interactions on the corporation level.

On *the global level* Russia continues to cooperate with IEA, in the framework of G8 and global producers-consumers dialogue, to participate in the Energy Charter process. In 1998 the Russian Federation started more active interaction with OPEC to coordinate oil-exporting policy. On *the regional level p*riorities of the energy diplomacy are promoting the cooperation on the post-Soviet area, in Caspian region, Europe and Asian-Pacific area. *All major international energy corporations* showed their interest to make business in Russia in upstream and downstream and put their flags. Many of them so far have not invested substantial money in the energy sector of Russia but patiently wait when their time comes to implement major international projects some of which are oriented for the Asia- Pacific countries.

Diagram 1

Oil and oil products export from Russia

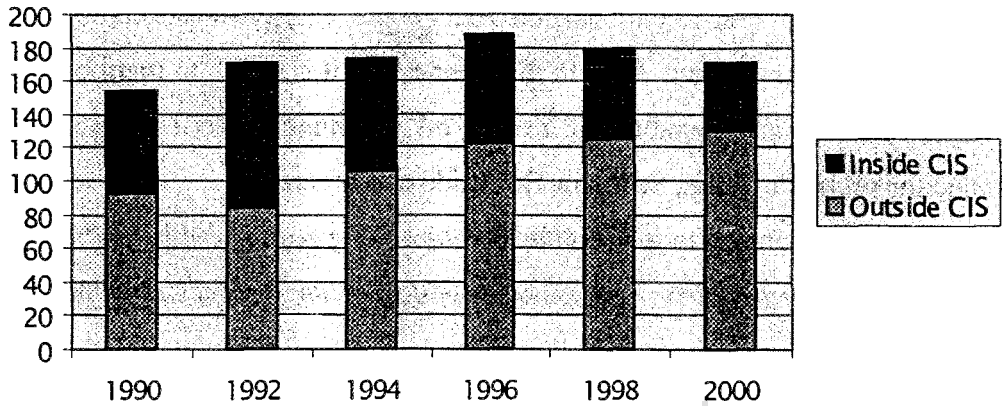
(Mtoe)



Source: *Fuel and Energy of Russia. - Moscow:Minenergo of Russia,2000; Estimation of Minenergo of Russia for 2000.*

Diagram 2

Gas export from Russia
(bln.cub.m.)



Source: *Fuel and Energy of Russia. - Moscow:Minenergo of Russia,2000; Estimation of Minenergo of Russia for 2000.*

5. Prospects for energy cooperation for Russia in the Asian -Pacific Area

Russia is both European and Asian- Pacific country. Promoting bilateral and multilateral cooperation with the states of this region is one of the highest priorities of Russian energy diplomacy for economic and political reasons. Firstly, it is well known that the Russian Federation contains vast yet untapped petroleum resources in Siberia and Far East. The demand for gas and oil in the countries of the region is growing in spite of the financial crisis of 1997-1999. It is logical that Russia as a supplier and a number of the Asian-Pacific countries as consumers of Russian resources have common interests in developing mutually beneficial cooperation in energy. Secondly, the countries of the region have a large capital potential that may be used for investing into multibillion energy mega-projects of regional dimensions. Thirdly, Russia is interested in exporting not only energy resources but also equipment, services and sending their specialists to some countries of the region.

Among the major directions of international energy policy fixed in *the New Energy Strategy of Russia till 2020* it is worth to mention the export of energy resources, participation in developing petroleum fields abroad, international transit, international technology cooperation etc. According to the prognosis the Russian export of energy resources may grow from 350 toe now days till more than 400 toe in 2012-2015. We consider possible to enter the world LNG and synthetic motor fuel markets after 2010. Proceeding from the energy and economic security needs Russia is going to diversify the directions of its export. We hope that by 2010 the new

south and east exports routes will be developed. Later those directions, primarily in the North-East Asia countries will have substantial share in geographic structure of Russian export.

Russia supports creation of unified energy and energy-transportation infrastructure in neighboring areas in Europe and Asia. In this connection it is worth to mention projects like gas pipelines Kovykta-China- Republic of Korea, oil pipelines Eastern Siberia – China, energy interconnections Siberia-China, Sakhalin-Hokkaido and others.

There are long-term interests for *bilateral cooperation between Russia and a number of countries - net importers of energy resources of the region.* Russia and ***China*** signed a number of agreements on energy cooperation that provide Russian participation in developing China power generation capacity with building new nuclear and conventional plants and modernizing aging plants. There are plans of creating the energy transportation infrastructure between both countries including high capacity power transmission line and gas pipelines. According to the plans of supplying Russian gas to China the gas pipeline will be built for transferring gas to the Central and Eastern provinces of China and further down to Pacific Ocean shores. The potential of Siberian gas resources makes it possible to supply the part of gas to other countries.

Energy factor is the most important in the economic cooperation between Russia and ***Japan.*** Energy projects are on the agenda of every bilateral summits and Intergovernmental Commissions. Japanese companies participate in Sakhalin projects and show the interest to upstream and downstream projects in gas and oil industry in Siberia. Potential for bilateral cooperation exists in the joint participation to develop several coal fields in Eastern Siberia and in building hydro power plants cascade in Southern Yakutia with electricity transportation to Russian Far East and Japan through power bridge Russia-Japan.

There are good prospects for cooperation in energy between Russia and ***Republic of Korea***. Those prospects are connected with South Korean participation in Sakhalin and Irkutsk petroleum projects and coal projects in Eastern Siberia. We have good experience in energy cooperation with the Democratic People's of Korea and hope that this cooperation will be continued.

It is worth stressing that there is a good potential for *cooperation between Russia and Asian-Pacific countries- net exporters of energy resources*. Energy is a very important factor in economic cooperation between Russia and ***Australia***. The company Petromina from ***Malaysia*** is the partner of Gasprom and French Total in the huge project to produce gas in South Pars gas field in Iranian sector of Persian Gulf. The markets for the gas from that field are located in Asian-Pacific area. For many years Russia and ***Vietnam*** are good partners within the joint venture VietSovPetro developing oil fields in that country exporting part of it to the regional

markets. Now the two countries study the possibility of joint development of gas fields. There is a potential for cooperation between Russia and ***Indonesia*** in coal industry.

It is known that in the Asian-Pacific Area the institutes for *multilateral energy cooperation* are developing particularly between the economies of the countries – members of the Asian-Pacific Economic Cooperation Forum. For Russia it is very important because the country officially joined that organization last year. The Russian Federation participated in the APEC energy working group sessions. We hope that Russia will be active in developing multilateral energy cooperation within APEC including participating in APERC programs.

There are several projects of developing petroleum resources in Russia that may be rather important for developing regional energy markets and transportation infrastructure in Far East and North - East Asia.

Sakhalin projects

There are four Sakhalin projects (Sakhalin-1, Sakhalin-2, Sakhalin-3, Sakhalin-4). Now the implementation of Sakhalin-1 and Sakhalin-2 projects is under way. The estimated reserves of oil account for about 500 Mt and gas- more then 1 trln.cub.m. The development of oil and gas fields within both projects may allow to produce about 350 Mt of oil and 100 bln.cub.m for a 25-year period. The main markets for oil and gas from Sakhalin are located in Asian-Pacific area. Several international consortiums are organized for implementation of those projects. The principle partner from Russia is the state owned company Rosneft. Among international companies participating in those projects are USA corporations Exxon, Texaco, Mobil, Japan's companies and others.

Irkutsk project

That project is based on the development of Kovyktinskoye gas field with proved reserves about 1 trln. m. The owner of those reserves is company Russia Petroleum that is controlled by Russian company Sidanko and British company British Petroleum. The basic goal of this project is development of gas that will be partly used in Irkutsk region and mainly exported to China and further to Japan and the Republic of Korea. According to estimates, the implementation of this project will allow to export 20 bln. cub.m annually for the period of 30 years.

Yakutsky project

The project may allow to develop gas field in Yakutskaya autonomous Republic with estimated reserves 500-700 bln.cub.m.

Gasprom project

Gasprom project is based on developing huge gas fields in West Siberia (Bolshekhetskaya zone). There are two major pipelines routes directly to China through Altay

region and through Krasnoyarsk and Urkutsk regions and also Mongolia. If the second route is chosen it will promote the establishment of Asian gas pipeline system in the future by uniting Urkutsk and Yakutsk projects pipeline systems.

6. Tables

Table 1

Dynamics of Principle Indices of Russia Energy Supply

Indices	1990	1991	1992	1993	1994	1995	1996	1997	2000*
Production of Primary Energy, Mtoe	1298	1220	1146	1067	1000	968	937	935	1042
Including:									
Production of oil and NGL, Mtoe	515	462	399	355	317	307	301	306	315
Production of gas, Bcm	640	643	641	618	607	596	602	571	595
Production of coal, Mt	396	353	337	306	271	264	255	244	249
Power generation, bln. KWh	1082	1068	100	957	876	860	848	834	880
Oil products, Mtoe	298	286	256	222	186	182	176	178	150

Source: Mastepanov A. Regional and Foreign economic aspects of Energy Policy of Russia- M.:Minenergo of Russia, 1997.- P. ; 18. Fuel and Energy of Russia-M. Minenergo of Russia, 2000-P.384-390.
*-Estimation of Minenergo.

Table 2

Dynamics of Principle Indices of Russia Energy Demand

	2000*	2005	2010
Electricity, bln. KWh	864	920-1120	1080-2050
Heat (centrally supplied), Mln. Gkal.	1468	1885-2000	1900-2050
Motor fuel, Mtoe	66	79-88	83-95
Primary energy – total, Mtoe. Energy consunption, toe per capita	664 4.5	685-797 4.6-5.2	706-839 4.6-5.45

Source: Mastepanov A. Regional and Foreign economic aspects of Energy Policy of Russia- M.:Mintopenergo of Russia, 1997.- P. 41. Fuel and Energy of Russia-M. Minenergo of Russia, 2000-P.384-390.
*- Estimation of Minenergo.

Table 3

Scenarios of Primary Energy Supply

	1995	2000*	2005		2010	
	Fact	Fact	Need	Max	Need	Max
Production of Primary Energy, Mtoe	968	1042	1034	1195	1084	1272
Including:						
- Oil and NGL, Mtoe	306.8	315	275	330	280	350
- Natural gas, Bcm	595.4	577	700	800	740	860
- Coal, Mt	262.2	258	275	295	300	340
Electricity production, Bln.kWh	860	880	1010	1100	1350	1620
- Hydropower Electricity, Bln kWh	176.4	170	172	180	180	190
- Nuclear power Electricity, Bln. KWh	99.3	125	122	140	125	160
- nonconventional energy, Mtoe	0,7	4,2	4,9	6,7	6,7	11,8

Source: Mastepanov A. Regional and Foreign economic aspects of Energy Policy of Russia- M.:Mintopenergo of Russia, 1997.- P. 45. ; Fuel and Energy of Russia-M. Minenergo of Russia, 2000-P.384-390.
*- Estimation of Minenergo.

Table 4

Share of Regional Primary Energy and Electricity Consumption in Russia (%)

Regions	1990		2000		2010	
	Primary Energy	Electricity	Primary Energy	Electricity	Primary Energy	Electricity
European	**71,8**	**68,6**	**71,0**	**67,4**	**71,7**	**67,6**
North-West	4,3	4,0	4,2	3,9	4,4	4,1
North	5,5	5,4	5,5	5,4	5,7	5,5
Central	15,2	15,0	14,9	14,5	15,1	14,8
Central- Chernozem	5,1	4,9	5,0	4,8	5,1	4,8
North Caucasus	6,8	5,9	6,6	5,7	6,6	5,7
Volga	11,9	11,2	12,0	11,4	12,4	11,6
Ural	18,9	17,3	18,7	17,0	18,3	16,6
Volga-Viatka	4,1	4,9	4,1	4,7	4,1	4,5
East	**28,2**	**31,4**	**29,0**	**32,6**	**28,3**	**32,4**
West Siberia	14,1	14,3	14,5	14,7	14,3	14,4
Eastern Siberia	8,8	12,4	9,1	13,1	9,0	13,5
Far East	5,3	4,7	5,4	4,8	5,0	4,5

Source: Mastepanov A. Regional and Foreign economic aspects of Energy Policy of Russia- M.:Mintopenergo of Russia, 1997.- P. 126.; Main Provisions of Energy Strategy of Russia till 2020- M. Minenergo of Russia, 2000.

Table 5

Some Indices of Energy Balance of Russia (Mtoe)

	1990	1995	1999
Primary Energy			
Production	1289	972	992
Consumption	896	656	654
Natural gas			
Production	526	492	490
Consumption	379	344	330
Export	147	148	160
Oil			
Production	516	307	310
Consumption	270	185	176
Export	246	122	134
Coal			
Production	270	184	160
Consumption	262	171	146
Export	8	13	14
Electricity Bln. KWh			
Production	1082	860	846
Consumtion	1078	835	824
Export	14	25	22
GDP(Bln.1990 doll.PPP)	1164	724	740
GDP per capita (1990 doll.)	5 600	3 800	4 900
Energy Intensity Toe/ 1000 doll.GDP	1.08	1.37	1.39
Energy Consumption Toe per capita	5.300	4.190	4 100
Structure of Energy Consumption (%)	100	100	100
Gas	40	50	51
Oil	25	21	20
Coal	26	21	20
Nuclear	5	5	5
Hydro and others	4	3	4
CO_2 Emission (Mt)	2 388	1 688	1320
Change in % to 1990.	0	-26%	-30

Source: Mastepanov A. Regional and Foreign economic aspects of Energy Policy of Russia- M.:Mintopenergo of Russia, 1997.- P. 18,41,120; Fuel and Energy of Russia-M. Minenergo of Russia,2000.-P.384-390; World Energy Outlook 2000/ IEA. Paris,2000.; Main Provisions of Energy Strategy of Russia till 2020- M. Minenergo of Russia, 2000.

*- estimation of Minenergo

Mongolian Energy Profile, Outlook and Perspectives on Regional Co-operation

Mr. Luvsanvandan Bold,
Chairman
Committee on the Promotion of Foreign Investment,
Mongolia

Dear Mr. Chairman,

First of all, let me express my sincere thanks to the Korea Energy Economics Institute for inviting me to the International Symposium on Energy Co-operation in Northeast Asia.

I am sure that this Symposium will make an important contribution to the promotion of energy co-operation schemes, the exchange of information and opinions among different organizations and individuals from our region and mutual understanding each other and finding policy options and actions in the future.

It is a great honor for me to address the distinguished participants of this international gathering on Energy Co-operation in Northeast Asia from my point of view.

My country, Mongolia faces with both domestic and international challenges and perspectives as concerned energy sector co-operation.

Before going into them, let me give you a very brief information on current energy situation in Mongolia. No doubt, the energy sector is a complex, but very important segment of Mongolian economy.

As you may know very well, Mongolia was used to be a member of COMECON system for many years until 1990s and had no energy supply constraint. The dissolution of the Soviet Union and collapse of the COMECON brought Mongolia's energy sector to the brink of crisis and consequently sharply declined energy consumption, declined almost to one half what was in the late 1980s. However, at high social and economic costs and

efforts, the country's GDP has been grown positively since 1995 as well as energy sector growth since 1998.

Approximately 70 percent of Mongolia's primary energy demand is met by domestically produced coal, and the rest, by imported petroleum products. Mongolia's power generators work mainly at coal. Coal is used for cogenerating electricity and heat. Mongolia is rich in coal deposits estimated to be 150 billion tons of which 10 billion tons are proven. There are more than 200 coal deposits within 12 coal basins and in other areas of the country. Coal range from lignite to bituminous coal. Mongolia produces about 5 million tons of coal (both hard and brown) a year to supply coal fired power stations.

There are three energy systems: Central, Western and Eastern energy system consisting of 12 power plants and 7 distribution systems in Mongolia. 80 per cent of domestically generated electricity is supplied by the Central power grid system connecting the capital city Unaanbaatar and nearby six provinces including industrial towns Darkhan and Erdenet. The Central power system comprises 5 coal fired plants: three in Ulaanbaatar, and one in Darhan, and one in Erdenet. The Central system, which is the largest one and the Western system, which covers western three provinces, are connected with Russian Electricity System. As concerned other remote towns and villages, they are supplied by mainly small size diesel generators.

The installed capacity is 772MW (plus 34 MW diesel stations) of which 540MW is available for production. Total annual consumption is about 360 million kWh. Imports from Russia accounted for about 11 per cent of the gross generation and 17 per cent of the total demand in 1997. About one third of the total demand is by Erdenet copper mine plant and Mongolrostsvetmet fluorspar company, and 30 per cent is used by householders.

Mongolia's power plants have outdated technology and work in-efficiently. It is proved by the fact that more than one third of total electricity generated at the plants are lost at the plants or on transmission.

Energy sector has swallowed one forth of the Mongolia's total Official Development Aid for the last 10 years. In concrete figure, USD256 million dollars were spent in energy sector between 1992-1999, while power production has increased only above one per cent. Therefore, the Government has been struggling to deal with this inefficient

production headache for the last a couple of years.

There is a number of policy issues and priorities identified by the Government and researchers. As concerned the energy policy the following can be listed as urgent and necessary:  Separation of Government's regulatory role from its ownership role;
 Separation between production, transmission and distribution system;
 Introduction of energy market principles and management and marketing;
 Restriction and elimination of state direct and hidden subsidies;
 Improvement of energy consumption efficiency;
 Struggle against the air pollution and Environmental protection;
 Promotion of renewable energy sources (solar energy, wind and gas);
 Physical interconnections and their international trade and commercial arrangements;
 Fuel choices and supply contract terms;
 Stockpiling crude oil and natural gas for emergencies;
 Adoption of international standards and policies and harmonizing energy policy with international commitments (Convention on Climate Change, Helsinki Protocol on sulfur emissions etc)

In addition to the above mentioned general policies, there are many other issues concerning:
 National legislation and regulations (internationally acceptable energy sector law, anti-monopoly, anti-trust, streamlining of licensing, safety standards in production, transmission and
distribution, so and so forth),
 Economics, finance and trade (liberalization of trade in energy commodities, appraisal of financial viability of industry, restriction of Government burden, economic efficiency determinations, amortization and depreciation schedules, improvement of collection rates from costumers, price setting structure and transparency, attraction of FDI in capital intensive projects, free and open trade and secure framework for investment, non-punitive taxation, introduction of international accounting standards)
 Conservation, efficiency and the environment (use of conservation and efficiency measures in energy forecasting, power generation expansion plans, households and industrial energy conservations, minimizing pollution and emissions and improved protection of environment, financial incentives, enforcement of energy

conservation laws, promotion of energy research and development/innovation, public participation in energy facility siting etc)
 Institutional structure, management and information (introducing management skills and corporate governance, corporatization of energy sector enterprises, business plans, cost-structure analysis, promotion of international accounting and auditing standards application, promotion of cooperation and coordination among energy market participants, consumer education and participation in price setting etc.)

Recently the Parliament has passed Electricity Law, according to which production, transmission and distribution system will be separated. Independent Regulatory Agency will oversee power sector development and deal with rate levels. The government will retain control of the transmission (power grid) system, and privatization is possible in production and distribution as well as coal mine.
In this conjunction, I would like to inform you that Mongolia's most valued enterprises? Privatization including energy sector is starting from this year. According to the Government Privatization Program large state owned and state involved companies including such as Neft Import Concern, the main importer of petroleum products, Trade and Development Bank, the Gobi Cashmere and national airline company MIAT will be privatized by international tender this year.

Mongolia is at the low end of attracting foreign direct investment (FDI) which is accounts for 3,5 per cent of GDP as compared to the Asia average of 15 per cent. For your information, a new draft Law on FDI is pending before the Parliament to create more favorable and conducive environment for FDI inflow into Mongolia.

In dealing with the challenges in energy policy restructuring Mongolia has been cooperating with international community, including the Northeast Asian countries, first of all Japan and Korea through both bi-lateral and multilateral cooperation (ADB and World Bank). For example, one of the three (Baga Nuur, Shivee Ovoo and Saryn Gol) largest coal mines – Sivee Ovoo coal mine is in rehabilitation and renovation with Japanese aid and cooperation. Also Japanese International Cooperation Agency is helping elaboration of the Government energy sector's development master plan. There is a power plant construction being completed with Korean assistance in South Gobi province, where is the largest coal deposit in Mongolia.

As you may know, so far Mongolia has neither commercial oil nor natural gas production. Therefore, the country is fully dependent on imports of refined petroleum products. Mongolia has been trying to diversify sources of petroleum products supply since early 1990s, but with limited results. We had petroleum and fuel supply shortages in several occasions for the last ten years.

Petroleum exploration operation started in 1990 in Mongolia. As a result of Mongolia's efforts to attract foreign direct investment in this sector, more than ten Production Sharing Agreements have been concluded since 1992. A modest volume of crude oil has been started to be exported to China since 1997.

So as you see, there is a number of problems and issues to be tackled by the national government and energy market players in Mongolia in coming years. At the same time Mongolia pays great importance to the energy co-operation the Northeast Asia region.

Northeast Asia is a unique region with vast energy resources and huge energy demands to sustain the well performing economic activities and growth of our nations. From my standpoint, there is a couple of options in the field of energy co-operation, where Mongolia may take an active participation and involvement.

First. Mongolia is potentially very rich in minerals, including coal, uranium and oil. Mongolia's Minerals Law (1997) is one of the most liberal laws in the world by many experts' opinion. Therefore, Northeast Asian countries (both public and private investors) may invest in exploration and exploitation of natural resources in Mongolia for export as well as internal market. This is first opportunity in Mongolia. The second opportunity is participation in state owned energy enterprises' privatization. As I mentioned earlier, there is going-on state property privatization, including energy sector. It is happening for the first time and also for the last time in this country. Foreign investors have equal opportunities to participate in state owned enterprise privatization without any discrimination and preferential treatment as domestic investors.

So, I would strongly encourage especially direct investment from our region into Mongolia.

Two. As I mentioned earlier, so far no commercial gas was found in Mongolia. However, Mongolia is a part of multilateral talks of Irkutsk (Kovyktonskoe field)

natural gas pipeline project to deliver natural gas from Russia to China. It is common knowledge that many issues concerning the project such as feasibility study, route, environmental issues have not yet finalized. However, from my personal point of view, the most cost effective and shortest route for this Gas Pipeline would be to lay it along the Trans-Siberian railroad via Mongolia to China, and possibly to PDR of Korea, Republic of Korea and Japan. To my best knowledge, the route through Mongolia is supported by supplier - Russia and some other potential investors. Implementation of the gas pipeline project may take years, but we have to try to shorten the time factors taking into consideration of rapid development and pace of regionalization and globalization. In my view, our Northeast Asia is lagging behind some other regions in terms of co-operation and integration for political, historical and other reasons.

Three. As you may have heard that there is also a going on talks on construction of high voltage electricity line and oil pipeline between Russia and China. One thing is sure that according to different forecasts there is growing demand in energy in China, Korea, Mongolia and Japan in coming years on one hand, and on the other hand there is a strong interest and huge potential in Russia to export energy products to China and other Northeast Asian countries. And Mongolia is interested in participation and facilitation of these potential mega-projects to be implemented in this region. Therefore, I consider that this Symposium will also contribute to the promotion of dialogues and cooperation in energy sector among the region's countries.
I am confident that energy co-operation will lead not only to energy security, but regional stability and prosperity in this century. From this kind of cooperation, all of us will benefit.

Mongolia had experienced with isolation from the Northeast Asia in the past. Now it is very clear that from isolation and confrontation we won nothing, but lost time and development opportunities. Present day Mongolia, which is in transition to market economy and democracy, is eager to promote broad co-operation with neighbors and other Northeast Asia countries.

In concluding my short statement, I would like to express my deep hope that energy co-operation will support other co-operation and integration in this region, if we look at European economic integration's history and experience. I mean the European Coal and Steel Community established by six countries in 1951, the European Natural Gas Pipeline, laid down in early 1960s and expanded into international market, and

conclusion of European Energy Charter. Why we should not start from thinking of the Regional Energy Co-operation by construction of gas, electricity and oil pipelines, which would connect Russian Siberia, China, Mongolia, two Koreas and Japan. If we are dependent and reliable on each other, then we will be able to concentrate our efforts on efficiency, productivity and prosperity of our nations. By doing this, our countries and our region will compete more successfully at the globalizing world market.

I believe that we, our region's countries, have natural resources, human resources, markets, technologies and skills, and wise leaders to manage these kind of ambitious and necessary projects and co-operation for the well-being of all of our nations. At the same time we have to be realistic. Yes, there are plenty of objective and subjective obstacles and barriers in energy cooperation in this region. But I do believe that they (obstacles) will be overcome only by us, with us and through us, through our national and joint efforts accordingly. God bless us.

Thank you for your attention.

Energy Profile and Perspectives on Northeast Asian Energy Co-operation of North Korea

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1. Profiles of Economy and Energy Supply

1.1 Brief Economic Profiles of North Korea

□ Population of North Korea has been increased from 20,221 thousand in 1990 to 22,082 thousand in 1999, with the annual average growth rate of 0.98%.

- But, after 1995 to 1999, the population of North Korea has been increased with the annual average increase rate of 0.62%, relatively lower than that of South Korea.

< Trend of North Korean Population Increase >

	North Korea		South Korea		(B)/(A)
	thousand(A)	Increase rate(%)	thousand(A)	Increase rate(%)	
1990	20,221	1.22	42,869	0.99	2.12
1995	21,543	0.88	45,093	1.01	2.09
1996	21,684	0.66	45,545	1.00	2.10
1997	21,810	0.58	45,991	0.98	2.11
1998	21,942	0.60	46,430	0.95	2.12
1999	22,082	0.64	46,858	0.92	2.12
'90-'99	0.98	-	0.99	-	-
'95-'99	0.62	-	0.96	-	-

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

□ GNI(Gross National Income) of North Korea which is converted by the exchange rate of Won to US dollar, has been increase from 23 billion dollar in 1990 to 15.8 billion dollar in 1999, with the annual average increase rate of minus 4.13%.

- Especially, from 1995 to 1999, GNI of North Korea has been decreased with the average annual growth rate of minus 8.25%. It means that economic depression of North Korea after 1995 was greater than that of the early years of 1990s.

- With the view of 1995 real GDP growth rate, North Korean economy appeared to succeed in turning to the plus growth phase in 1999 after the long rally of minus growth in 1990s

< Trend of Economic Growth of North Korea >

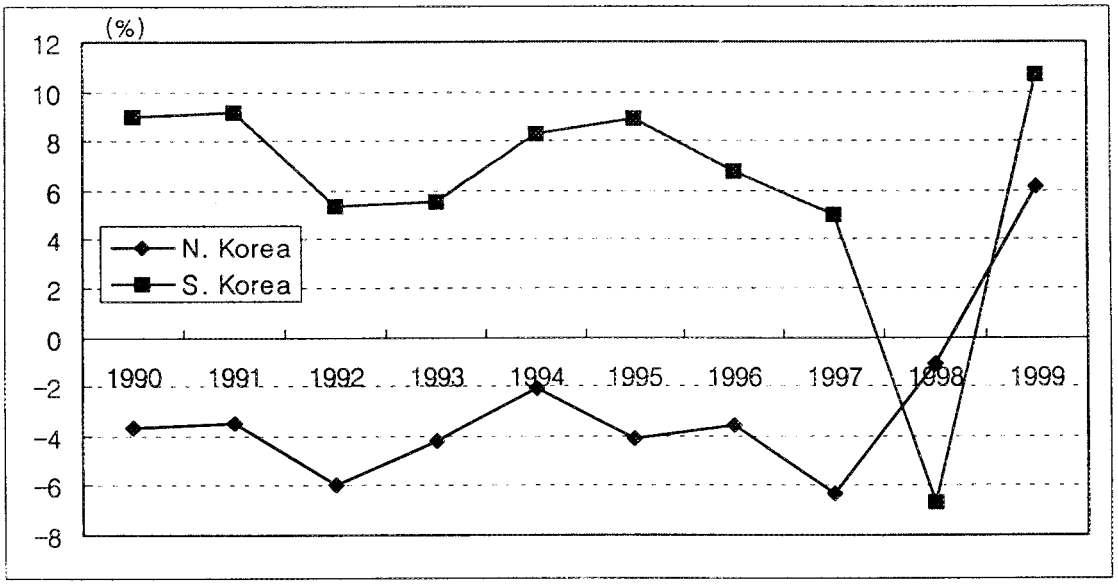
	North Korea			South Korea			Comparison	
	Nominal GNI (billion $),A	Growth Rate(%)	Per Capita GNI (US$),a	Nominal GNI (billion $),A	Growth Rate(%)	Per Capita GNI(US$),a	(B)/(A)	(B)/(b)
1990	23.1	-3.7	1,142	252.3	-.0	5,886	10.9	5.2
1995	22.3	-4.6	1,034	488.1	8.9	10,823	21.9	10.5
1996	21.4	-3.7	989	518.3	6.8	11,380	24.2	11.5
1997	17.7	-6.8	811	474.0	5.0	10,307	26.8	12.7
1998	12.6	-1.1	573	313.0	-6.7	6,742	24.8	11.8
1999	15.8	6.2	714	402.1	10.7	8,581	25.4	12.0
'90-'99	-4.13	-	-5.08	5.32	-	4.28	-	-
'95-'99	-8.25	-	-8.84	-4.73	-	-5.64	-	-

- Growth rate represents the real GDP growth rate

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

The bank of Korea, Estimation of North Korean GDP in1999, 2000. 6

[Comparison of Economic Growth Path of two Koreas]



Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

The bank of Korea, Estimation of North Korean GDP in1999, 2000. 6

□ North Korean industrial structure has shown significant variations in 1990s. The share of mining and manufacturing, electricity, gas and water, and construction has been decreased. On the other hand, the share of agriculture and fishery, and service has been increased.

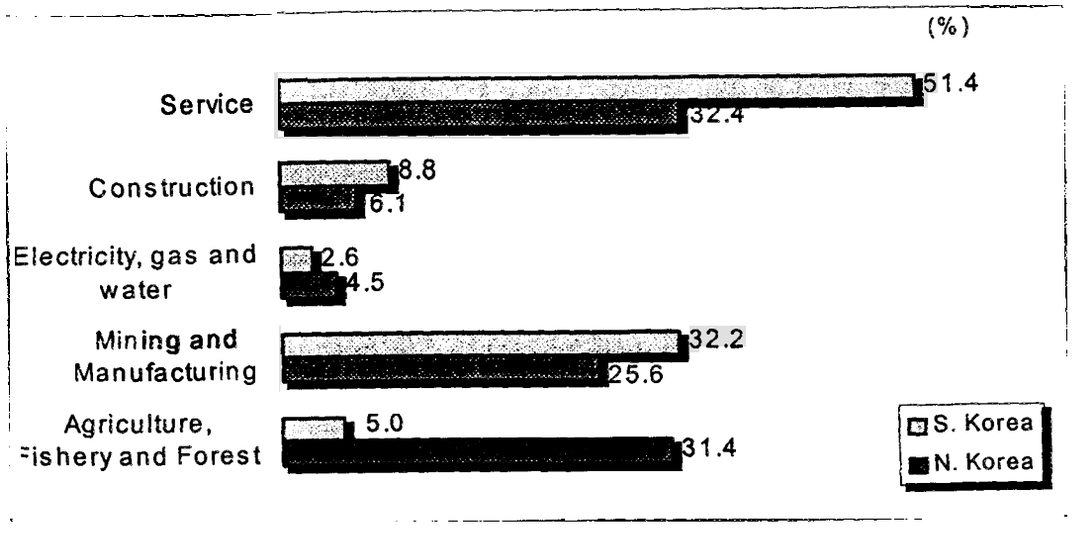
- In the comparison between two Koreas, the share of North Korean agricultural sector in 1999 was 31.4% which is 6 times of 5% of South Korea in that year. Contrarily, the share of service sector of North Korea in 1999 was 31.4%, which is smaller than 51.4% of South Korea in same year.

< Industrial Structure of North Korea >

(Unit: %)

		1992	1995	1996	1997	1998	1999
North Korea	Agriculture and fishery	28.5	27.6	29.0	28.9	29.6	31.4
	Mining and manufacturing	33.8	30.5	28.0	25.5	25.6	25.6
	Electricity, gas and water	5.1	4.8	4.3	4.3	4.2	4.5
	Construction	9.1	6.7	6.4	6.3	5.1	6.1
	Service	23.5	30.3	32.3	35.0	35.6	32.4
South Korea	Agriculture and fishery	7.4	6.2	5.8	5.4	4.9	5.0
	Mining and manufacturing	29.3	29.8	29.3	29.3	31.2	32.2
	Electricity, gas and water	2.1	2.1	2.1	2.1	2.4	2.6
	Construction	12.0	11.3	11.6	11.6	10.1	8.8
	Service	49.1	50.6	51.2	51.6	51.2	51.4

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000



Source: The bank of Korea, Estimation of North Korean GDP in1999, 2000. 6

1.2 Primary Energy Supply of North Korea

□ Primary energy supply of North Korea has shown the decreasing trend from 1990 to 1999 with the annual average growth rate of minus 4.7%. Primary energy supply in 1999 recorded 15.6 million TOE which is 65% of the primary energy supply in 1990.

- From 1995 to 1999, primary energy supply of North Korea increased annually by 2.6%. Compared to the early years in 1990s, it is somewhat tranquilized during period.
- In 1999, primary energy supply of North Korea increased by 10.9% compared to previous year.

< Primary Energy Supply of North Korea >

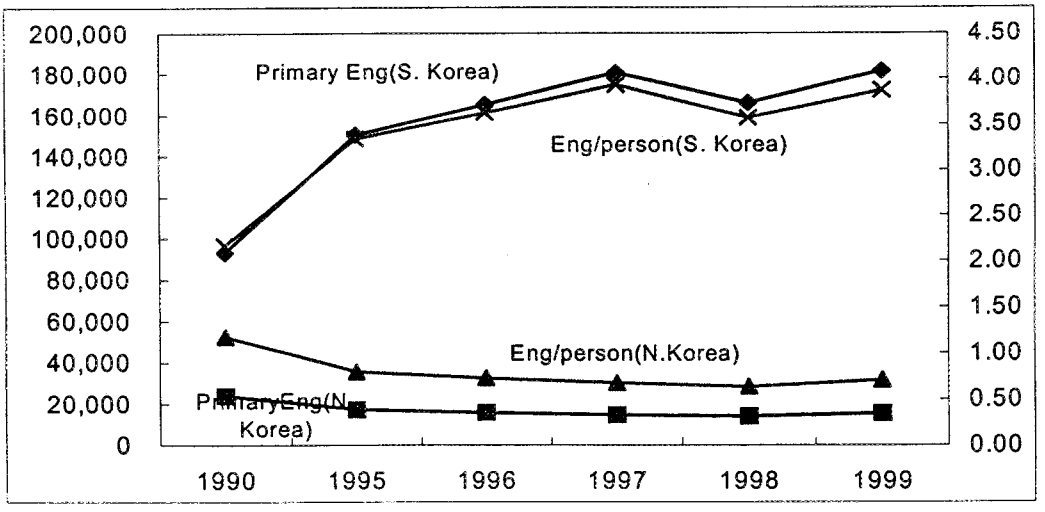
	Primary Energy(thou.TOE)			Energy per person(TOE)		
	N. Korea(a)	S. Korea(b)	(b)/(a)	N. Korea(a)	S. Korea(b)	(b)/(a)
1990	23,946	93,192	3.9	1.18	2.17	1.8
1995	17,280	150,437	8.7	0.80	3.34	4.2
1996	15,836	165,212	10.4	0.73	3.63	5.0
1997	14,746	180,638	12.2	0.68	3.93	5.8
1998	14,030	165,932	11.8	0.64	3.57	5.6
1999	15,570	181,363	11.6	0.71	3.87	5.5
'90-'99	-4.7	7.7	-	-5.5	6.6	-
'95-'99	-2.6	4.8	-	-2.9	3.8	-

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

The bank of Korea, Estimation of North Korean GDP in1999, 2000. 6

[Comparison of Primary Energy Supply between two Koreas]

(Unit: thou.TOE, TOE/person)



□ Per capita primary energy of North Korea has decreased after 1990 to 1999 with the annual average growth rate of minus 5.5%. In 1999, per capita primary energy of North Korea recorded 0.71TOE.

- Declining trend of per capita primary energy of North Korea is interpreted not by the improvement of energy efficiency but by the insufficient energy supply.

□ Primary energy supply structure of North Korea is composed mainly of coal and hydro. The share of petroleum in 1999 was just 12.4%. This shape of primary energy supply structure of North Korea is resulted by the "Principle of self-reliance" which is the major energy policy objective of North Korea. The energy self-reliance rate of North Korea was 87.6% in 1999.

- In spite of severe constraints in energy supply for so many years, any significant change in energy supply structure by source is not observed.
- The share of coal in primary energy supply was 65.9% and that of oil was 12.4% in 1999. In 1985, the share of coal in primary energy supply mix reached at the highest level of 75.2%, which is 9.3% point higher than that of 1999.

< Primary Energy Supply Structure by Source >

(Unit: thou.TOE, %)

		1990	1995	1996	1997	1998	1999
Primary energy(N.Korea)		23,946	17,280	15,836	14,746	14,030	15,570
Share (%)	Coal	69.2 (26.2)	68.6 (18.7)	66.3 (19.5)	69.9 (19.3)	66.3 (21.7)	65.9 (21.0)
	Oil	10.5 (53.8)	6.4 (62.5)	9.1 (60.5)	6.8 (60.4)	10.0 (54.6)	12.4 (53.6)
	Hydro	15.6 (1.7)	20.5 (0.9)	19.7 (0.8)	18.0 (0.7)	18.2 (0.9)	16.2 (0.8)
	Nuclear	0.0 (14.2)	0.0 (11.1)	0.0 (11.2)	0.0 (10.7)	.00 (13.5)	0.0 (14.2)
	Natural gas	0.0 (3.2)	0.0 (6.1)	0.0 (7.4)	0.0 (8.2)	0.0 (8.4)	0.0 (9.3)
	Others	4.7 (0.9)	4.5 (0.7)	4.9 (0.7)	5.3 (0.7)	5.5 (0.9)	5.5 (1.0)
Primary energy(S.Korea)		93,192	150,437	165,212	180,638	165,932	181,363

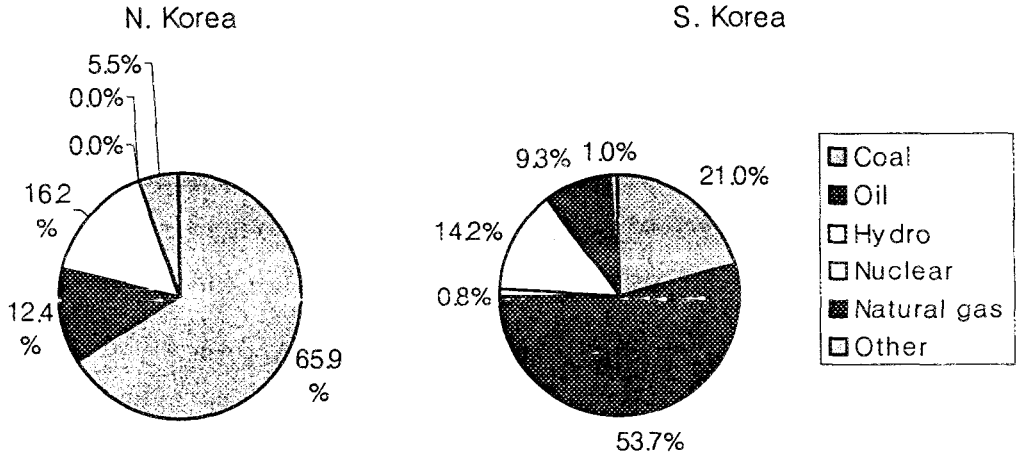
- Values in ( ) represents the share of primary energy supply of South Korea.

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

Korea Energy Economics Institute, Yearbook of Energy Statistics 2000, 2000

- For the supplement of the decrease of coal production, North Korea has tried to develop hydropower. So, the share of hydropower in primary energy supply mix reached at 20.5% in 1995. But after 1995, because of the consecutive natural disasters, the share of hydropower has decreased again to 16.2% in 1999.
- In spite of severe difficulties in energy supply, the share of other energies such as wood are not enlarged so much. It is well known that forests in North Korea are naked already except remote deep mountains.

[Comparison of Primary Energy Supply Structure between two Koreas(1999)]



1.3 Energy Supply by Sources

□ Coal

- The coal reserve of North Korea is reported differently by sources. U.N. statistics estimates the coal reserve of North Korea as 7.5 billion ton, and 2.6 billion ton among them is regarded as confirmed reserves. On the other hand, Ministry of Unification of South Korea estimates the coal reserve of North Korea as 15 billion ton, and among them, 12 billion ton are regarded as anthracite coal and 3 billion ton are regarded as bituminous coal. The coal reserve of North Korea is greater than that of South Korea by more than 10 times in the case of Ministry of Unification estimates.
- Coal production of North Korea reached at the highest level in 1985. But after the

peak in 1985, coal production of North Korea has been decreased with the annual average growth rate of minus 2.4%, minus 6.5% and minus 2.4% in every five years.

< Trend of Coal Production of North Korea >

Year	Production (thou.M/T)	Share to primary energy(%)	Index (1985=1)
1965	17,860	71.9	0.476
1970	13,240	72.5	0.353
1975	20,850	-	-
1980	30,270	72.0	0.807
1985	37,500	75.2	1.000
1990	33,150	69.2	0.884
1991	31,100	70.7	0.829
1992	29,200	71.3	0.779
1993	27,100	71.3	0.723
1994	25,400	71.1	0.677
1995	23,700	68.6	0.632
1996	21,000	66.3	0.560
1997	20,600	69.8	0.549
1998	18,600	66.3	0.496
1999	21,000	70.2	0.560

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

- As the reasons of the decrease of coal production in North Korea, difficulties in development of new coal mine, deep exploitation in coal mines, insufficient mining machinery and natural disasters are indicated. Especially, by the consecutive flooding, it is known that many coal mines in flatland were damaged severely.

□ Oil

- North Korea has two refinery plants with the total refining capacity of 72 thousand barrel per day.
- Crude oil import of North Korea has entirely relied on the supply from China and Russia. After the colla0pse of Former Soviet Union, the supply from Russia in a very

low price decreased drastically. Thus, after 1996, crude oil import of North Korea has entirely relied on China. But China also is asking the normal price to North Korea.

< Trend of Crude Oil Import of North Korea >

Year	Import (thou. bbl)	Index (1990=1)	KEDO heavy oil (10 thou. ton)	Product supply (thou.TOE)	Oil/Primary Eng(%)
1965	2,842	0.154	-	351	3.0
1970	6,190	0.335	-	764	4.2
1975	-	-	-	-	-
1980	15,393	0.833	-	2,100	10.0
1985	14,369	0.778	-	1,960	7.9
1990	18,472	1.0	-	2,520	10.5
1991	13,854	0.75	-	1,890	8.6
1992	11,142	0.603	-	1,520	7.5
1993	9,969	0.534	-	1,360	7.2
1994	6,670	0.361	15	910	5.1
1995	8,063	0.436	50	1,100	6.4
1996	6,861	0.371	50	1,436	9.1
1997	3,709	0.201	50	1,006	6.8
1998	3,694	0.200	50	1,400	10.0
1999	2,325	0.126	50	881	5.9

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

- It is known that there is no oil product import from abroad in North Korea except the heavy oil from KEDO(Korea Energy Development Organization). Thus all of the oil products consumed in North Korea are estimated as the oil products distillated in North Korea. By the Geneva Nuclear Agreement between North Korea and U.S.A. in 1994, 500 thousand ton of heavy oil is delivered to North Korea every year by U.S.A.
- Up to 1994, there was small amount of oil product export from North Korea, but after 1994, any significant oil product export is not observed.
- Crude oil import of North Korea has decreased steadily after the highest amount of 1.85 million barrel in 1990. Especially in 1998, crude oil import of North Korea was 3.7 million barrel, which is relevant to the 20% of crude oil import in 1990.

◻ Electricity

- It is known that the installed power generation capacity of North Korea is 7,387MW, of which 4,437MW is thermal and 2,950MW is hydro. Recently, it is reported that many small hydro power plants have been built in North Korea, but because they are not connected to the main grid and the capacities are so small, they are not so helpful for the enhancement of power generation facility.
- Installed power generation capacity of North Korea keep similar level since 1990. But total electricity generated has been decreased steadily since 1990. Insufficient electricity supply acts as a main trouble to the rehabilitation of North Korean economic situation.

< Power Generation Facilities of North Korea >

(Unit: thou. kW, %)

Year	Hydro		Thermal		Total
1965	2,105	(88.3)	280	(11.7)	2,385
1970	2,550	(71.8)	1,000	(28.2)	3,550
1975	2,730	(60.3)	1,800	(39.7)	4,530
1980	2,910	(58.2)	2,100	(41.9)	5,010
1985	3,310	(56.0)	2,605	(44.0)	5,915
1990	4,292	(60.1)	2,850	(39.9)	7,142
1995	4,337	(59.9)	2,900	(40.1)	7,237
1999	4,437	(60.1)	2,950	(39.9)	7,387

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

< Power Generation of North Korea >

(Unit: 100 GWh, %)

Year	Hydro		Thermal		Total
1965	72	(54.5)	60	(45.5)	132
1970	90	(64.3)	50	(35.7)	140
1975	98	(53.6)	85	(46.4)	183
1980	106	(50.0)	106	(50.0)	212
1985	123	(49.0)	128	(51.0)	251
1990	156	(56.3)	121	(43.7)	277
1995	142	(61.7)	88	(38.3)	230
1999	103	(55.4)	83	(44.6)	186

Source: National Statistical Office, Republic of Korea, Comparison of Economic and Social Status between two Koreas, 2000

- Superficial reasons of the decrease of power generation are discussed as the reduction of coal production, damages from flooding, and the lack of facility repair and so on. But fundamental reason can be said the long-term policy failure which do not develop various power sources such as oil, gas and nuclear power generation.

2. Major Energy Policy Issues of North Korea

2.1 Energy Policy of North Korea

□ Energy policy of North Korea is basically based on the "Principle of Self-reliance". Throughout the active development of domestic energy sources, North Korea try to maximize the energy self-reliance as well as to minimize the outflow of currency for the import of energy.

□ But, the "Principle of Self-reliance" of energy sector brought about the excess dependency on coal and hydro, and eventually causes the contraction of oil and natural gas consumption. This kind of adverse reaction of the "Principle of Self-reliance" is the major reason of overall weakness of national-wide economic system.

2.2 Policy Issues of North Korea in Energy Sector

□ Urgent policy question North Korea is facing is the enlargement of energy supply for the recovery of economic crisis. In a long-term, the enforcement of energy system for the support of continuous economic growth is also very important energy policy objective. For these policy objectives, followings are recommended for North Korea to set up effective energy policy directions.

□ Flexible application of the "Principle of Self-reliance": Flexible application of the "Principle of Self-reliance" in energy sector is needed. It will be difficult to pursue further economic growth with only domestic energy sources any more. The change of policy mind to introduce commercial energy from international energy market should be the major policy direction for the recovery and enforcement of energy system.

□ Inducement of foreign investment in energy sector: For the implementation of policy measures to solve current energy crisis and to enhance the energy system, including

short-term and long-term measures, large amount of investment is inevitable. Thus, for the inducement of active foreign investment in energy sector, related legal, institutional systems should be arranged.

□ Establishment of commercial energy system: In the case of foreign investment, it may be possible in the early stage with barter trade but, in the mid-term or long-term view, energy market system in which the recovery of invested money from energy price system is possible, is needed to be established. There is no room to introduce commercial energy in such a system as government supplies energy and consumer consumes it without any payment. The introduction of price system in energy sector can facilitate the transformation of economic system to capitalism.

□ Enhancement of energy policy basis: There is no systematic energy data collection and analyzing system in North Korea. Therefore, in reality, there is no professional energy policy procedure except elementary energy conservation. Current habitual practice is based on the planned economy in which energy supplied without any delicate energy demand analysis and just consumed within given amount. Throughout the establishment of scientific energy statistics and monitoring system, energy demand analysis and forecasting, the basis for energy policy should be enhanced.

□ Establishment of open energy system throughout South-North Korean and Northeast Asian energy cooperation: Because of her location in the central area of Northeast Asia, North Korea have a good condition to be the largest beneficiary from Northeast Asian energy cooperation. North Korea can pursue the enforcement of energy supply capability and related huge economic profits from the connection of energy network, energy trade and the cooperation in energy-environment issues with South Korea and Northeast Asian countries.

3. Perspectives on Northeast Asian Energy Co-operation of North Korea

□ It is not known actually what kinds of perspectives North Korea has on the Northeast Asian energy cooperation. But, it can be said that Northeast Asian energy cooperation can be the best chance for North Korea to solve current energy crisis and to transfer the economic system to capitalism for the recovery of national economy. Followings are estimated to be

the North Korean perspectives on Northeast Asian energy cooperation.

- Establishment of energy infra structure from Northeast Asian energy cooperation: Construction of natural gas pipeline and connection of electricity grid are discussed as major cooperative projects in Northeast Asian energy cooperation. Because North Korea is located in the pass way of those energy infra connection among Northeast Asian countries, Northeast Asian energy cooperation will offer some chances to North Korea to avoid the huge amount of investment for energy infra construction.

- Establishment of open energy system throughout Northeast Asian energy cooperation: It can be possible for North Korea to establish the open energy system connected to South Korea and Northern continent throughout Northeast Asian energy cooperation. This is very important to North Korea for the enhancement of energy supply capability and related economic profits.

- Seeking for the ways for the proper operation of KEDO nuclear power plant: Owing to the insufficient power grid capacity of North Korea, it is discussed that the proper way for the normal operation of KEDO nuclear power plant should be considered. Power grid connection to South Korea and Northern countries such as China and Russia can be the answer to the questions on the supply of large amount of stable electricity for the test operation of nuclear power plants, and the excessive electricity export in the case of power grid trouble in North Korea.

- Promotion of domestic energy resources development throughout Northeast Asian energy cooperation: North Korea can seek the effective development of her domestic coal resource throughout Northeast Asian energy cooperation. And North Korea can promote the oil resource development by way of joint development and financial cooperation among member countries in the context of Northeast Asian energy cooperation.

- Introduction of energy technology and the improvement of energy efficiency throughout Northeast Asian energy cooperation: When current level of North Korean energy technology is taken into account, it can be said that technology import from other countries can be effective for the following-up the modern energy technology level. When energy supply constraints is overcome, the improvement of energy efficiency will rise to the surface as major energy policy issue like as the case of China. Northeast Asian energy cooperation can suggest the effective cooperative activities for the improvement of energy technology and energy efficiency of North Korea.

□ Pursuit of economic profits from Northeast Asian energy cooperation: Because the major activities of Northeast Asian energy cooperation are the various development projects, North Korea can have various chances for the pursuit of economic profits from Northeast Asian energy cooperation. From the participation of North Korean labor forces and raw materials to Northeast Asian energy development projects North Korea can obtain huge size of economic profits. As well as the construction process, after the construction of Northeast energy network such as natural gas pipeline and electric power grid, North Korea can pursue the economic profits from passage fees and maintenance projects.

□ Promotion of economic transition throughout Northeast Asian energy cooperation: As of now, North Korea is in the transition stage to the open economy to facilitate the national economic development. Northeast Asian energy cooperation can promote North Korean economic transit from socialism to capitalism by way of the promotion of the reforming of legal, institutional systems and socio-political cultures.

4. Interests of North Korea on Northeast Asian Energy Co-operation by energy sources

□ Oil: Currently, North Korea import crude oil from China and Russia with very preferable price condition and process it in two refinery plants. The core of North Korean oil supply problems are the reduction of crude oil import from the withdrawal of preferable price condition by China and Russia and the insufficiency of finance for the import of crude oil. In the long-run, expansion of investment for the construction of refinery plants, storage facilities and oil importing harbor will rise to the surface as the major policy issues.

- In the short-run, Northeast Asian energy cooperation can offer some ideas to assist North Korean oil supply problem. North Korea can lease her oil refinery plant to the other member countries, and North Korea can secure heavy oil as a refining fee. For the member countries of which the demand of light oil products dominant to the demand of heavy oil products such as South Korea and Japan, investment for the construction of heavy oil reprocessing equipment and the handling of the surplus heavy oil are very difficult problem to manage.
- In the short and mid-run, Northeast Asian energy cooperation can suggest the cooperative chances to facilitate the development of North Korean oil resources. In spite of North Korean efforts for the inducement of foreign capital, there is no

significant outcome up to now. Cooperative investment and financial cooperation for the oil development in North Korea can be realized in the context of Northeast Asian energy cooperation.

- In the long-run, when oil import from Middle East or Southeast Asia is inevitable from the growth of oil demand, various cooperation for the investment on oil refinery plants, oil transportation, cooperative oil purchase and the cooperation on the physical distribution of oil can be substances of Northeast Asian energy cooperation. From these kind of cooperation among member countries, North Korea can pursue various national profits.

□ Coal: Coal will have a greatest share in North Korean energy supply mix for a considerable period. Problems North Korea is facing with in coal supply are the limitation of production increase from outmoded development of coal mine and the difficulties in the development of new coal mines. Northeast Asian energy cooperation can supply some positive motives for North Korea to overcome the current coal supply constraint and the modernization of coal mine.

- For the aid to the North Korean current coal supply constraint, some cooperative projects among member countries such as the supply of South Korean reserved coal and the development of Northeastern Asian coal mines in China and Russia can be considered in the context of Northeast Asian energy cooperation.

- For the modernization of North Korean coal mining machinery, the supply of retired coal mining machines and the transfer of coal mining technologies and coal utilizing technologies from other member countries can be considered in the context of Northeast Asian energy cooperation.

- In the long-run, in the process of North Korean problem solving for the overcome of coal supply constraint throughout effective development of coal mine, Northeast Asian energy cooperation can support various technological and financial aids to North Korea.

□ Natural gas: As of now, there is no natural gas in North Korean energy supply mix. But, if North Korea is involved in currently discussing natural gas pipeline project among member countries of Northeast Asia, natural gas will be the promising energy source for North Korea to enhance her energy supply capability.

- Several natural gas development projects such as Iruktsk, Saha and Sahalin are

actively under discussion among interested Northeast Asian member countries. From the participation with her excellent and cheap labor forces and raw materials, North Korea can get huge size of economic profits. And from the maintenance of pipeline and passage fee also can be the potent sources of economic profits for North Korea.

- If natural gas pipeline go through North Korea, it can be very good chance for North Korea to secure natural gas infra structure. In the long-run, natural gas is very important energy source for North Korea to diversify energy sources and enhance energy supply capability.

□ Electricity: Troubles in electricity production and supply is the core of current North Korean energy supply constraint. Northeast Asian energy cooperation can be a reliable way for North Korea to overcome current problems and to secure sufficient electricity supply in economical and stable way for the mid and long-run economic growth.

- Financial and technical aids from foreign countries is crucial for the solving of current North Korean electricity supply constraint such as insufficient energy supply for power generation, outmoded power generation facilities and outmoded power grid. In the structure of Northeast Asian energy cooperation, some reliable ways to solve these problems can be provided.

- In the context of Northeast Asian energy cooperation, technological and financial cooperative activities and the participation to the investment can be secured for the construction of power generation facilities in North Korea. Thus, North Korea will be able to try to secure the power generation capacity building from Northeast Asian energy cooperation.

- Owing to the insufficient power grid capacity of North Korea, it is discussed that the proper way for the normal operation of KEDO nuclear power plant should be considered. Power grid connection to South Korea and Northern countries such as China and Russia can be the answer to the questions on the supply of large amount of stable electricity for the test operation of nuclear power plants, and the excessive electricity export in the case of power grid trouble in North Korea.

- From the connection of power grid among member countries of Northeast Asia, North Korea can pursue economic profits from the participation to development projects and the enlargement of power supply capability from the transaction of electricity among connected member countries.

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International Symposium on

Energy Co-operation in Northeast Asia

7-8 June 2001. Sherton Walker Hill Hotel, Seoul, Korea

Session II

Chair: Dr. Young Sik Jang, Former President of KEPCO

Future Challenges in the Energy Sector in Northeast Asia

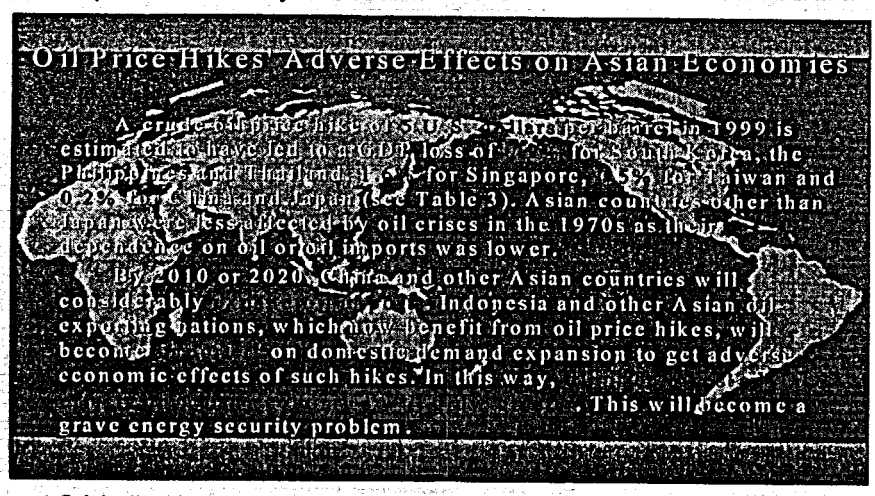
Energy Security and Northeast Asian Petroleum Market	*Mr. M. Soga, Senior Economist, IEEJ* *Dr. S. Kaku, Economist, IEEJ* *Mr. Jung Hwan Choi, Economist, IEEJ*
Power Interconnection Network in Northeast Asia	*Dr. S. Popov,* *Head of Laboratory, ESI, Russia*
Natural Gas Infrastructure Development in Northeast Asia	*Mr. Sunwoo Hyun Bum,* *Advisor to the President, NAGPF*
Energy-Environment Issues and Implication of the CDM for Northeast Asia	*Dr. G. Timilsina,* *Senior Researcher, CEERD,AIT*

Energy Security And Northeast Asian Petroleum Market

2001. 6. 7. (Thu)

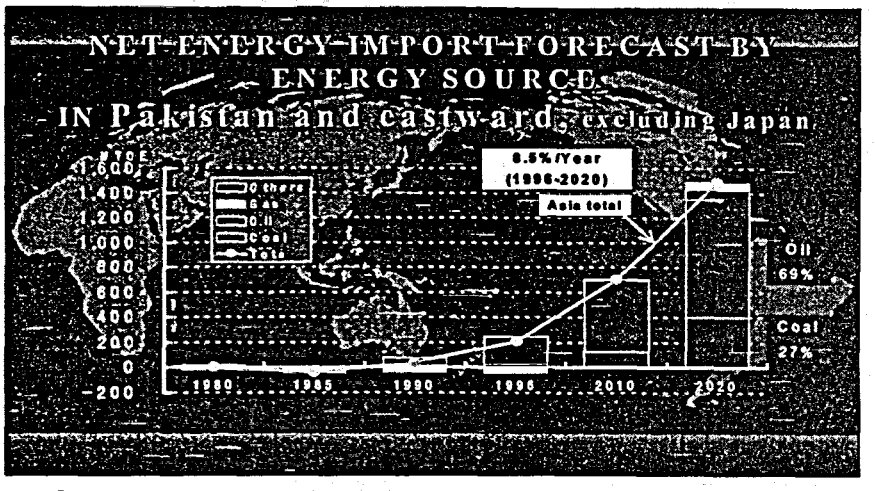
Mr. Masayoshi Soga
Senior Researcher
The Institute of Energy Economics,
Japan

The higher difference in Asian crude price among E.U., U.S.A. & Asia can produce lower GDP.
The balanced advance of GDP is based on fair price of the crude.
It is the most important for the equilibrium growth that the every consumer's energy price should be competitive internationally.



* Originally this paper is prepared by Mr. Fujime.

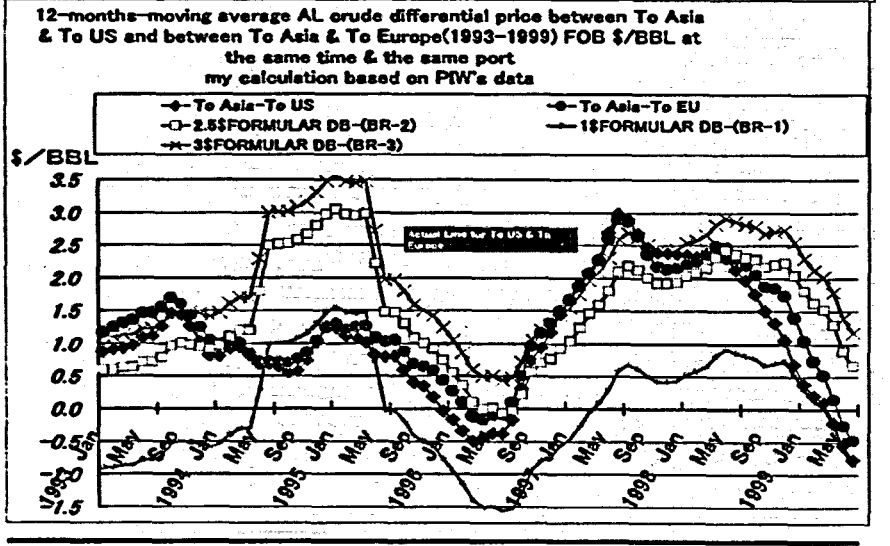
Asian imported energy is mainly oil and oil price can strongly influence the other energy price.



* Originally this paper is prepared by Mr. Fujime.

Page 3

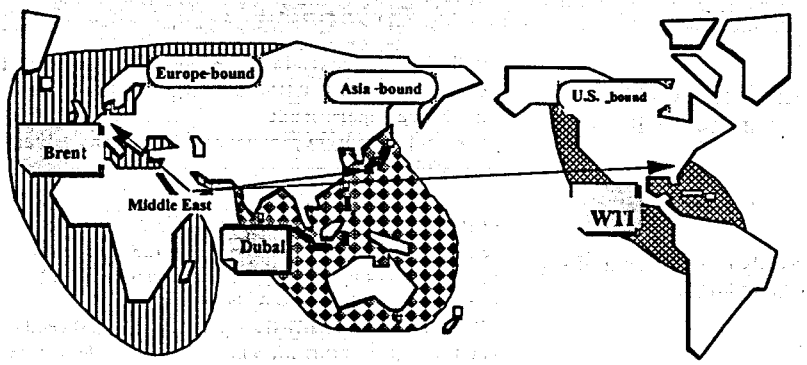
The higher price level to Asian market
Almost the same price level in the destination between to Europe and to USA.
Asian would like to discover how to escape from the almost higher different price.



Page 4

There are the three crude pricing systems in the world now.

Can NE Asian have the forth pricing system ?



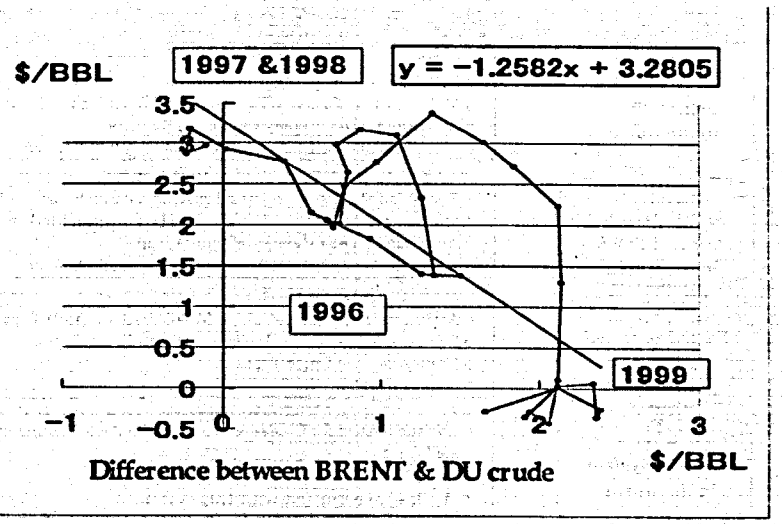
Pricing formula : PX = PM + a

PX : Crude oil export price set by producing country
PM : Marker crude spot price
a : Adjustment factor

Marker crude : Crude oil which provides the benchmaek of the market price in a given crude oil market.

AL crude differential price between To Asia & To Europe(1996-1999) $/BBL

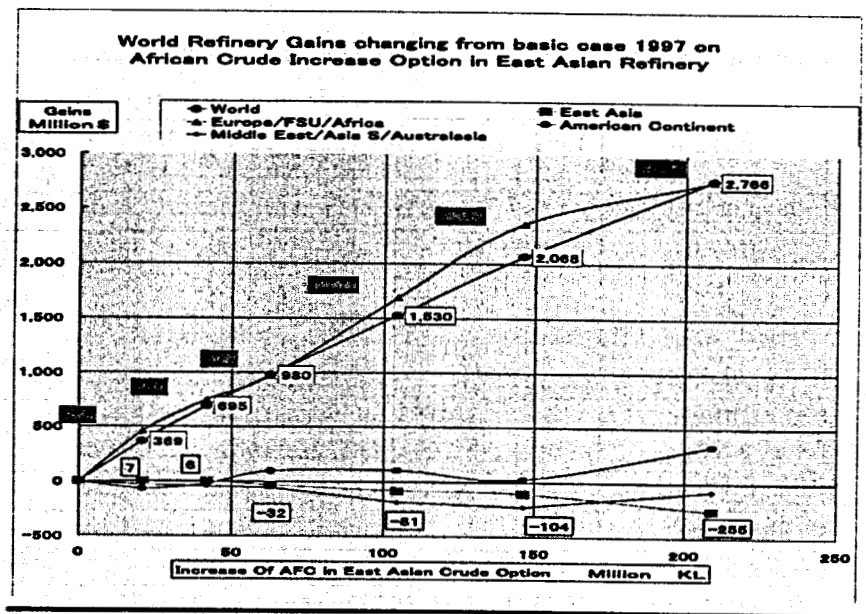
By calculated with 3-months-moving average



Analysis of Problems in Asian Crude Oil Market	• Basically inferior crude oil flexibility in Asian market • Lack of liquidity and transparency of Dubai crude as a bench – mark crude • Lack of transparent product prices that can evaluate the crude value
Study of Solution and Its Verification	• LP Model study for the possibility and economic effect of drastic increase of non-Middle East crude • The merits of utilization of the strategic crude oil • storage tanks in Korea & Japan • The means to improve transparency of Dubai crude • and the other option for a bench-mark crude in Asia
Abstraction of Desirable Cooperation Schemes Among North East Countries	• Creation of circumstance enables the refineries to access more easily to North Sea and West African oil • Suggestion of the effective way to utilize the strategic crude oil storage tanks for lower cost logistics • Building up influence to oil price formula &premium through establishment of so-called Buyer's Forum

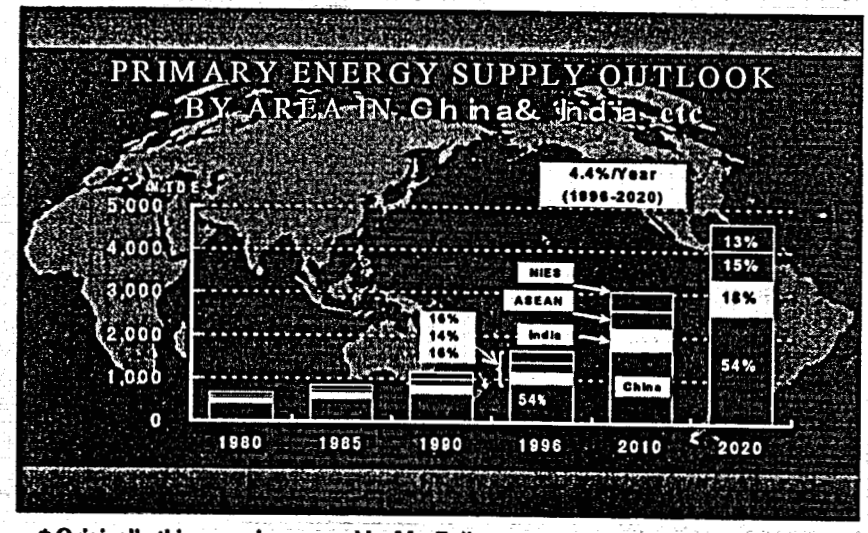
The LP Model for the study for "How can Asian escape from unfair pricing system of Crude ?"

A **Sorted refinery in the world**	o East Asian Refinery o The other Asian&Australasian Refinery o Middle East Refinery o European, FSU & African Refinery o American PAD-5 (Mainly California) Refinery o The other American continental (including south) Refinery
B **Sorted petroleum product market in the world**	o East Asian Market o The other Asian&Australasian Market o Middle East Market o European, FSU & African Market o American PAD-5 (Mainly California) Market o The other American continental (including south) Market
C **Sorted supplied crude types in the world**	o Asian Crude Types o Middle Eastern Crude Types o European & FSU Crude Types o African Crude Types o North American Crude Types o South American
D **Logistic system in the world**	o Logistic System for Crudes & Petroleum Products Trading in the World • A, B, C are unified with this system



Page 9

The potential of primary energy in China & India is a matter of great interest to Asian.



* Originally this paper is prepared by Mr. Fujime.

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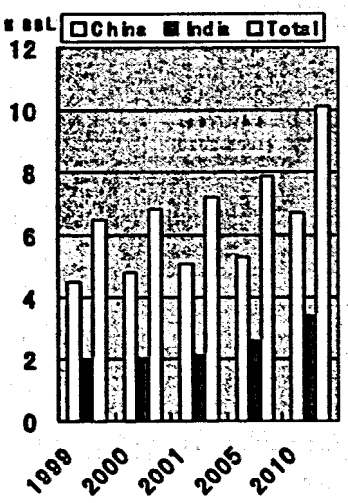
The potential of petroleum demand in China, India & Middle East is great.

[Million BBL/DAY]

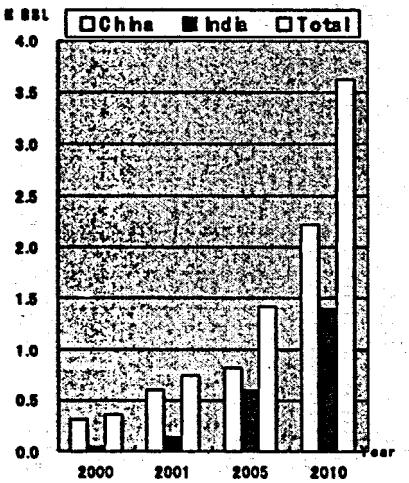
Region	1999 (A)	2000	2001	2005 (B)	2010 (C)	2005 (B-A)	2010 (C-A)
North East Asia	12.1	12.4	13.0	13.5	15.3	1.4	3.2
Korea	2.1	2.1	2.3	2.5	2.8	0.4	0.7
Japan	5.6	5.5	5.6	5.7	5.8	0.1	0.2
China	4.5	4.8	5.1	5.3	6.7	0.8	2.2
India	2.0	2.1	2.1	2.6	3.4	0.6	1.4
Middle East	4.3	4.3	4.5	5.7	6.7	1.4	2.4
Others	5.0	5.2	5.4	6.3	7.6	1.3	2.6
Asia Deman	23.4	24.0	25.1	28.1	33.0	4.7	9.6
OECD EU	15.1	15.1	15.3	-	-	-	-
North America	23.9	24.1	24.6	-	-	-	-
World Demand	74.7	75.6	77.5	85.1	95.0	10.4	20.3

* Prepared by the data on 12.2000 EA O L Market Report & International Energy Outbok 2001

Oil Demand in China & India



Increased Oil Demand From 1999



Many shallow ports on Chinese shelf use smaller tankers.
Why not use Okinawa port ?

Logistic Cost on Some Chinese refinery and Okinawa in 1997

($/BBL)

Area	Crude Name	Lording Port	Shanghai (A)	Okinawa (B)	A-B	(A-B)/A
Middle East	Murban	Jebel Dhanna	1.26	0.89	0.37	30
	Arab Light	Ras Tanura	1.31	0.92	0.39	30
	Arab Heavy	Ras Tanura	1.36	0.95	0.40	30
	Dub	Fateh	1.26	0.89	0.37	30
Africa	Bon	Bonny	2.14	1.54	0.60	28
	Cabinda	Malongo Term'l	2.02	1.41	0.60	30
Europe	Brent	Sullom Voe	2.95	2.07	0.88	30
	Gullfaks	Mongstad	3.07	2.16	0.92	30
Asia	Arun Condensate	Bintang Lancang	0.85	0.84	0.00	0
	Tapis	Kerteh	0.78	0.78	0.00	0
	Minas	Dumai	0.87	0.87	0.00	0

(prepared with numbers based on past records of 1997 ogistics data)

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EU15 have been discussing the energy infrastructure in EU region with the best efficiency.

	DGXVII 1995	CONCAWE Original 2010	DGXVII Pre Kyoto 2010	CONCAWE Pre Kyoto 2010
LPG	2.8	3.0	13.0	3.0
Gasoline	121.0	146.3	149.2	127.2
AGO	113.4	127.4	134.8	155.0
Jet	32.5	45.0	38.3	46.4
Gas Oil	–	10.0	–	10.0
Other Oil	1.2	–	1.5	7.1
Bio	0.0	11.0	3.0	1.0
Other Non Oil	5.0	–	9.8	–
Total	275.9	342.7	349.6	349.7
Total Oil	600.0	658.7	684.4	642.4

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The potential of regional EU – 15 joint study is fruitful.

CRUDE (No.of Refineries)	Scandinavia (9)	Benelux (9)	Germany/ Austria (06)	France (03)	UK / Ireland (01)	Total EU (91)
Brent Blend	9.8	15.9	75.8	33.4	48.3	182.5
Iranian Light	6.2	32.7	14.0	20.6	15.6	121.5
Kuwait	9.6	30.3	24.7	11.6	19.7	213.2
Nigerian Forcados	11.4	-	-	15.0	11.2	91.0
Algerian Condensate	1.2	1.0	1.0	1.5	1.8	10.3
Total	38.2	79.9	115.5	82.1	96.6	618.5

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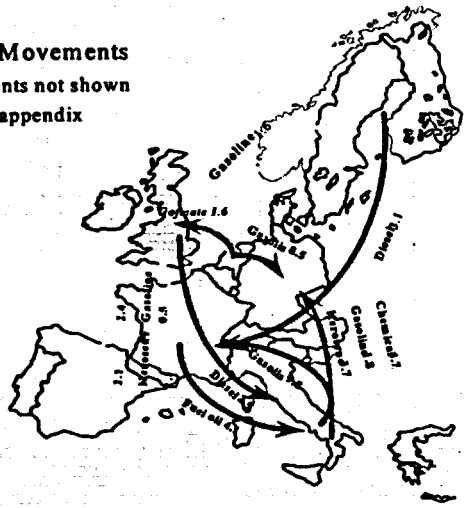
The potential of regional EU-15 joint study can discover the best efficiency.

Key Product Movements
- Minor movements not shown
- For details see appendix



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The potential of regional EU-15 joint study is fruitful

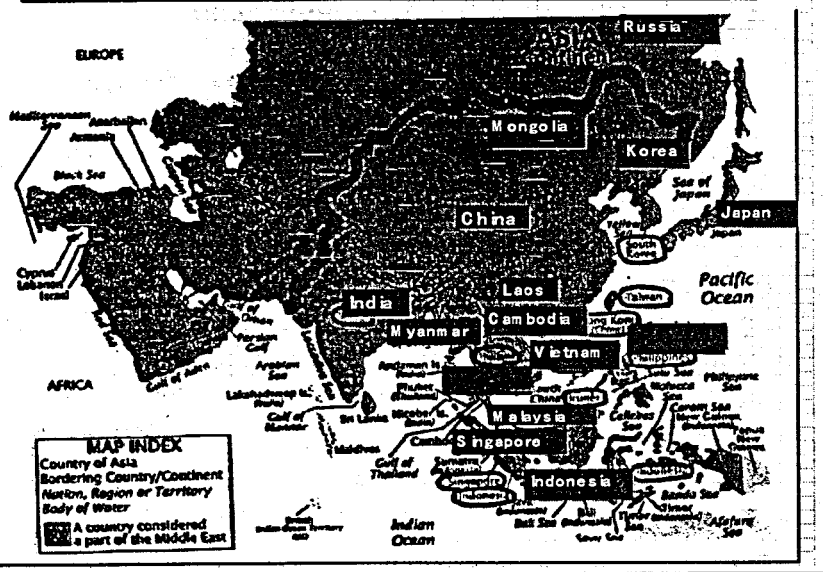
[Crude Purchase Mtpa] *7 Regions 2000*

	Scandinavia All Refineries Year 2000	Benelux All Refineries Year 2000	Germany/Austria All Refineries Year 2000	France All Refineries Year 2000
Number of Refineries	**9**	**9**	**16**	**13**
Crude Purchase Mtpa				
Brent Blend	9.8	15.9	75.8	33.4
Iranian light	6.2	32.7	14.0	20.6
Kuwait	9.6	30.3	24.7	11.6
Nigerian Forcados	11.4	-	-	15.0
Algerian condensate	1.2	1.0	1.0	1.5
Total	**38.1**	**79.9**	**115.4**	**82.1**

The crude slate change in EU15 LP Model study

[Crude Purchase Mtpa]	*7 Regions 2010*	
	Total EU-15 All Refineries Year 2010	Change from 2000
Number of Refineries	**91**	
Brent Blend	182.5	-90.0
Iranian light	121.6	0.0
Kuwait	213.2	73.9
Nigerian Forcados	91.0	60.0
Algerian condensate	10.3	4.7
Total	**618.5**	**48.6**

Would Asian be able to consider Asian 15 as the same as EU15 ?



Page 3

The refining cost table in 1998 shows that Korean cost is very low and Japanese cost is high. Japanese good upgrading facility and Korean efficient refinery should be handled with the aggressive cooperation in some best location.

			JAPAN	KOREA	SINGAPORE
Crude Quantity (BBL/C DAY)			4,185	2,262	1,017
Utilization Ratio (%)			77.8	81.7	81.7
			(US$/bbl)	(US$/bbl)	(US$/bbl)
ALL Cost of Refinery	RUN	Fuel	0.86	0.4	0.51
		Elec	0.11	0.09	0.12
		Cat/Chemic	0.25	0.17	0.14
			1.21	0.66	0.77
	FIXED	Manpower	0.89	0.19	0.44
		Main	0.61	0.15	0.38
		Dep	1.12	0.80	0.75
		Tax/Insur	0.24	0.00	0
		Other	0.46	0.17	0.23
			3.33	1.31	1.81
			4.54	1.97	2.58
DIFFERENCE			BASE	▲2.57	▲1.96

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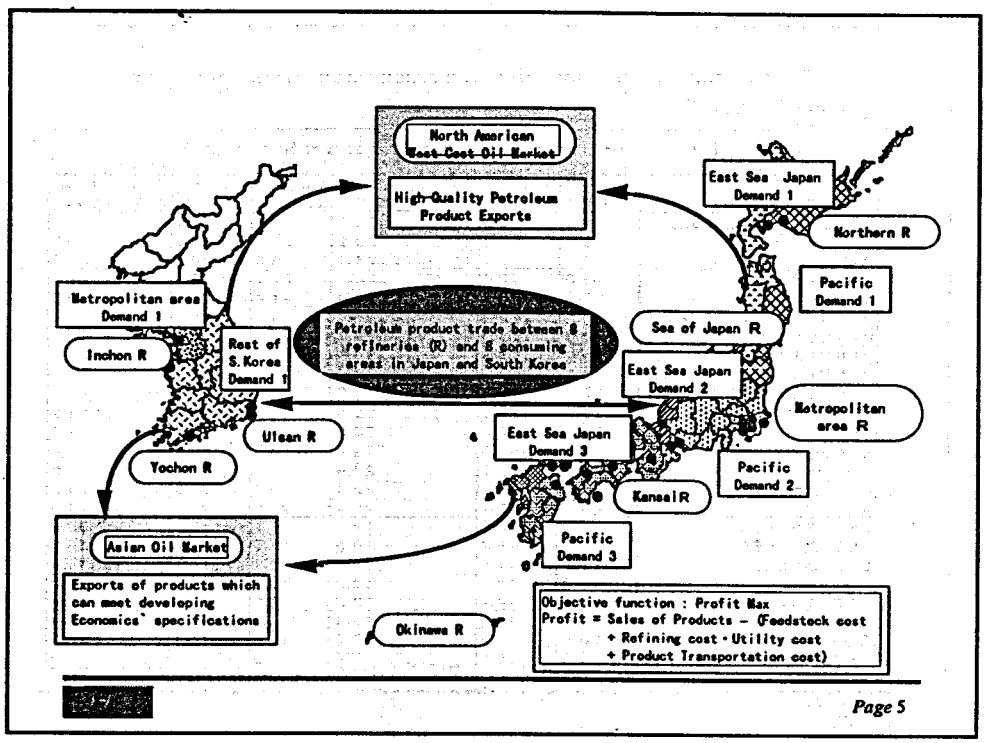
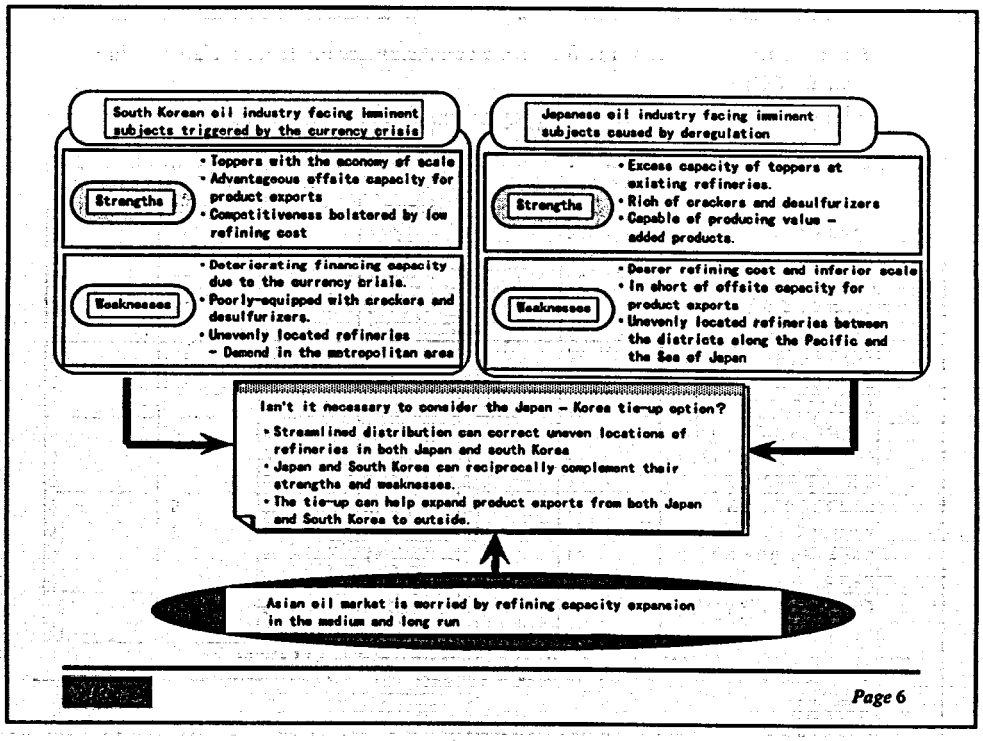

North American West Coast Oil Market
High-Quality Petroleum Product Exports
East Sea Japan Demand 1
Northern R
Pacific Demand 1
Metropolitan area Demand 1
Inchon R
Rest of S. Korea Demand 1
Petroleum product trade between 8 refineries (R) and 8 consuming areas in Japan and South Korea
Sea of Japan R
East Sea Japan Demand 2
Metropolitan area R
Ulsan R
East Sea Japan Demand 3
Pacific Demand 2
Yochon R
KanseiR
Asian Oil Market
Exports of products which can meet developing Economies' specifications
Pacific Demand 3
Okinawa R
Objective function : Profit Max
Profit = Sales of Products − (Feedstock cost + Refining cost + Utility cost + Product Transportation cost)
Page 5


South Korean oil industry facing imminent subjects triggered by the currency crisis
Strengths
• Toppers with the economy of scale
• Advantageous offsite capacity for product exports
• Competitiveness bolstered by low refining cost
Weaknesses
• Deteriorating financing capacity due to the currency crisis.
• Poorly-equipped with crackers and desulfurizers.
• Unevenly located refineries − Demand in the metropolitan area
Japanese oil industry facing imminent subjects caused by deregulation
Strengths
• Excess capacity of toppers at existing refineries.
• Rich of crackers and desulfurizers
• Capable of producing value − added products.
Weaknesses
• Deeper refining cost and inferior scale
• In short of offsite capacity for product exports
• Unevenly located refineries between the districts along the Pacific and the Sea of Japan
Isn't it necessary to consider the Japan − Korea tie-up option?
• Streamlined distribution can correct uneven locations of refineries in both Japan and south Korea
• Japan and South Korea can reciprocally complement their strengths and weaknesses.
• The tie-up can help expand product exports from both Japan and South Korea to outside.
Asian oil market is worried by refining capacity expansion in the medium and long run
Page 6

The LP Model for the study for "How can Asian escape from unfair pricing system of Crude ?"

Data of Price on petroleum product in each region 1997

($/BBL)

	East Asia	Mid East	Europe FSU Africa	West USA	The oth America	South Asia Australasia
LQE(Liquified Ethan)	11.5	—	10.1	—	11.4	—
C3	20.8	—	20.9	20.8	20.9	19.5
C4	24.3	—	24.3	24.3	24.3	22.6
NAPHTHA1	23.0	20.0	20.1	22.7	22.7	21.9
REFORMATE	30.5	30.5	28.4	31.4	31.4	30.5
PREMIUM GASOLINE	26.6	25.4	23.6	26.2	26.2	25.4
REGULAR GASOLINE1	30.5	23.9	22.9	27.1	24.6	—
REGULAR GASOLINE2	25.1	23.9	22.9	27.1	24.6	—
REGULAR GASOLINE3	25.1	23.9	22.9	27.1	24.6	—
REGULAR GASOLINE5	25.1	23.9	22.9	27.1	23.9	23.9
JET 1	26.3	23.5	23.8	26.5	23.5	24.9
JET 3	26.3	23.5	23.8	26.5	23.5	24.9
KEROSINE	26.3	23.5	23.8	26.5	23.5	24.9
GAS OIL 2	25.7	22.7	23.4	26.5	23.0	24.2
GAS OIL 5	25.7	22.7	22.4	25.6	22.9	24.2
AFO	25.4	22.7	22.4	25.6	22.6	24.0
LSC (SULFER 0.2)	22.4	20.8	18.1	19.1	18.2	20.8
LSC (SULFER 0.3)	20.8	19.2	16.5	17.5	16.6	19.2
LSC (SULFER 1. 0)	19.2	17.6	14.7	16.2	16.1	17.6
MSC (SULFER 2. 0)	18.4	16.8	13.9	15.8	14.4	16.8
HSC 2 (SULFER 3.5)	16.9	14.1	12.3	15.8	14.4	15.4
ASPHALT	15.4	14.1	13.4	15.8	14.4	15.4
COKES (LS)	10.8	9.9	9.9	11.0	10.1	10.8
COKES (HS)	9.2	8.5	8.6	9.5	8.6	9.2

(prepared with numbers based on Platts Oilgram 1997)

The LP Model for the study for "How can Asian escape from unfair pricing system of Crude ?"

Data of Refinery facility in each region 1997

(Million KL)

	East Asia	Mid East	EU FSU Africa	West USA	The other America	South Asia Australasia
TOPPER	626	337	1,316	166	1,219	358
VACUUM	196	106	504	81	488	78
NAPHTHA UNIFINER	127	38	219	42	264	37
KERO,GAS OIL UNI	106	18	100	54	188	36
GAS OIL UNIFINER (HE	65	0	83	34	173	6
REFORMER	32	21	62	14	111	16
CATALYTIC REFORMER	27	17	148	14	111	20
ALKLATE	8	3	34	1	66	2
INDIRECT DESULFUR.	55	12	53	19	65	8
DIRECT DESULFUR.(AR	24	8	9	0	10	0
DIRECT DESULFUR.(VR	6	0	0	0	0	0
HYDROCRACKING	17	25	43	25	54	16
VISBLAKING	0	16	116	1	27	19
DELAYED COKING	21	7	31	28	67	5
H-OIL	1	0	0	0	0	0
FLUID CUT CRACKING	47	8	124	9	81	20
RESID FCC	45	5	40	30	110	12

The LP Model for the study for "How can Asian escape from unfair pricing system of Crude ?"

Petroleum demand quantity in each region 1997

(Million KL)

	East Asia	Mid East	Africa	Europe・FSU	West USA	The other America	South Asia Australasia
LQE (Liquified Ethan)	5.0			45.0		30.0	
C3	22.3		0.5	32.2	8.8	45.4	5.5
C4	22.4		0.0	29.8	1.0	36.2	13.7
NAPHTHA1	121.8	2.8	0.9	84.8	3.5	34.7	13.1
REFORMATE	9.8	3.1	2.1	28.6	0.0	44.4	3.6
PREMIUM GASOLINE	0.1						
REGULAR GASOLINE1	11.3						
REGULAR GASOLINE2	0.0				26.9	140.6	
REGULAR GASOLINE3	53.6			209.6	66.1	298.5	0.9
REGULAR GASOLINE4	53.9						
REGULAR GASOLINE5	0.0	34.7	30.7	41.8		53.7	65.3
JET 1	22.8	7.2	7.3	65.4	30.7	80.9	29.4
JET 3(EXPORT)	4.9	14.6	7.6	4.7		4.7	28.6
KEROSINE	42.6			4.6	0.2	5.5	
GAS OIL 2	75.2			240.8	28.4	155.5	
GAS OIL 4	41.3						
GAS OIL 5	0.0	69.1	38.6		5.6	85.9	163.5
AFO	56.7			124.2	0.5	58.2	
LSC (SULFER 0.2)	22.3	0.5	1.1	12.4	1.0	14.8	2.5
LSC (SULFER 0.3)	23.2			85.0	4.5	15.9	
LSC (SULFER 1. 0)	6.7						
MSC (SULFER 2. 0)	0.0						5.0
HSC 2 (SULFER 3.5)	87.7	63.6	28.9	130.9	10.0	97.2	82.6
ASPHALT	19.5	2.9	1.4	31.8	5.0	49.9	6.9
COKES (LS)	3.7			3.0		1.0	0.9
COKES (HS)	3.8		0.1	9.8		8.0	0.3
TOTAL	710.5	198.5	119.2	1,184.4	192.3	1,261.1	421.7
					WORLD TOTAL		4,087.6

(prepared with numbers based on IEEJ in cooperation with IEA)

The LP Model for the study for "How can Asian escape from unfair pricing system of Crude ?"

Data of The Various Product Yield on Each Crude

	Middle East					Africa			-
	ARAB SL	ARAB EL	ARAB L	ARAB M	ARAB H	NIGE C	BON L	CAB	IRN
Home Fuel Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
C3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.7	0.0
C4	4.4	1.3	1.4	2.1	1.6	0.5	1.7	1.4	0.0
C5-70℃ LT NAPHTHA	7.9	4.5	5.0	5.5	4.8	22.5	3.1	2.7	24.9
70-145℃ HVY NAPHTHA	25.1	14.6	13.1	12.3	10.3	40.3	14.5	10.8	65.4
145-155℃ SWING CUT	3.3	2.3	1.9	1.8	1.6	3.6	1.9	1.4	9.7
155-230℃ KEROSINE	21.0	15.6	13.9	12.7	11.2	20.3	14.8	10.2	0.0
230-260℃ SWING CUT	6.9	5.9	5.5	4.9	4.5	5.2	8.1	4.9	0.0
260-343℃ LT GOL(LS)	14.8	0.0	0.0	0.0	0.0	6.6	22.2	13.7	0.0
260-343℃ LT GOL(HS)	0.0	16.1	14.8	13.4	12.9	0.0	0.0	0.0	0.0
343-360℃ HVY GAS OIL	2.4	3.2	3.0	2.7	2.7	1.0	3.7	2.8	0.0
360℃+ ATMO RESID	13.7	36.3	41.4	44.5	50.5	0.0	29.9	51.3	0.0
合計	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The LP Model for the study for "How can Asian escape from unfair pricing system of Crude ?"

Data of Availability on varbus crude 1997

Area	Crude name		Availability Million KL
	Symbol		
Middle East	ARAB SL	ARAB SUPER LT-50	38
	ARAB EL	ARAB EXTRA LT-37	170
	ARAB L	ARAB LT-33	553
	ARAB M	ARAB MEDIUM-31	309
	ARAB H	ARAB HEAVY-27	70
Africa	ALGE C	ALGE CONDENSATE	58
	BON L	AFR LT (Bonny Light)	218
	CAB	AFR HVY (CABINDA)	143
Europe	BRENT	BRENT-38	344
	GUL	GULFAKS	426
America	WTI	W.TEXAS INT-40	396
	ANS	ANS-29	111
	MAYA	MAYA-22	333
	FURRIAL	VENEZU (FURRIAL)	285
Asia Australasia	ARUN C	ARUN CONDENSATE	84
	TAPIS	TAPIS BREND	82
	MINAS	MINAS-34	260
–	WN	Whole Naphta	198
TOTAL	–	–	4,076

(prepared with PIW 'World Crude Trading Manual etc)

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The LP Model for the study for "How can Asian escape from unfair pricing system of Crude ?"

Data of Crude Cost (C&F) in each refinery in each region 1997

($/BBL)

Area	Crude name	East Asia	Mid East	Europe +FS Africa	West USA	The other America	South Asia Australasia
Mid East	ARAB SUPER LT-50	22.6	21.0	20.4	–	20.4	22.2
	ARAB EXTRA LT-37	22.0	20.3	18.8	–	18.7	21.5
	ARAB LT-33	20.3	18.7	18.0	–	17.9	19.9
	ARAB MEDIUM-31	19.5	18.0	16.8	–	16.9	19.1
	ARAB HEAVY-27	18.7	17.2	16.1	–	16.2	18.3
Africa	NIGE CONDENSATE	–	–	21.1	–	–	–
	AFR LT (Bonny Light)	21.6	–	21.1	22.6	21.2	21.1
	AFR HVY (CABINDA)	20.2	–	19.9	21.6	20.0	19.8
Europe	BRENT-38	21.8	–	19.9	22.4	21.1	21.4
	GULFAKS	21.3	–	19.2	21.9	20.6	20.8
America	W.TEXAS INT-40	20.0	–	20.0	20.0	19.4	20.0
	ANS-29	21.1	–	24.4	20.7	22.8	21.7
	MAYA-22	17.9	–	17.0	16.0	15.4	18.5
	VENEZU (FURRIAL)	20.5	–	20.0	20.2	18.6	20.1
Asia Australasia	ARUN CONDENSATE	20.6	20.0	–	22.0	21.2	19.9
	TAPIS BREND	22.2	–	25.0	23.8	25.1	21.5
	MINAS-34	20.1	–	22.9	21.8	22.9	19.3
–	Whole Naphta	23.9	–	23.9	23.9	23.9	23.9

(prepared with numbers based on PIW 'Data 1997)

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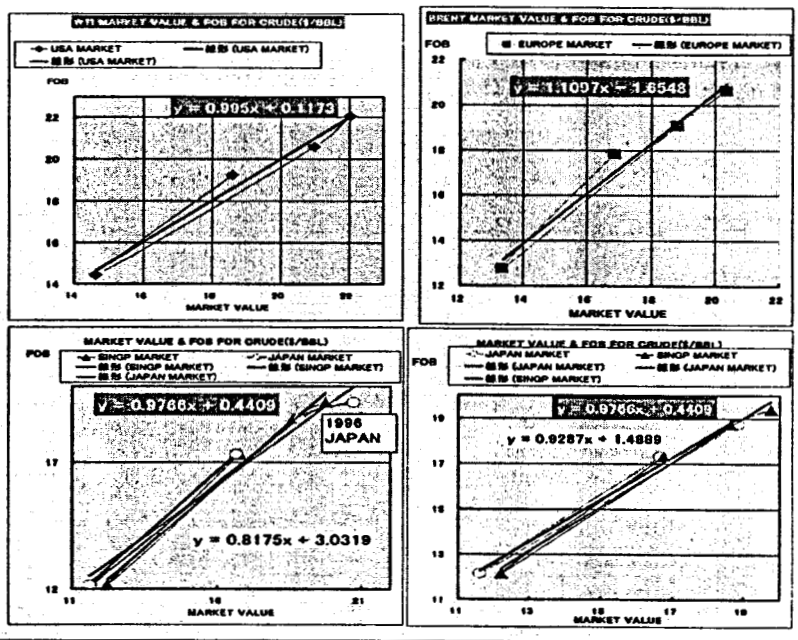
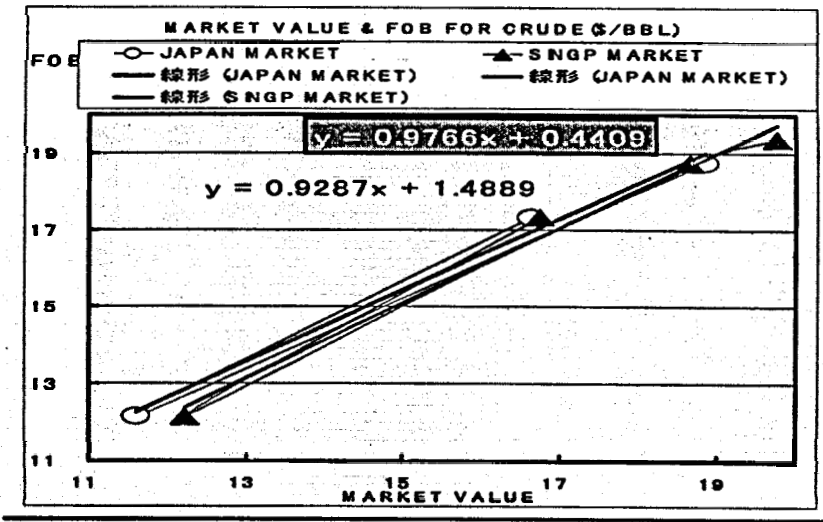


Page 13

Korean & Japanese aggressive trading will have some possibility of the opening the forth market that can evaluate the crude in the world.



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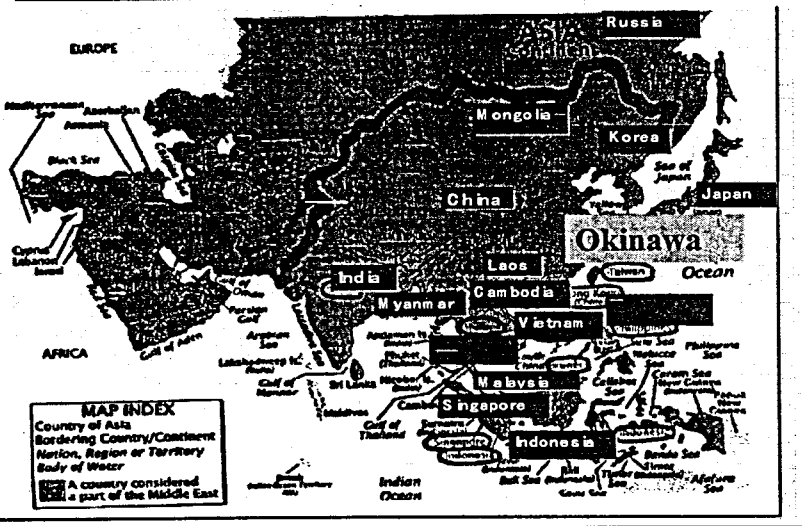
Would N.E.Asian be able to have some crude to be evaluated the value In this region as the same as EU 15 ?



Power Interconnection Network in Northeast Asia: directions and problems

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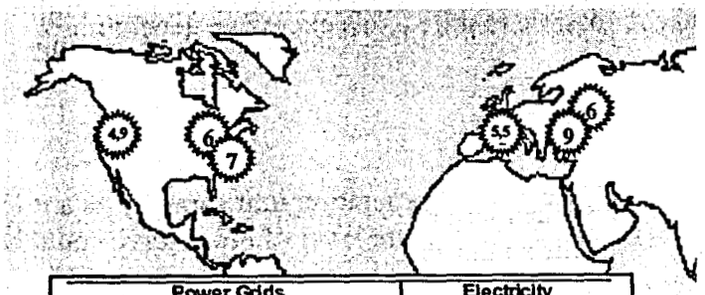
Energy Systems Institute of the Russian Academy of Sciences, Siberian Branch

1. Prerequisites for Power Interconnection Network in Northeast Asia

Power industry and electric power infrastructure development secure a key positions in any country's economic development.

It was the very beginning of XXth century when in Russia the significant role of electric power was realises and necessity to develop large scale power utilities was proved [1]. There was some of the world biggest power grids established in the European part of the Soviet Union by mid 30th (fig.1).



Power Grids	Electricity Production, bil.kWh
South, USSR, 1937r.	9
Moscow, USSR, 1937r.	6
Niagara-Hudson, USA, 1936r.	7
New-York, USA, 1936r.	6
Pacific, USA, 1936r.	4,9
Rhine-Westfalia, Germany, 1936r.	5,5

Fig. 1 Large Power grids in mid 30th.

In mid 70th of the last century unique Unified Electric Power System (UEPS) of the Soviet Union was created. As a technical object it was characterised with the highest level of integrity. Installed capacity of UEPS reach 334 GW in 1990, including thermal - 241 GW, hydro – 65 GW, nuclear – 38 GW. Length of transmission lines above 35 kV was exceeded 1 million km, that of lines above 220 kV – 200 thousand km [2]. Total economic effect of creation UEPS was characterised as follow: investment decreasing by 2 billion dollars, operating expenses decreasing by 1 billion dollars annually, decreasing of generation facilities was estimated by some 15 GW. There never were huge system disruptions in UEPS like those in USA, Canada, France, Sweden [2,3,4,5].

International power system (IPS) MIR was created in 80th by connecting power grids of some European socialist countries. Six national power grids besides of European section of UEPS of the USSR were included in this IPS in synchronous way and a central dispatching board was established. At present part of this IPS under CENTREL acronym is a connecting gain between giant European power union UCPTE and national power grids of Former Soviet Union countries.

Taking into account experience accumulated during development and exploitation of Unified Electric Power System of the Soviet Union and International power system MIR some components of power systems (power grids) interconnection effect [3,6] could be described as follows:

1) Generating effect

Some factors are counted as generating capacity requirements are decreased after power grids interconnection:

- ***Load curves combination*** – due to time zones difference and load curves configurations because of different structures of electricity consumption.

- ***Decrease of operating reserves*** – due to less probability of simultaneously accidents in interconnected power grids.

- ***Decrease of reserves for repairing*** - due to difference in yearly load curves and structure of available generating capacities.

- ***Increasing in guaranteed hydro station capacity.*** Guaranteed hydro station capacity is based on low water year evidence. In interconnected systems guaranteed hydro station capacity increased due to asynchronous river flows in different areas (as non coincidence of low water period) and uses of long period regulated cascades of reservoirs.

- ***More useful utilisation of capacity commissioned.*** It should be excessive installed generating capacity in a single power grid. After large power unit commissioning surplus capacity is locked. Intersystem link make it possible to utilise this excessive generating capacity.

2) Frequency effect

Hot reserve in a single power grid should be not less then largest generating unit capacity as a rule. The share of such unit is less in interconnected systems so the absolute level of hot reserve could be less.
In case of accident in interconnected systems the probability of frequency changes above standardised limits is match lower.

3) Structural effect

Interconnections of power grids make an advantage in more rational structure of generating capacities and lessening operational expenses. There is three parts constituting such effect:

- Mouth-mine power plants, making it able to utilise cheap and non-transportable primary energy sources.
- More rational utilisation of unused or peak capacity of hydro power stations.
- Economical supply of electric power to areas situated between interconnected power grids

4) Regime effect

Optimisation of power plants load regime makes it more economic primary energy resources utilisation. Load curve of interconnected power grids is denser then that of single one so it became possible to have more load hours for cheaper fuel burning power plants.

5) Ecological effect

It became available to build power plant in such place where environmental impact of it operation would be minimised.

In case of unfavourable weather conditions it became possible to stop power plant operation and load distant units without environmental limitations in this particular time.

The degree of integration of interconnected power grids influenced greatly to the quantity of appearing of above described intersystem effect. Due to complex issue of interaction of interconnected electric power systems it could not be simply summarised. The maximum effect of Power grids interconnection could be achieved under synchronous generation regime co-ordinated by single dispatching centre, responsible not only for smooth operation but also for long-term development of the power grids concerned.

It was estimated [2,3] that effectiveness of synchronous work of power grids interconnected in Unified Electric Power System of the Soviet Union was characterised by installed generating capacities decrease to 4-6% and annual fuel consumption decrease by 5-7%.

There are some international interconnected power systems in the world. The largest one are situated in Europe – unification of national energy systems of west European countries UCPTE interconnected in 1995 with central European international power system CENTREL; and interconnected national grids of north European countries NORDEL. There is strong AC and HVDC ties between electric power systems of Canada and United States, which connect cascades of Canadian hydro power stations with US electricity consuming sites.

There are real prerequisites to create international power interconnections network in Northeast Asia[1] [3,7,8,9] and then transform it to the form of international electric power system, namely:

- presence of large national and regional electric power systems (table 1), so significant system effect could be obtained
- type of electricity consumption is quite different in NEA countries so more densely cumulative load curve could be obtained. Thus, for instance, there is summer maximum load in Japan and South Korea, while in Russia and north China it is winter maximum load. It is possible to eliminate some half-loaded thermal power plants by combining opposite types of yearly load curves. The same could be said in case of weekly and daily load curves.

Table 1. National and regional electric power grids in Northeast Asia*

Power grid	Installed capacity, GW	Thermal, %	Hydro, %	Nuclear, %
Japan	220	70	9	21
China**:				
North-East	37	94	6	-
North	34	84	16	-
North-West	19	64	36	-
Russia:				
Siberia	44	51	49	-
Far East	8	81	19	-
Republic of Korea	48	66	6	28
DPRK	10	50	50	-
Mongolia	1	100	-	-

* as of 1.1.2001 (rounded)
** as of 1.1.1998 (rounded)

[1] Some international publications and official documents in Japan, China and Korea count on Japan, China, DPRK, ROK and Mongolia as Northeast Asia. In this paper the authors means that Asian part of Russia (East Siberia and Far Russian East) also belong to Northeast Asia.

Three macro regions with huge electric power potentialities could be distinguished in Northeast Asia (fig. 2):

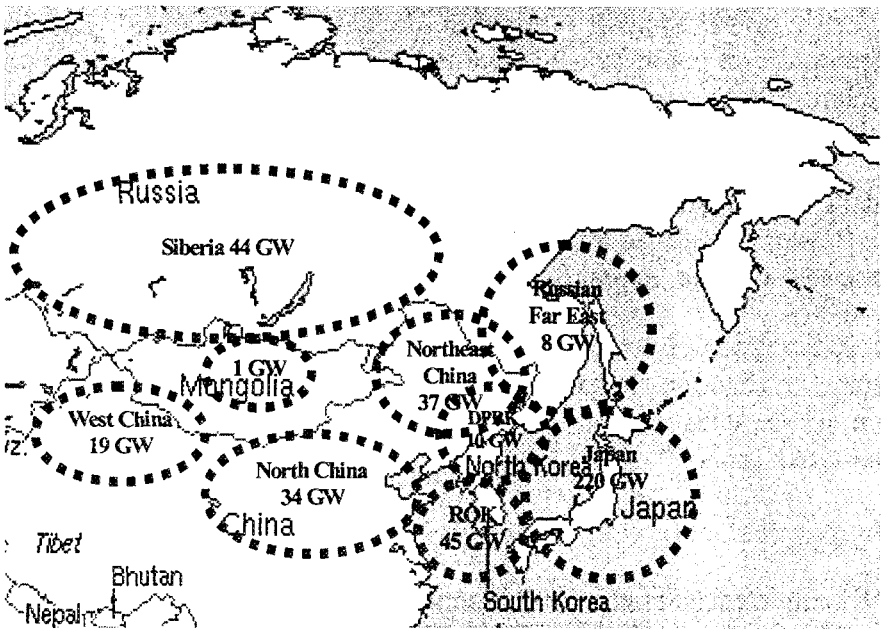


Fig.2 National and regional electric power grids in Northeast Asia

- Japan, with large national interconnected power system, isolated by seas;
- Region of Yellow Sea and Bohai gulf, Manjuria and Korean peninsula;
- East Siberia and Russian Far East, spread from Yenissei River on the west to the Pacific on the east.

There is only three power grids in East Siberia and Far East of Russia have excessive generating capacity – in Krasnoyarsky Krai and Irkutsk Oblast' (East Siberia) and Amur Oblast' (RFE). Outlook assumptions shows it could be excessive 16-18 TWh in Irkutsk Oblast', and 10-15 TWh in Krasnoyarsky krai (after commissioning Boguchansky HPP (3GW) and Berezovsky TPP (6,4 GW) in 2005-2010. This excessive electricity could be combined with that of Chita Oblast' after commissioning Kharanorsky Power Plant (2GW) to reach 30-35 TWh. Export abilities of these region could reach up to 50-60TWh after completing cascade of Bureisky HPP in Amur Oblast and construction of export TPP on Sakhalin island.

High Voltage Transmission Lines (HVTL) could transfer this amount of electricity to China, Japan, Republic of Korea and Mongolia. Interconnection of Siberia Power System and Russian Far East Power System by HVTL will improve reliability of power supply of these regions and make it possible to create East Asian branch of the Global Electric Power System.

The main "disadvantage" of the Northeast Asia region from Power Industry point of view is that it is "too vast". There are thousands of kilometres between energy consumption centres. The NEA region cover some 6000 km from west to east and 3000 from north to south.

Also there is an essential difference in technical characteristics of equipment, conditions and regimes for control systems, reliability and quality of electric power supply.

Direct current transmission lines as the best economic choice should be in wide use for interstate power grids interconnection in Northeast Asia as there are different power system frequency and high voltage levels. The high voltage direct current (HVDC) transmission lines operation could substantially decrease negative effect of technical factors, transmission losses, make it possible to operate in asynchronous regime for interconnected power grids.

Technically there are three variants [3] to develop power interconnection network in Northeast Asia:

- HVDC transmission lines;
- Power grids interconnection through back-to-back links (breaks of alternative current ties);
- alternative current (AC) transmission lines.

Long HVDC transmission lines could be implemented both for capacity and electricity exchange, as well as serving long-term contracts for electricity supply. Power interconnection network in Northeast Asia is likely to be constructed as HVDC transmission lines network.

Power grids interconnection through back-to-back links allows to connect power grids with different frequency and regime of control while keeping the possibility to power exchange. Due to characteristics of NEA power grids the only way to implement this techniques is in International Zone for economic development on the delta of river Tumannaya, next to Russia-China-North Korea borders.

The last variant (alternative current transmission lines) require synchronous (parallel) units operations, thus dispatching centre for the interconnected electric system should be established and a lot of technical and economic issues should be co-ordinated and resolved. In case of interconnections in Korea peninsula and border regions in Russia, Mongolia and China it is the natural and simplest way to create international power grids interconnections.

2. Projects for Power Interconnection Network creation in Northeast Asia

There are interstate power interconnections in Northeast Asia region already. Some AC transmission lines are operating between Russia and Mongolia, Russia and Chine across Amur River. The very possibility to thinking about international power interconnection network in Northeast Asia became true only in early 90th of last century.

One of the first suggestions was formulated in 1991 [10]. The creation of High Voltage Transmission Lines network more then ten thousands kilometres length could link two giant hydro power plants complexes (in East Siberia and in South-West China) with leading industrial centres of East Asia. One route was originated on Yenissei and Angara Rivers, combining capacity of large hydro power plants with coal fired plants in Krasnoyarsky Krai. The route then pass through Ulaan Baatar to one of the biggest energy consuming centres in China – Beijing and Shanghai, then through undersea cable to the large industrial centre on the south of Japan. The next route has to connect should-be built huge hydropower complexes in South-West of China and largest south China ports – Hong Kong and Shanghai.

The joint Russia-Japan project to develop Comprehensive Energy Plan in East Siberia and Far East of the Russian Federation was carried out in 1992-1995 [11]. Important part in this Energy Plan takes projects of electricity export to Northeast Asia countries based on thermal and hydro power plants of Asian Russia. It was proposed to build power plants, improve systems transmission lines in east regions of Russian Federation and create interconnections to export electricity to all of the Northeast Asia countries. Total export might be as high as 50-70 TWh in year 2020.

East Siberian regional power company "Irkutskenergo" and "China North Power Grids" work jointly in 1993-1998 to promote HVDC transmission line from Russia to China [12]. Parameters of this interconnection are as follows: length more then 2,5 thousands kilometres, capacity 2 to 3 GW, electricity export up to 18 TWh, estimated project cost – 1,5 billion USD.

Russian Joint stock company "Unified Energy System of Russia" make a lot of efforts to evaluate export project to Japan in 1996-1999. In 1999 UES of Russia and Marubeni Corporation conducted a preliminary feasibility study of the "Russian-Japan Power Bridge" [13]. This study includes construction of a large power plant (4GW) on Sakhalin Island and high voltage direct current transmission line from this power plant to the power systems of Hokkaido and Tokyo on Honshu Island. HVDC include four undersea cables with transfer capacity of 1 GW each. Length of submarine section is 1400 kilometres out of total 1800 km of transmission line. Electricity export was estimated up to 22 TWh and total cost of the project was 9,6 billion USD.

In a 1994 agreement for two new pressurised light-water reactors construction in DPRK was signed. KEDO, an international consortium, was established to implement the agreement. The European Union joined KEDO in September 1997 [14]. Cost of 2GW LWR nuclear power plant estimated as 4,6 billion USD. It is expected that North-South power interconnection on Korea peninsula would be constructed using alternative current transmission lines [15].

PEACE network project (Power, Economy And Clean Environment) was proposed in 1996 by Task Force, which has been assembled to undertake the Feasibility Studies [15, fig.3]. The PEACE project is based on HVDC transmission lines interconnecting Northeast Asia power grids and large hydro, nuclear (and possible tidal) power plants to be build in the Russian Far East.

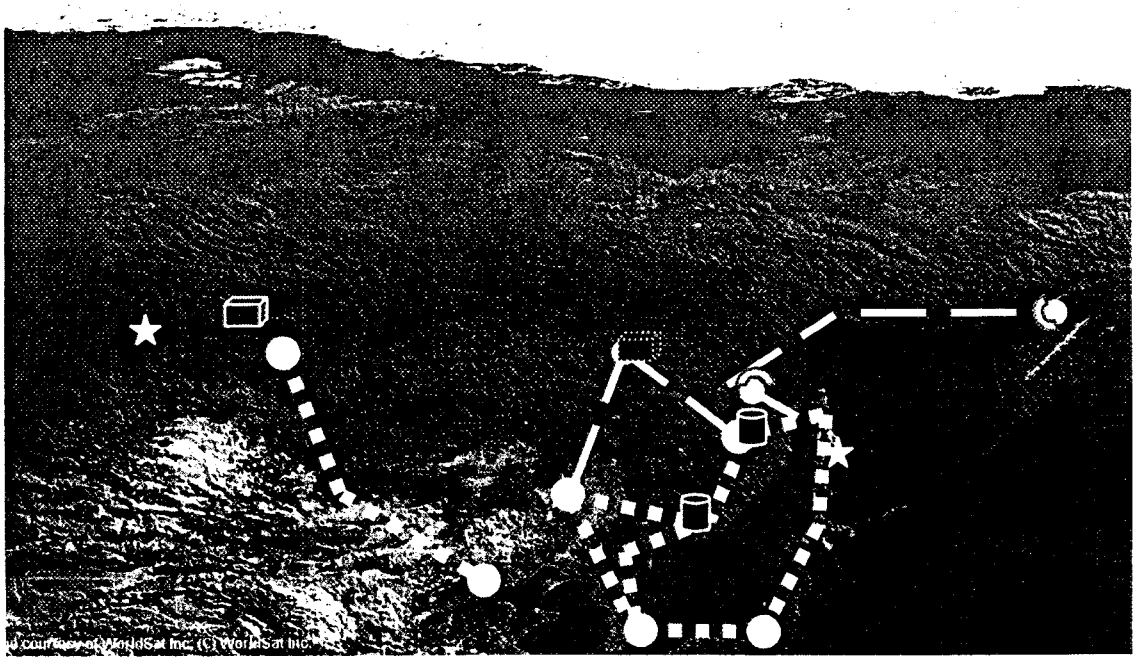


Fig. 3 PEACE project

Since early 90th the problems and issues for Global Electric Power System construction are discussed [3,7]. Interconnected Power Network of Northeast Asia could be important integral part of this GEPS.

The International Project under UN protection for the mouth of Tumannaya River Economic Zone development might be the best initial base to establish International Power grids interconnection in Northeast Asia [16]. All along while International Economic Zone developments and its energy

consumption raising the experience to regional co-operation in power interconnection would be accumulated.

International conference "Energy integration in Northeast Asia: Perspectives for the creation of interstate electric power systems" was held in Irkutsk, Russia on September last year. A lot of technical, economic, ecology and political issues has been discussed. Summary of the projects might be implemented in the Northeast Asia region are presented in table 2.

Creation of the Power Interconnection Network in Northeast Asia will require a lot of investments. For example the PEACE project needs more than 7 billion USD noly for transmission lines construction (as it could be derived from the table 2). It is estimated on the other side that Power Interconnection Network might be very effective. Until 2020 the construction of Russian Federation – DPRK – Republic of Korea HVDC transmission line and nuclear Power Plant on the Russian Far East could save more then 12 billion USD and eliminate the necessity some 7,8 GW of electric power capacities in the Republic of Korea [15,17,18]. In this case annualised cost for energy supply of the region might be decreased by 1,9-2,8 billion USD.

3. Directions of activities for Power Interconnection Network creation in Northeast Asia

It is important to note that there are great uncertainties in evaluation of economic, ecology and political consequences of such unification besides technical issues for Power Interconnection Network creation in Northeast Asia. The conception of national energy security and sovereignty would be changed and corresponding economic and political prerequisites should be established.

The energy integration issues among Russia and Northeast Asia countries is quite actual and based on mutual supplementary of energy, financial, labour and other resources. Creation of Power Interconnection Network could lead to cheaper and more reliable energy supply to the customers, to more clean environment in the region [8,21].

Regional energy integration in Northeast Asia is just in the beginning. It intensive development is not only expedient but also real due to mutual interest in economic and energy interactions of all countries involved.

Common complex strategy should be elaborate to vitalise energy integration in the region. The co-ordination in electric power industry as well as other energy related industries should be implemented to take into account resource, economic, social, politic and other factors [9]. Main research activities might include [fig.4]:

- Outlook for the regional energy markets development
- Influence of energy export outside the region to the markets
- Sensitivity to the world energy price changes for export effectiveness
- Influence of the regional energy projects to the structure of energy balance, national economy, security and reliability of energy supply, ability to solve social and environmental issues.

Common efforts of research and scientific centres of all Northeast Asia countries, as well as international institutions, banks and energy companies are required to elaborate and implement this complex strategy of regional energy integration. Energy Systems Institute named after L.A.Melentiev of Siberian branch of the Russian Academy of Sciences – organisation with high scientific experience in the field of system research in energy related issues – could be a co-ordinator from the Russian side in common research efforts to promote complex international strategy of energy integration in the Northeast Asia region.

Table 2. Current and projected interstates power interconnections in Northeast Asia

Transmission line	Countries interconnected	Type of transmission line	Capacity, GW	Length, km	Investments, bil.USD	Source
Current						
Gusinoozerskaya TPP-Central Power Grid	Russia-Mongolia	AC 220kV	0,1	300	-	
Amur river crossing Blagoveshchensk - Heihe	Russia-China	AC 110kV, AC 220kV	N/A.	N/A.	-	
Projected						
Saijano- Shushenskaya HPP-Urumchi	Russia-China	AC 500kV	0,6-1	1600	N/A.	[19]
Bratsk – Beijing	Russia-China	DC ±500kV	2-3	2600	1,5	[12]
Bratsk – Shenijang	Russia-China	DC ±500kV	2-3	2800	1,6	[12]
PEACE Project	Russia – China-DPRK-ROK-Japan	DC ±500kV	N/A.	1800	1,7*	[14]
North Korea – South Korea	DPRK-ROK	AC 154/345kV	N/A.	N/A.	0,9*	[14]
Bureiskaya HPP – Harbin	Russia-China	DC ±400kV	1	700	0,3	[17]
Khabarovsky krai - North Korea – South Korea	Russia –DPRK-ROK	DC ±500kV	4 (8)**	1100	2	[17]
Sakhalin – Hokkaido	Russia-Japan	DC ±500kV	4	470	2,6	[17]
Primorsky krai – China – South Korea	Russia – China-DPRK-ROK	DC ±500kV	2,5	2300	3	[17]
Uchur HPP – China – South Korea	Russia – China-DPRK-ROK	DC ±500kV	3,5	3500	4,5	[17]
Sakhalin – Honshu	Russia-Japan	DC ±600kV	4	1800	9,6 (incl.TPP)	[13]
Khabarovsky krai – Beijing	Russia-China	DC	1	2125	1,1	[20]
Primorsky krai – Beijing	Russia-China	DC	2,5	1700	1,7	[20]
Khabarovsky krai - Hokkaido	Russia-Japan	DC	2,5	1460	1,6	[20]
Primorsky krai - Honshu	Russia-Japan	DC	2,5	650	2	[20]
Primorsky krai - Honshu	Russia-Japan	DC	2,5	560	3	[20]
Primorsky krai - South Korea	Russia –ROK	DC	2,5	1160	1,4	[20]

Note. * Annualised cost = discount * Investments + expenses

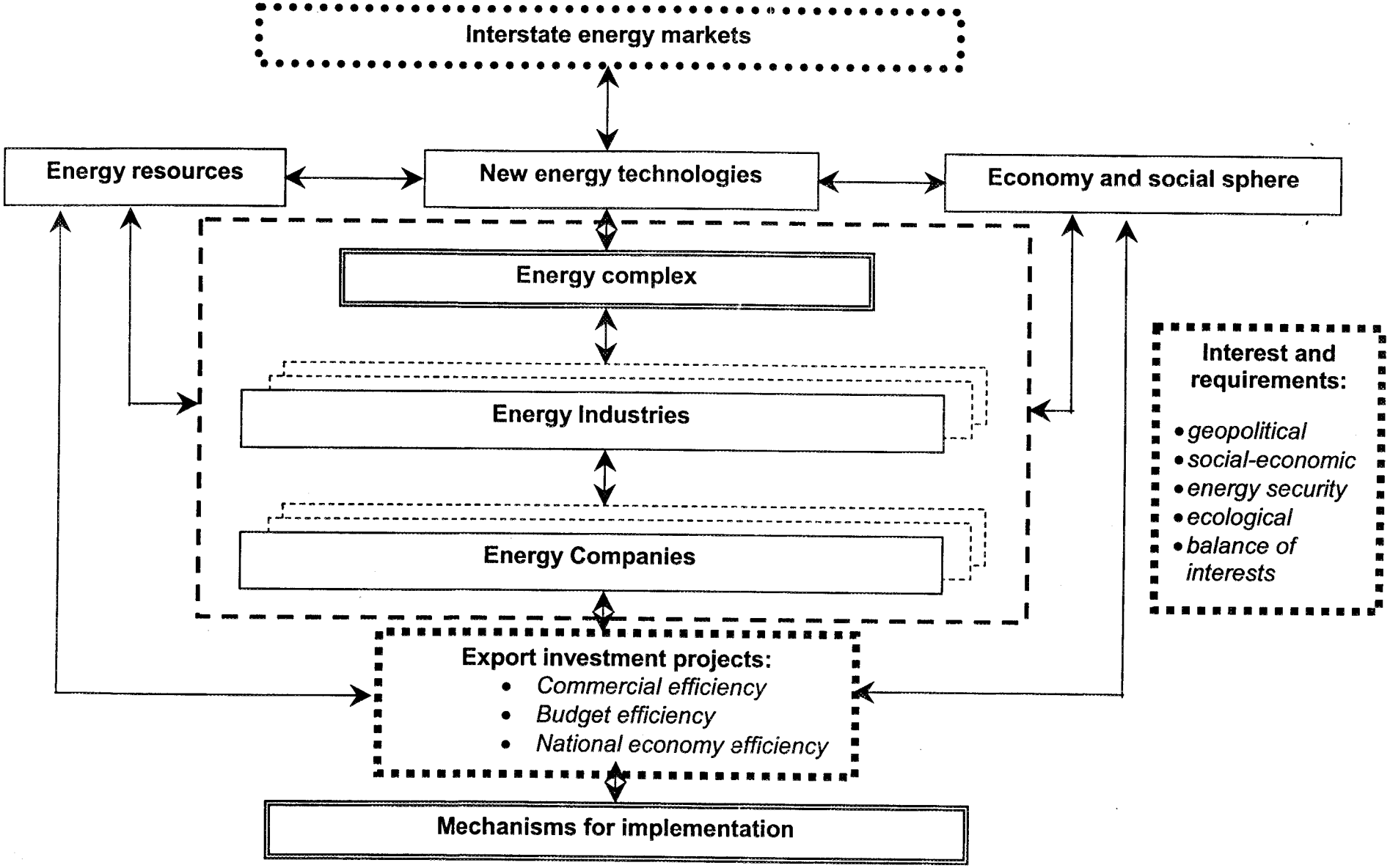


Fig.4 PROBLEM BLOCK OF THE STRATEGY OF ENERGY COOPERATION OF RUSSIA AND NEA COUNTRIES

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A LONG-TERM VISION OF NATURAL GAS TRUNKLINE IN NORTHEAST ASIA

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This report is consisted of Executive Summary, Chapter 4 & 5 of "A Long-term Vision of Natural Gas Trunkline in Northeast Aisa", a comprehensive report prepared by a task force of Northeast Asian Gas & Pipeline Forum(NAGPF), a committee of private specialists in this field from Republic of Korea, Japan, China, Russia, Mongolia and Democratic People's Republic of Korea. The task force made the aforementioned report based on the papers presented at conferences of NAGPF, held every year from 1995 to 2000 at each country.

Executive Summary

Objectives

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

However, no comprehensive vision of the international gas pipeline has been proposed, although individual plans of pipeline projects have been presented. Moreover, organizations in Eastern Russia, who produces natural gas, and in China, South Korea and Japan, who are consumers, have not gotten around the table and discussed a comprehensive vision of the International

Pipeline.

Therefore, being directed by the Task Force, which consists of member organizations of Northeast Asian countries and areas, this research has presented a comprehensive long-term vision of the International Pipeline on the basis of the regional balance of natural gas supply and demand in Northeast Asia.

Current and Future Trends of Energy in the Northeast Asia

This research provides latest information on the current and future trends of energy in the Northeast Asian countries and areas and their natural gas policies. The results can be used as a reference concerning the energy situation of related countries and areas.

Regional Balance of Natural Gas Supply and Demand

This research examines the future natural gas supply and demand of each Northeast Asian country and area by regions. As a result, excluding their own consumption, East Siberia and the Far East, which are geographically near to Northeast Asia among the regions of Eastern Russia, will be able to export 28 BCM in 2010 that will not be enough to meet the future shortage of natural gas in Northeast Asia. Therefore, it is obvious that Northeast Asian countries and areas have to consider importing natural gas from West Siberia and Central Asia who have enormous natural gas resources.

The Long-Term Vision of the International Pipeline

Taking account of the regional balance of supply and demand, this research presents the long-term vision of the International Pipeline, setting 2020 as the target year. Its basic concept is *Ladder-type Trunk Pipeline + Circular Line.* The Ladder-type Trunk Pipeline consists of two trunk lines: Northern Trunk Line, which connects West Siberia, Krasnoyarsk, Irkutsk, Sakha Republic and Sakhalin, and Southern Trunk Line, which connects Central Asia, Northwest China and Shanghai. The Circular Line, which connects each demander, is a great circular pipeline. It connects north Sakhalin, Khabarovsk, northeast China, Shanghai and Japan. The Circular Line consists of two sub-circular lines: Japan Sea Circular Pipeline and Bohai Circular Pipeline.

Socio-Economic Impacts of the International Pipeline

The Construction of the International Pipeline will bring socio-economic impacts on Northeast Asian countries and areas. Main impacts are the following six:

- Conservation of Global Environment and Local Environment
- Introduction of Principles of Competition in Energy Sector

- Assurance of Energy Security
- Coping with Changes in Energy Demand Structure
- Dissolution of Non-electrification Areas
- Establishment of Relations of Mutual Reliance among Northeast Asian Countries and Areas

Subject of Future Investigation

Important steps toward the realization of the International Pipeline in Northeast Asia is to investigate the following two items:

—First is to construct a framework of International Cooperation. In the process of establishing the framework of the future international cooperation, it will become possible to create a community and constitute a Northeast Asian Energy Charter;

—Second is to support the promotion of individual projects, such as the Irkutsk project and the Sakhalin project, cooperating in developing technologies for the construction of pipelines and the utilization of natural gas and financing of the projects

How to Utilize This Report

It is important for NAGPF to make public announcement of the results of this research "A Long-Term Vision of Natural Gas Trunkline in Northeast Asia" and approach the governments of countries and areas concerned and international organizations, such as the World Bank, the Asian Development Bank and the International Energy Agency for the realization of the International Pipeline.

Chapter 4 A Long-Term Vision of Developing the International Pipeline

4.1 The Position of Natural Gas in Each National Plan

Natural gas plays an important role in the energy policy of each country and area in Northeast Asia. Table 4.1.1 shows the role of natural gas in the national energy plan of each country and area.

Russia is a main producer of natural gas in Northeast Asia. For Russia, rapid and large-scale energy development in its Asian regions and penetration to the energy markets of the Asia Pacific countries and areas, particularly Japan, China and Korea, are key tools for taking its proper position in this strategically important world region at the right time.

On the other hand, increasing the ratio of natural gas to energy, China, South Korea and Japan, which are main consumers of natural gas, are aiming to change their energy structures based on coal and oil for the best mix of energy, including natural gas.

China is trying to improve its energy mix through reducing the ratio of coal and increasing natural gas utilization rapidly.

South Korea is aiming for an environment-conscious energy mix through reducing the ratio of oil and increasing the supply of clean energy, such as natural gas.

In Japan, according to the long-term supply and demand forecast of the Advisory Committee for Energy, it is expected that the importance of natural gas will become greater in view of the difficulties of building a new nuclear power plant and the checkmate of its oil policy.

Table 4.1.1 The Position of Natural Gas

Country	Plan	Position/ Contents
Russia	Energy strategy of Russia for a time horizon to 2020. – Ministry of Fuel and Energy of Russian Federation. – M., 2000. – p.441 (In Russian); Main Concepts of Russia's Oil and Gas Complex Development. - M.: Ministry of Energy of RF, 2000 – p.112 (In Russian)	Natural gas production in the country increases from 590 BCM in 2000 to 680-700 BCM in 2010 and to 700-750 BCM in 2020.
China	The portion of natural gas in energy mix forecasted by the State Bureau of Petroleum and Chemical Industries, China	The portion of natural gas in the energy mix of China will be 2.18% in 2000, be 3.59% by 2005, be 7.71% by 2010 and be 10.08% by 2015. The portion of coal in primary energy consumption will be decreased gradually.
S. Korea	Long-term Energy Demand under IMF(1999)	The share of natural gas is 10.5 % in 2000, but is expected to increase to 12.6% in 2010, and further to 14.8 % in 2020.
Japan	Long-term supply and demand forecast of the Advisory Committee for Energy (1998. 6)	The Advisory Committee for Energy regarded natural gas as one it would "positively promote to introduce due to its relatively high stability of supply and lower CO_2 emission among fossil fuels". However, according to its forecast, the share of natural gas will be 12.3% in the BAU case and 13.0% in the Environmentally friendly case in 2010. It did not assume the share of natural gas to increase dramatically.
	Announcement of its reconsidering the long-term supply and demand forecast of the Advisory Committee for Energy (2000. 4)	It has become difficult to build new nuclear power plants generation due to, for example, the critical accident in Tokai village. The oil policy of the Japanese government has also been thwarted after the Arabian Oil Co., Ltd. lost its mining rights in Saudi Arabia. Under these circumstances, the long-term supply and demand forecast of the Advisory Committee for Energy is to be reconsidered, with the promotion of natural gas as well as natural energy being proclaimed as policy objectives.
Mongolia	Presentation by PAM on "Natural gas policy in Mongolia" on the 5th International Conference on NEANGP (1999.08)	"Given the necessity to improve the reliability and efficiency of the power generation sector, it is possible that natural gas will find its use in power generation. It appears that natural gas could complement coal in meeting the increasing demand in power generation. Utilization of natural gas by industrial and household consumers is also a possibility. In general, it is widely accepted that the utilization of natural gas in Mongolia will be beneficial for the well-being of the Mongolian people via improving efficiency of the energy sector, diversification of the energy balance and lessening pollution in urban areas."
N. Korea	Prospect of Natural Gas Utilization in DPR of Korea (1998)	In order to meet her rapidly increasing energy demand during the long-term plan period, the DPRK will use natural gas as a primary energy source. The share of natural gas in the composition of primary energy will reach 7.2 % in 2005 and 11.6 % in 2010.

4.2 Natural Gas Supply and Demand

This section examines natural gas supply and demand by region in Northeast Asia in 2010 and 2020 forecasted by several organizations.

If it is possible to obtain the amount of natural gas supply and demand by region needed in the future, it will be easier to draw a picture of a pipeline network by means of analyzing the regional balance of natural gas supply and demand. Therefore, we have tried to obtain data of natural gas supply and demand not only by country but also by region to the greatest possible extent. Especially, as for Russia and China which have huge land masses, it is necessary to divide each of these countries into several regions and analyze their balance of natural gas supply and demand by each region. Russia is divided into three regions: West Siberia, East Siberia and the Far East. China is divided into seven regions: Northeastern China, Bohai Bay, Yangtze River Delta, Central/Southern Area, Central China, West China and South China. However, the regional balance of natural gas supply and demand in China is not mentioned, since the data for natural gas supply by region can not be obtained.

In addition, as we can not obtain all data for 2020 in the related countries and regions, we set 2010 for the target year and mainly use the data for 2010. The data for 2020, which we have been able to collect, are shown in Table 4.2.1 and 4.2.2 for reference.

4.2.1 Natural Gas Demand

The natural gas demand of each country in 2010 is briefly shown below. In the case that forecasts of the several organizations are different, the ranges of amounts are indicated.

— Eastern regions of Russia	115.0 BCM
— China	45.0-136.5 BCM
— South Korea	27.8- 35.5 BCM
— Japan	75.7- 86.7 BCM
— Mongolia	0.3 BCM
— North Korea	9.7 BCM

Details of each organization's forecast are shown in Table 4.2.1.

Table 4.2.1 Forecast of Natural Gas Demand in Northeast Asia

Country	Organization	Forecast of Demand
Russia	Energy Systems Institute (Iruktsk) (1999.7)	2010 West Siberia 89.2BCM East Siberia 17.5BCM Far East 8.5BCM Total 115.2BCM 2020 West Siberia 104.3BCM East Siberia 36.0BCM Far East 22.4BCM Total 162.7BCM
China	China National Petroleum Corporation	2010 Northeast China 18.9BCM Bohai Bay 26.6BCM Yangtze River Delta 31BCM Central/ Southern area 17.3BCM Central China 16.1BCM West China 5.2BCM South China 21.4BCM Total 136.5BCM
	Asia Gas and Pipeline Cooperation Research Center of China	2010 100-110BCM 2020 200BCM
	China Energy Research Institution	2010 68-75BCM
	World Bank	2010 45BCM
	Comprehensive Energy Investigation Society	2010 56BCM (5,080oet)
	ELA of the USA	2010 74-108BCM
S. Korea	Korea Energy Economics Institute (1996.12)	2010 35.5BCM (26.75 Mt LNG equivalent) 2020 48.1BCM (36.29 Mt LNG equivalent)
	Korea Gas Corporation (2000.3)	2010 27.8BCM (20.97 Mt LNG equivalent)
Japan	Advisory Committee for Energy (1998.6)	2010 BAU Case 80.8BCM (60.90 Mt LNG equivalent) Environmentally Friendly Case 75.7BCM (57.1 Mt LNG equivalent)
	The Institute of Energy Economics, Japan (1998.12)	BAU Case 2010 86.5BCM 2020 94.3BCM Environmentally Friendly Case 2010 86. 7 BCM 2020 106.2BCM
	Mitsubishi Research Institute, Inc. (2000.2)	2020 82.4-106.1BCM
Mongolia	Petroleum Authority of Mongolia (2000)	2010 0.3 BCM 2020 2 BCM
N. Korea	DPRK Natural Gas Pipeline Association (1998.6)	2010 9.7BCM (13.58 Mt coal equivalent)

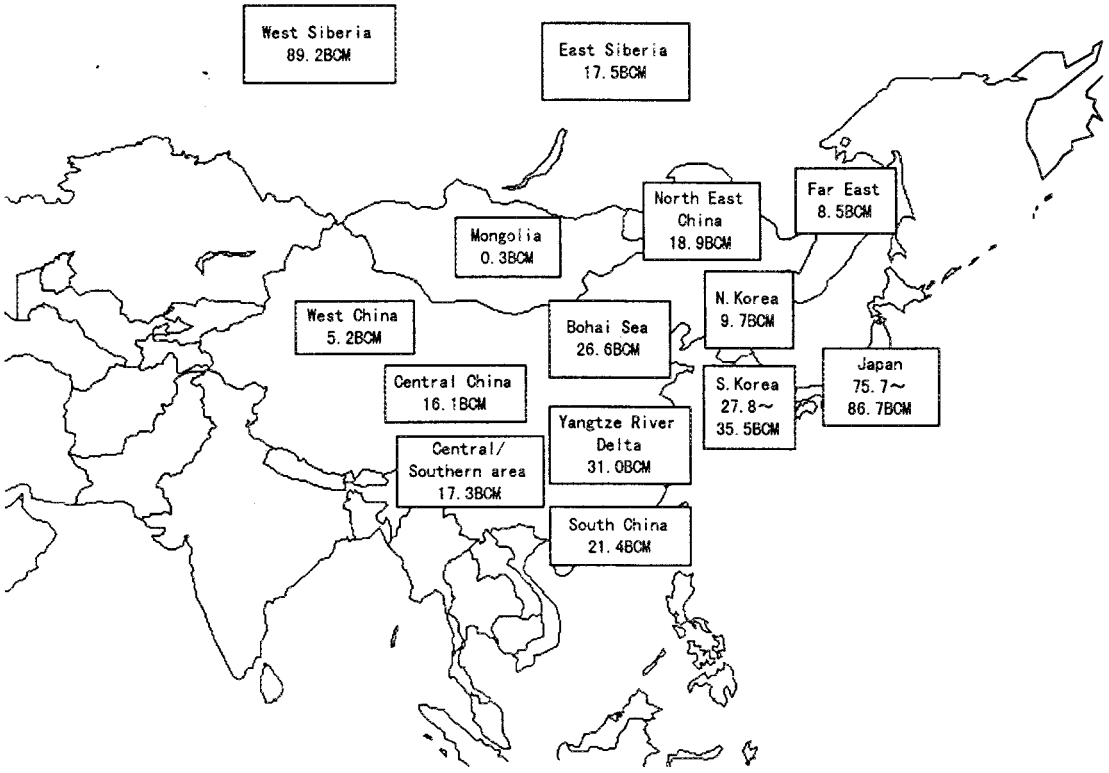


Figure 4.2.1 Distribution of Natural Gas Demands in Northeast Asia (2010)

4.2.2 Natural Gas Supply

The natural gas supply of each country in 2010 is briefly shown below. It is the total of indigenous natural gas products and existing LNG purchasing contract amount. If the forecasts of the several organizations are different, the ranges of amounts are indicated.

— Eastern regions of Russia 719 BCM
— China 26~78 BCM
— South Korea 22.4 BCM
— Japan 73.9 BCM

Details of each organization's forecast are shown in Table 4.2.2.

Table 4.2.2 Forecast of Natural Gas Supply in Northeast Asia

Country	Organization	Deposit/ Production/ procurement		
Russia	Energy Systems Institute (Iruktsk) (1999.7)	Gas Production		
		2010	West Siberia	665.0BCM
			East Siberia	28.0BCM
			Far East	26.0BCM
			Total	719.0BCM
		2020	West Siberia	700.0BCM
			East Siberia	61.0BCM
			Far East	54.0BCM
			Total	815.0BCM
China	Asia Gas and Pipeline Cooperation Research Center of China	2010	CNPC	48BCM
			SINOPEC	14BCM
			CNOOC	16BCM
				70~80BCM
		2020	CNPC	62BCM
			SINOPEC	26BCM
			CNOOC	24BCM
				110~120BCM
	World Bank	2010		26BCM
	Comprehensive Energy Investigation Society	2010		56BCM
	IEA	2010		47BCM
	China Energy Research Institution	2010		65BCM
S. Korea	Korea Gas Corporation (2000.3)	Existing LNG Purchasing Contracts 22.4BCM (16.86Mt)		
Japan	The Japan Gas Association (1998.6)	2.3BCM (Existing indigenous product, 1998) Existing LNG Purchasing Contracts (1998.7) 71.6BCM (53.94 Mt)		

4.2.3 Regional Balance of Supply and Demand

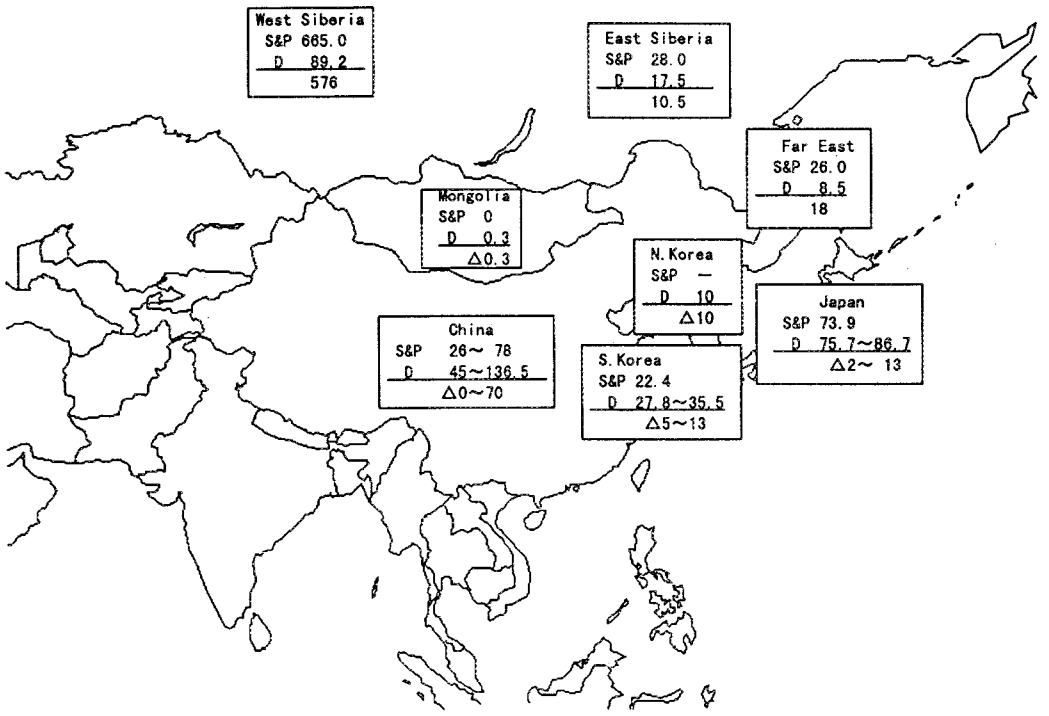
Figure 4.2.1 shows the natural gas supply and demand for each Northeast Asian country and area in the year 2010.

Among the Northeast Asian countries and areas, in China, S. Korea, Japan, Mongolia and N. Korea, but Russia, natural gas demand exceeds their supply which includes the contract quantities of LNG. The difference between supply and demand in these five countries is approximately 17-106 BCM. Especially, China might face maximum 70 BCM shortage of natural gas, since its increase in demand will exceed any production increases.

Therefore, in order to fill the difference between supply and demand, it is necessary to increase LNG imports from southeast Asia, Australia and the Middle East, and transport natural gas produced in Eastern Russia.

East Siberia and the Far East are geographically near to Northeast Asia in the region of Eastern Russia. In 2010, their production of natural gas will be 28 BCM in East Siberia and 26 BCM in the Far East. The volume of export, excluding their own consumption, is approximately 28 BCM, which will not be enough to meet the shortage in Northeast Asia. Therefore, it is necessary for

Northeast Asia to take into consideration supplies from West Siberia and Central Asia where natural gas production is enormous.



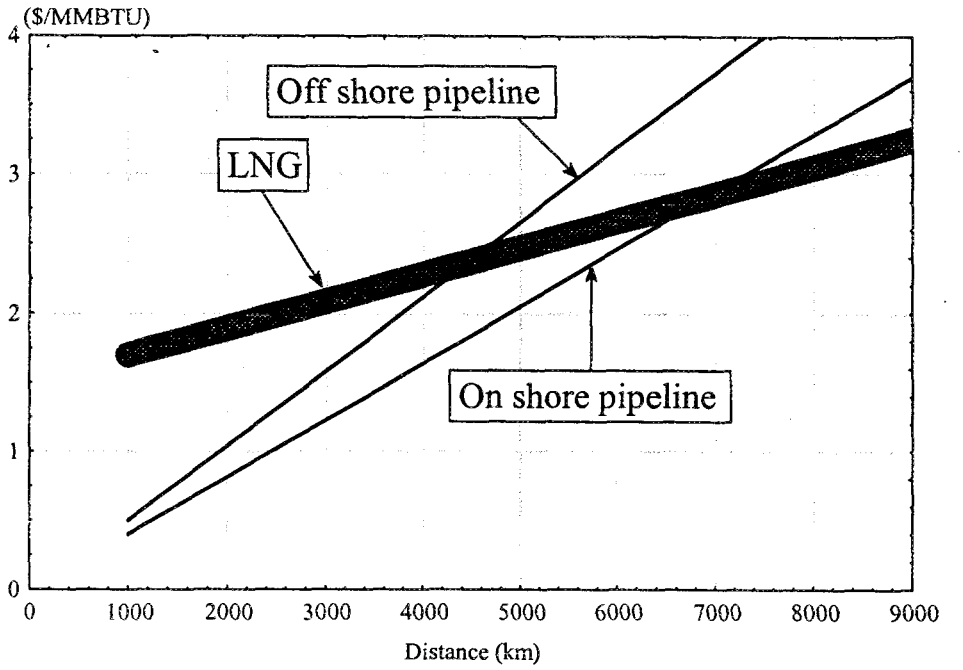
Note: S&P Indigenous Natural Gas Supply + Existing LNG Purchase
D Demand of Natural Gas

Figure 4.2.2 Demand-and-Supply Balance

4.2.4 Natural Gas Transportation by Means of Pipelines

It is recommended that in Northeast Asia, transportation of natural gas should be mainly effected by means of pipelines. Two reasons can be cited as follows.

First, it is necessary to view this from the standpoint of transportation costs. A comparison of the costs of natural gas transportation as LNG and by means of pipelines has revealed that the pipeline method is more economically favorable when marine transportation is within 3,000-4,000 kilometers and land transportation within 6,000-7,000 kilometers. In the case of transporting natural gas produced in Eastern Russia to the Northeast Asian market, the transportation distances from the place of production to the place of consumption are always within the distance range, with the pipeline transportation method being more advantageous. Therefore, from the transportation cost viewpoint, the possibility of ensuring economic viability through pipeline transportation is higher.



Note: The volume of transport; 12 BCM/year
Source: Agency of Natural Resources and Energy, Ministry of International Trade and Industry, (1998. 6)

Figure 4.2.3 Comparison of Transport Cost between Pipeline and LNG

Secondly, this has to be seen it is from the point of view of global environmental conservation. In debating the global warming issue, generally speaking, much has been devoted to the problems of emission of carbon dioxide when energy is burnt. However, in order to enhance the accuracy of the discussion, it is necessary to take into consideration quantitatively CO_2 emission that accompanies energy consumption from the energy production place to the final consumption place.

Table 4.2.3 shows a result of comparison by energy category of CO_2 emission volume at the time of burning and of transportation from the production place to the final consumption place. In comparison with other fossil fuels, natural gas when burnt emits lower CO_2 Moreover, in comparison with LNG, natural gas transportation by means of pipelines emits lower CO_2 at the time of transportation, and insofar as its life cycle CO_2 emission from production to combustion is concerned, the pipeline method has demonstrated a considerable superiority.

In other words, when natural gas is transported from Eastern Russia to the Northeast Asian market, from the viewpoint of global environmental conservation, transportation by means of pipelines is recommended.

Table 4.2.3 CO_2 Emission by Energy Sources

Energy	CO2 Emission (g-Ceq./ MJ prim.)		
	During Transporting (from gas fields to end users)	End User (in burning and consuming)	Total
Coal	2.5	24.6	27.1
Heavy fuel oil	3.2	19.2	22.4
Light fuel oil)	2.5	18.7	21.2
Pipeline Gas (Norway-Belgium)	1.0	13.5	14.5
LNG	4.4	13.5	17.9
Uranium concentrated by gas diffusion	0.06	0	0.06
Uranium concentrated by an ultra-centrifugal process	0.06	0	0.06

Source: C. G. E. E., Belgium

4.3 A Long-term Vision of the International Pipeline

4.3.1 Basic Concept

In the basic structure of the International Pipeline Network of Northeast Asia, the resource supplier is Russia and the users are the markets of China, S. Korea and Japan.

Considering the regional balance of natural gas supply and demand, it is difficult for a single area to supply sufficient natural gas to meet the entire demand. Therefore, as for the International Pipeline Network, it is necessary to examine a network which connects main gas fields of three areas of Eastern Russia: West Siberia, East Siberia and the Far East.

Moreover, from the viewpoint of assuring energy security, it would be better for the users to secure several supply lines and alternative routes in case of an emergency. Therefore, the users have to think about a network which will guarantee ties with several suppliers, connecting each user. In addition, considering the importance of developing indigenous natural gas in Northwest China, and the necessity of natural gas supply from Central Asia, basic concepts of the International Pipeline Network in Northeast Asia can be proposed as follows:

Ladder-type Trunk Pipeline + Circular Line

The Ladder-type Trunk Pipeline consists of two trunk lines: Northern Trunk Line, which connects West Siberia, Krasnoyarsk, Irkutsk, Sakha Republic

and Sakhalin, and Southern Trunk Line, which connects Central Asia, Tarim, Xian and Shanghai. The Northern Trunk Line is linked with a branch line, which connects gas fields in West Siberia and Sakha Republic, and one which supplies gas to, for example, northeast China. While, the Southern Trunk Line is linked with a branch line, which connects gas fields in West Siberia and Tarim, and one which supplies gas to Beijing.

The Circular Line, which connects each demander, is a great circular line. It connects north Sakhalin, Khabarovsk, northeast China, Shanghai and Japan. The Circular Line consists of two sub-circular lines: Japan Sea Circular Pipeline and Bohai Circular Pipeline. The scale of demand in the areas along the Great Circular Line is approximately 198-217 BCM. The existing LNG purchasing contract of the areas is 95 BCM and main contractors are Japan and S. Korea. The shortfall of natural gas needs to be supplied from Eastern Russia through the Great Circular Pipeline.

4.3.2 Network

Figure 4.3.1 shows a pipeline network of Northeast Asia in the year 2020 based upon the above concepts.

"Planned Pipeline Routes" indicate pipelines on which some kind of feasibility study has already started or is about to start. These are strongly expected to be completed by 2020.

The rest of the lines are indicated as "Possible Pipeline Routes" which are expected to be completed by around 2020.

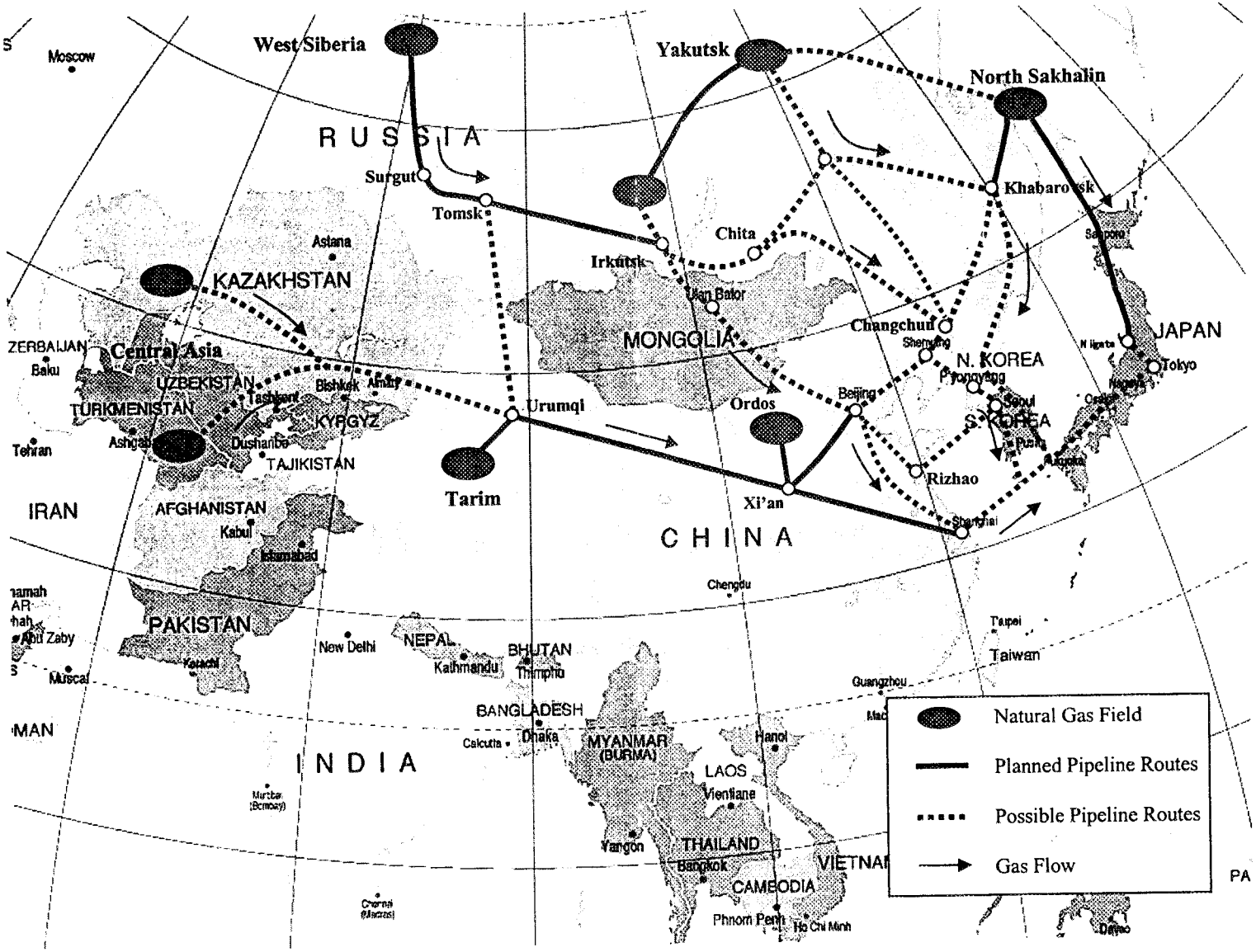


Figure 4.3.1 International Pipeline Network in Northeast Asia

4.4 Socio-Economic Impacts of the International Pipeline

4.4.1 Conservation of Global Environment and Local Environment

To harmonize energy with the environment is now one of the highest policy priorities. Promotion of natural gas development and utilization through establishing international pipelines will give its share of contribution to the resolution of the problems of global environment and local environment in Northeast Asia.

All over the world, all countries and areas are trying to accomplish a best energy mix in order to reduce CO_2 emission (Table 4.4.1). It is feared that CO_2 emitted as the result of burning fossil fuels is having an impact on climate changes such as global warming. In accordance with the Kyoto Protocol reached at COP3 (the Third Conference of Parties to the United Nations Framework Convention on Climate Change), with 2008-2012 as the target, the greenhouse gases in the advanced countries should be reduced at least by 5% against the reference year of 1990. Of the various fossil fuels, the expansion of natural gas use will be an effective means to cope with climate change problem, due to its lower emission of CO_2 per unit heating value.

Table 4.4.1 CO_2 Emission Prospects in Northeast Asia

(MtC)

	1995	2000	2005	2010	2000-2010 Average Increase (%)
BAU (Business as Usual)					
China	819.7	986.7	1154.5	1313.1	2.9
Japan	344.1	355.9	378.2	407.1	1.4
Korea	113.3	124.5	147.2	166.8	3.0
Total	1277.1	1467.1	1679.9	1887.0	2.5
from Coal	800.5	921.7	1045.7	1161.5	2.3
Environment Friendly Energy Scenario					
China	819.7	901.7	994.3	1100.7	2.0
Japan	344.1	342.0	344.6	348.5	0.2
Korea	113.5	118.9	130.4	136.8	1.4
Total	1277.3	1362.6	1469.3	1586.0	1.5
from Coal	800.5	829.0	869.5	912.5	1.0

Source: APERC, *APEC Energy Demand and Supply Outlook*, 1998

Table 4.4.1 tells that in the three Northeast Asia countries of China, Japan and Korea, the estimated CO_2 emission in base case will be 1,161Mt-C and even in environmental friendly case 912Mt-C. Accordingly, expanding utilization of natural gas in Northeast Asia countries will be a very effective measure for prevention of global

warming up.

Besides, burning of coal also induces the atmospheric and other pollution problems due to SPM (Suspected Particle Matters), SOx and NOx contents in flue gas. Natural gas emits nearly no SPM or SOx when it is burnt. Therefore, utilization of natural gas by construction of natural gas thermal power station, widespread use of town gas will be an effective measure not only for resolving at local level pollution problems which have been occurring due to coal burning, but also contribute to improvement of acid rain problems for the entire Northeast Asia.

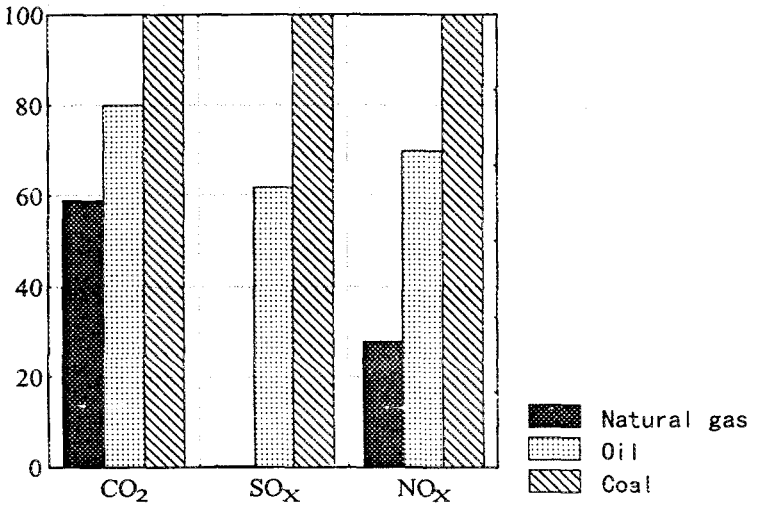


Figure 4.4.1 Comparison of CO_2, SOx, NOx Emission (coal considered as 100)
Source: IEA/National Gas Prospect to 2010

4.4.2 Introduction of Principles of Competition in Energy Sector

Assurance of natural gas supply by the establishment of an international pipeline will contribute to energy cost reductions through diversification of energy sources and introducing among the various countries the principle of competition in the energy sector.

In recent years, as the world's general trend, deregulation and introduction of the principle of competition has been in progress in public utility industries, including electricity and gas supply and in the petroleum industry. In China, with the introduction of opening up and reform policies and of market economy socialism, separation of originally state-owned energy industry into administrative sector and enterprise sector is in progress. In the electricity sector, market penetration by IPP (independent power provider) has been recognized. Not only joint venture projects

but also solely foreign-owned projects can be approved for trial operation. In the S. Korea, originally electricity and gas industries were operated as state-owned enterprises. However as one of the counter-measures to cope with the economic recession which had arisen from the currency crisis, a policy of privatization has been adopted. In Japan too, for such undertakings as petroleum, electricity, gas and other energies, deregulation and introduction of competition is in swift progress.

Table 4.4.2 An Outline of Deregulation of Electricity and Gas Undertakings

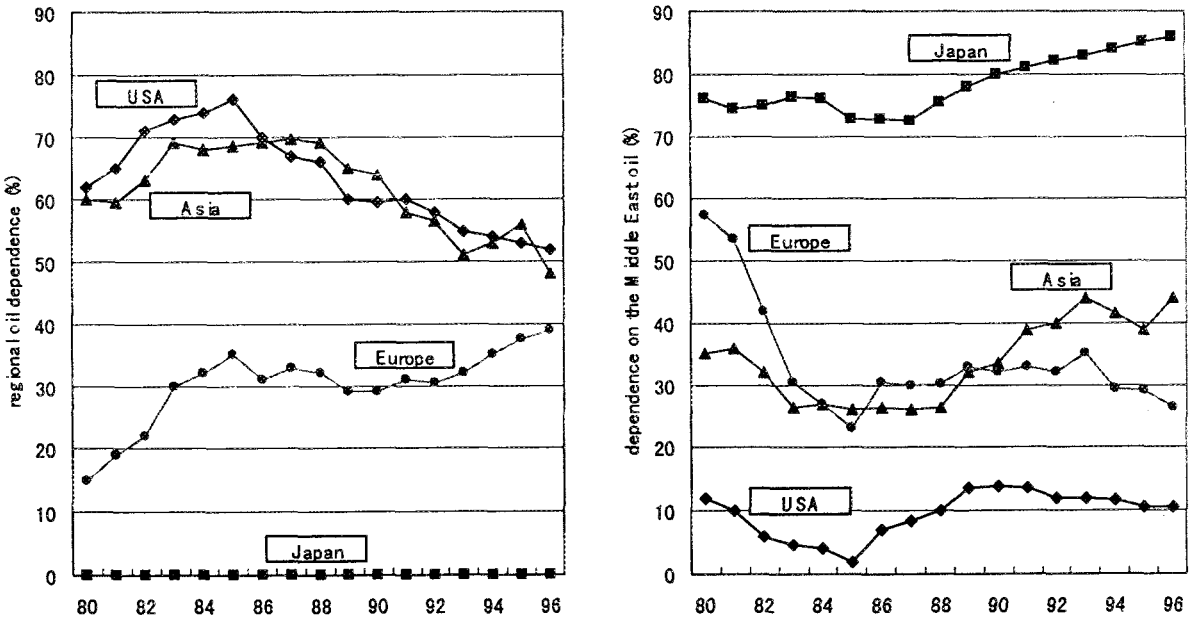
Country	Electric Power Industry	Gas Industry
China	• Separation of administrative and enterprise functions in electricity undertaking • Approval of IPP • Utilization of foreign investments in electric undertaking	• Separation of administrative and enterprise functions in gas undertakings • Utilization of foreign investments in natural gas development
Japan	• Overall introduction of competition in the newly established thermal power generation sphere • Partial liberalization of large volume supply • Review of to-door service and of special supply	• Partial liberalization of large volume supply • Review of to-door service
S. Korea	• Privatization of National electric power corporation • IPP participating in power generation market	• Privatization of National gas corporation • Partial liberalization of LNG import

Source: Based on "Electricity enterprise overseas" (Overseas Electricity Investigation), "International Energy Movement" (Japan Energy and Economy Research Institution), etc.

In order to introduce the principle of competition, two points are deemed important: firstly an infrastructure must be built to a certain level, and secondly the number of entrants into the market must be increased or in other words deregulation must be promoted to facilitate the flexibility of infrastructure usage. The construction of international pipelines is actually envisaged in the sense of the former point. Furthermore, if deregulation is suitably complemented, by the introduction of the competition principle into the energy market in Northeast Asia, a reduction of energy prices including that of natural gas can be expected. Reduction in energy prices will further contribute to the strengthening of the international competitiveness in industries in Northeast Asia.

4.4.3 Assurance of Energy Security

The construction of international pipelines will facilitate the utilization of natural gas resources not only in Southeast Asia but also in Eastern Russia where there is an abundance of such reserves, and a diversification of energy sources. In this way, this can contribute to the assurance of energy security in Northeast Asia. In Europe and North America, there is a growing tendency of less reliance on the Middle East oil. On the contrary, in Asia, with its increased demand in energy and stagnation of crude oil production growth, the dependence on the Middle East oil is still quite high. At the present stage, the dependence on Middle East oil exceeds 50%, and in comparison with other areas, such as 29% for West Europe and 10% for North America, is indeed very high.



Note: Europe ; Austria, Belgium, Denmark, Finland, France, Germany, Greek, Iceland, Ireland, Italy, Luxembourg, Holland, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom.
Asia ; Bangladesh, Taiwan, Hong Kong, India, Indonesia, S. Korea, Malaysia, Myanmar, Nepal, Pakistan, Philippine, Singapore, Thailand, Vietnam.
Source: Agency of Natural Resources and Energy, Ministry of International Trade and Industry of Japan, (1998. 6)

Figure 4.4.2 Dependence of Europe, North America and Asia on the Middle East Oil

In Japan and South Korea, due to their scanty domestic indigenous natural resources, around 80% of the energy supply must rely on import from overseas.

Particularly with petroleum, it is pointed out that in future, the dependence on Middle East oil will increase further. Therefore, it is all the more important for the sake of energy security assurance to introduce natural gas of which resource dispersion is far less unbalanced than petroleum. Besides, China which has always depended on herself for indigenous energy supply, has become, in recent years, a pure petroleum import country, and with the sudden increase of petroleum demand, it is anticipated to become a pure import country in 2000 for primary energy as a whole. As China's movement can possibly give a great impact on the world's oil market, her expanded utilization of natural gas will certainly contribute to the stable supply of energy within the region

4.4.4 Coping with Changes in Energy Demand Structure

In recent years, remarkable progress has been made in the technological development in natural gas utilization. In particular, due to the fuel cell's high electricity generation efficiency (40-60%), when it is used as a co-generation system, it becomes a new energy system that can give a upward move in energy efficiency (around 80% in total efficiency).

Table 4.4.3 shows the prospect of the world automobile market in the year 2020. According to this prospect, in the Japanese market, fuel cell powered vehicles will have the second largest share in 2020. In the world market, fuel cell powered vehicles will have the third largest share and CNG vehicles will have the forth largest. Both fuel cells vehicles and CNG vehicles use natural gas instead of gasoline.

Table 4.4.3 World Automobile Market Ranking in 2020

(Billion US$ 1US$=JPY110.00)

Japan		World	
1. Electric Vehicles	80.82	1. Electric Vehicles	172.73
2. Fuel Cells Vehicles	60.98	2. GDI[1)] Vehicles	153.27
3. GDI Vehicles	19.60	3. Fuel Cells Vehicles	127.03
4. Vehicles with CVT[2)]	11.38	4. CNG[3)] Vehicles	41.36
5. Hybrid Electric Vehicles	10.43	5. Vehicles with CVT	25.09

Note 1: GDI (Gasoline Direct Injection)
Note 2: CVT (Continuously Variable Transmission)
Note 3: CNG (Compressed Natural Gas)
Source: Mitsubishi Research Institute, Co.

Its utilization for automobiles and in households is anticipated and aiming at its commercialization at the beginning of the 21st century, and automobile and electric

goods manufacturers have been competing fiercely in its development. Other energy-saving and clean technology developments such as micro-gas turbine, co-generation, re-powering etc. which are most suited for natural gas as fuel are also under way. When these technologies are introduced into Northeast Asia, it is anticipated that the energy demand structure will undergo a tremendous change.

Against the background of progress in these technological developments, a ground swell towards natural gas utilization on a global scale is in progress. Insofar as the global energy is concerned, it is said that the time prior to the 19th century was the era of firewood and charcoal; that with the advent of 20th century up to the 1960's, there came the era of coal and from the 1960's to the beginning of 2000, the era of petroleum; and that the era of natural gas and hydrogen will come hereafter. The construction of international pipelines in Northeast Asia is considered as a basic infrastructure aspect in the era of natural gas and hydrogen.

4.4.5 Dissolution of Non-electrification Areas

The dispersion-type electricity generation system with natural gas as the fuel will not only be made use of in the urban areas. It will also promote electrification in the rural areas along the pipelines where there is no electricity supply, thereby contributing to the enhancement of the inhabitants' living standard.

In Northeast Asia, there are still areas where circumstances around electricity are poor. Especially in China with the vast land mass, there are still some mountain areas yet to be electrified. The dispersion-type power generation systems that utilize fuel cells or micro gas turbines with natural gas as the fuel are certainly an effective means to achieving electrification in these non-electrified areas. This is important also in North Korea and other areas where electricity conditions are still poor although electrification has already been realized. This is because of the dilapidation of the electricity facilities such as power transmission lines etc. Therefore dispersion-type power generation systems utilizing natural gas as the fuel will also be an effective means.

4.4.6 Establishment of Relations of Mutual Reliance among Northeast Asian Countries and Areas

The promotion of natural gas utilization in Northeast Asia will contribute to relations of mutual reliance among the Northeast Asian countries and areas through export and import of natural gas.

In Northeast Asia, from the points of view of population, natural resource

distribution, economic development situation and energy demand forecast, the possibility of establishing relations of mutual reliance centering around natural gas energy is considered very high. A summary of energy resources and economic conditions in Northeast Asia is shown in Table 4.4.4.

Under such circumstances, when Eastern Russia provides in a stable manner her energy resources to Northeast Asia, economic development will be facilitated in Eastern Russia, Mongol and North Korea, and stable energy supply will be assured for Japan, China and the S. Korea. In this way, these countries' mutual benefits will increase further. The achievement of Northeast Asia's economic development over the whole region is an important task confronting Northeast Asia. Through natural gas import and export, the need to lift barriers among individual countries and establish an energy reliance system, namely "energy alliance", will become a more and more pressing one.

Table 4.4.4 Strength and Weakness of Each Country and Area

Countries and Areas	Energy Resources	Population	Energy Market	Technology	Fund
Eastern Russia	+++	□ □	+	++	-
China	+	+++	++	++	+
South Korea	-	+	++	++	++
Japan	-	++	+++	++	+++

Note: except Mongolia, North Korea and other countries and areas
Source: Mitsubishi Research Institute, Inc.

Chapter 5 Conclusion

5.1 Why This Study

In Northeast Asia, there is a high possibility to be able to establish the Energy Alliance for natural gas energy. An international natural gas pipeline will become a strong driving force for realizing the Energy Alliance.

However, no comprehensive vision of the international gas pipeline has been proposed, although individual plans of pipeline projects have been presented. Moreover, organizations in Eastern Russia, who produces natural gas, and in China, South Korea and Japan, who are consumers, have not gotten around the table and discussed a comprehensive vision of the International Pipeline.

Therefore, being directed by the Task Force, which consists of member organizations of Northeast Asian countries and areas, this Research has presented a comprehensive long-term vision of the International Pipeline on the basis of the regional balance of natural gas supply and demand in Northeast Asia.

5.2 New Features

First, the Research provides latest information on the current and future trends of energy in the Northeast Asian countries and areas and their natural gas policies. The results can be used as a reference concerning the energy situation of related countries and areas.

Second, the Research examines the future natural gas supply and demand of each Northeast Asian country and area by regions. As a result, excluding their own consumption, East Siberia and the Far East, which are geographically near to Northeast Asia among the regions of Eastern Russia, will be able to export 28 BCM in 2010 that will not be enough to meet the future shortage of natural gas in Northeast Asia. Therefore, it is obvious that Northeast Asian countries and areas have to consider importing natural gas from West Siberia and Central Asia who have enormous natural gas resources.

Third, taking account of the regional balance of supply and demand, the research presents the long-term vision of the International Pipeline, setting 2020 as the target year. Its basic concept is *Ladder-type Trunk Pipeline + Circular Line.* The

Ladder-type Trunk Pipeline consists of two trunk lines: Northern Trunk Line, which connects West Siberia, Krasnoyarsk, Irkutsk, Sakha Republic and Sakhalin, and Southern Trunk Line, which connects Central Asia, Northwest China and Shanghai. The Circular Line, which connects each demander, is a great circular pipeline. It connects north Sakhalin, Khabarovsk, Northeast China, Shanghai and Japan. The Circular Line consists of two sub-circular lines: Japan Sea Circular Pipeline and Bohai Circular Pipeline.

5.3 Subject of Future Investigation

Important steps toward the realization of the International Pipeline Network in Northeast Asia is to investigate the following two items:

(1) The Construction of a Framework of International Cooperation (The Concept of the Northeast Asian Energy Community)

It is necessary to coordinate rules, codes of conduct and domestic common practices related to the natural gas business in order to promote it by using the International Pipeline in Northeast Asia. In addition, it is important to establish a framework of international cooperation which can be used for all sorts of arrangements.

In the process of establishing the framework of the future international cooperation, it will become possible to create a community and constitute a Northeast Asian Energy Charter.

(2) Support for the Promotion of Each Project

The idea of the International Pipeline proposed above can be realized by the implementation of the projects, one by one. Therefore, it is necessary to support the promotion of individual projects, such as the Irkutsk project (including gas fields in Irkutsk and the Sakha Republic) and the Sakhalin project, cooperating in developing technologies for the construction of pipelines and the utilization of natural gas and financing of the projects.

5.4 How to Utilize This Report

It is important for NAGPF to make public announcement of the results of this research "A Long-Term Vision of Natural Gas Trunkline in Northeast Asia" and approach the governments of countries and areas concerned and international

organizations, such as the World Bank, the Asian Development Bank and the International Energy Agency for the realization of the International Pipeline.

ENERGY-ENVIRONMENTAL ISSUES AND IMPLICATIONS OF THE CDM FOR NORTHEAST ASIA

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1. INTRODUCTION

Northeast (NE) Asia comprises six countries, namely, China (including Hong Kong), Japan, the Republic of Korea (ROK), the Democratic People's Republic of Korea (DPRK), Russia, and Mongolia. The region accounts for 27% of world's population and around 20% of global GDP in 1998. Japan's GDP alone accounts for more than 12% of the world's total in 1998 and ranks sixth in terms of per capita GNP (US$32,230 in 1998).

According to latest statistics published by the Paris based International Energy Agency (IEA), NE Asia accounts for one-fourth of world's total primary energy supply (TPES) and more than one-fifth of the world's total energy production. The region is a net energy importer, particularly because of Japan and ROK. The regional per capita energy consumption is slightly below the world average. It is estimated that NE Asia's (excluding Russia, DPRK, and Mongolia) total energy demand will increase at an annual average rate 3.4% over the next 20 years.

NE Asian countries have given priority to energy conservation and efficiency improvements. Utilization of relatively environmental friendly fossil fuel (i.e., natural gas) is ever increasing. Moreover, promotional activities for new and renewable energy technologies are underway. In addition to this, energy sector deregulation, including market restructuring, price reforms, and privatization, is a thrust in the region,.

Total CO_2 emissions from the region were estimated at 6,008 million tons in 1998 and accounted for nearly 25% of global CO_2 emission in that year (IEA 2000a). On a per capita basis, the average CO_2 emission is recorded at 3.77 tons, which is slightly lower than the world average (3.87 tons). The most important feature of the region in the context of global climate change is that it has a potential of mitigating CO_2 emissions by the amount that could surpass the Annex B countries' total demand for CO_2 mitigation for the first commitment period of the Kyoto Protocol. This has a significant implication on the global market of carbon credits generated through the clean development mechanism (CDM). With the assumption of full fledge CDM operation thereby considering a global emission trading situation, McKibbin et al. (1999) estimates that China could receive US$7 billion from emission credit sales in year 2010, whereas Japan would need to spend US$1.2 billion to buy emission credits for that year. It is obvious then that NE Asian countries could benefit from

the mutual cooperation for climate change activities especially under the CDM. Due to the geographical proximity, Japan would have better access to NE Asian countries' relatively cheaper emission credit market. China and Russia could meet Japan's need for emission credits through the flexibility mechanisms.

In this paper we first highlight the current and future energy and environmental situation in NE Asian countries. This is followed by a brief discussion of prevailing policies and programs that govern energy issues in the region. Section 4 shows the greenhouse gas (GHGs) mitigation potential in the NE Asian region through project specific activities as well as through shifts in government policies especially energy import policies of highly energy dependant countries in the region. Key conclusions and final remarks are presented in section 5.

2. ENERGY AND ENVIRONMENTAL SITUATION

Table 1 presents the key energy and economic indicators for NE Asian countries.

Table 1: Key demographic and economic indicators in NE Asia (1998)

Country	Population (millions)	GDP (billion 1990 US$)	Per capita GDP (1990 US$)	Per capita energy consumption (kgoe)	Per capita CO_2 emissions (tons)
China	1239	805	650	832	2.32
DPRK	23	382	16,485	2,375	8.62
Hong Kong, China	7	101	15,133	2,479	6.05
Japan	126	3,304	26,117	4,032	8.92
Mongolia*	3	1	384	...	...
Russia	147	334	2,276	3,960	9.64
ROK	46	387	8,335	3,519	7.97
NE Asia	1591	5,314	3,340	1,482	3.77
World	5,865	26,326	4,488	1,639	3.87

*Sources: IEA 2000a, *World Bank (2000)*

2.1 Energy Situation

2.1.1 Historical situation

Largely because of China and Russia, NE Asia is endowed with abundant coal resource, which was equivalent to 27% of the world coal recoverable reserves in 1999. Russia's coal reserves accounted for over 16% of NE Asia's total followed by China with over 11%. In contrast, NE Asia accounted for only 7% of world crude oil reserves in 1999, to which China contributed 2.3% and Russia 4.7%. As for natural gas, NE Asia accounted more than one-third of world natural gas reserves in 1999. This is largely because of Russia, which accounted for 33% of world natural gas reserves in 1999. In addition to fossil fuel reserves, the region has substantial hydropower and other renewable energy resources. NE Asia shared more than 18% of world hydropower supply in 1998. China alone accounted for 43% of NE Asia's hydropower supply in 1998. NE Asia is also endowed with combustible renewables and waste, contributing more than one-fifth of world combustible renewable energy supply in 1998.

Total energy production in NE Asia reached 2,137 million tons of oil equivalent (mtoe) in 1998 and represented more than one-fifth of the world total. Of this around half was produced by China, followed by Russia, which accounted for 43% of NE Asia's total energy production. China showed a continuous growth of total energy production up to 1996, while Japan had a continuous growth up to 1998. After declining until 1997, Russia showed an increase in total energy production in 1998.

In 1998, total primary energy supply (TPES) in NE Asia represented one-fourth of world TPES. China alone shared around 43% and Russia shared one-fourth of NE Asia's TPES in 1998. Russia's TPES decreased 5.34% per year over 1992-1998 period. On the other hand, total final energy consumption reached 1,493 mtoe in 1997 or slightly above a quarter of world total. Total final energy consumption in NE Asia decreased 0.9% per year in 1992-1998. This combined Japan's that increased slightly and Russia's that decreased 7.5% per year in the same period.

In 1992, NE Asia produced 749.37 mtoe of coal and accounted for over 34% percent of world total coal production. This reached 842.25 mtoe in 1997, increasing its share of world total coal production to 36.4% and at the rate of 2.3% per year over 1992-1997. China, the largest coal producer in the world, leads NE Asia and accounted for 29.7% of world coal production in 1999, despite a declining coal production since 1997. Despite declining at a constant rate since 1992, Russia's coal production reached 95.88 mtoe in 1998 and has remained the second largest in NE Asia .

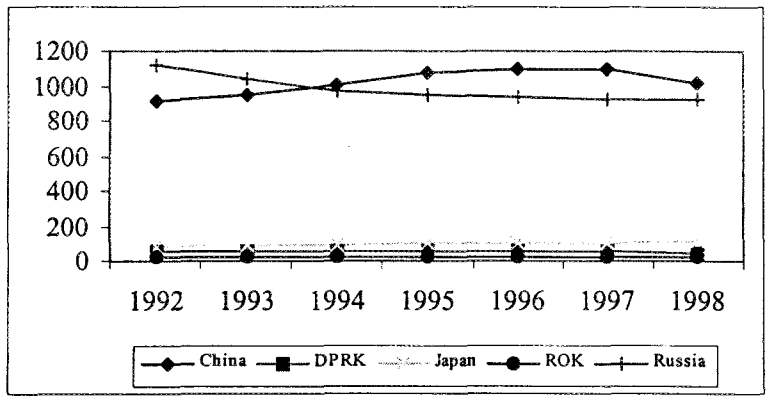

Figure.1. Total energy production (mtoe) in NE Asian countries

China and Russia are also the major crude oil (including natural gas liquids) producer in NE Asia. Russia's crude oil production represented 65% of the region's total and 8.3% of the world total in 1998. China accounted for 4.45% of world crude oil production in 1998. Overall, NE Asia's crude oil production accounted for around 13% of world crude oil production in 1998.

NE Asia shared more than one-quarter of world natural gas production in 1998. Russia's crude oil production alone accounted for 24.4% of the world total in 1999, though declining slightly since 1992. Russia in fact is the world's largest natural gas producer. China is the second largest natural gas producer in NE Asia, accounting for 4.49% in 1998.

Except Mongolia, all NE Asian countries are producing petroleum products. NE Asia shared about one-fifth of world petroleum products output in 1997. Japan ranked as the top producer of petroleum products in the region (accounting for more than 32% in 1997), followed by Russia (25.17%) and China (24.3%). Production is fastest in ROK, which was more than 16% per year in 1990-1998, followed by China's 6.39%. Meanwhile, Russia's petroleum products output declined 7.13% percent per year in 1992-1998.

In NE Asia, Japan, Russia, ROK and China are nuclear energy producers and accounted for around 22% of world nuclear energy production in 1997. Japan is the largest in the region and accounted for 61% of NE Asia's nuclear energy production in 1997 and for 13.6% of the world total nuclear energy production in 1998, ranking third after United States (29.2%) and France (15.9%). Japan showed the highest growth rate, at 6.7% per year in 1990-1997, of nuclear energy production in NE Asia. Russia's nuclear energy production declined slightly since 1996, but accounted for 4.3% of the world total in 1998. ROK shared 3.7% of the world nuclear energy production in 1998. China accounted for only 2.8% of NE Asia's nuclear energy production in 1997. In terms of installed capacity, Japan has 44 GW of nuclear capacity (or 12.3% of the world total in 1999), followed by Russia with 20 GW (5.6%) and ROK with 13 GW (3.6%). Nuclear energy contributed 38% to total domestic electricity generation of ROK in 1998, 32% in Japan, and 13% in Russia.

NE Asia has a substantial hydropower power potential because of China, Russia and Japan. NE Asia accounted for more than 18.25% of the world total hydropower production in 1997, with China contributing 41.96% of NE Asia's total followed by Russia (33.72%) and Japan (19.22%). China also had the highest growth rate of over 6% in hydropower production in 1990-1998, increasing its share of world hydropower production from 2.9% in 1973 to 7.9% in 1998. Hydropower contributed 19.3% to total electricity generation in Russia, 17.4% in China, and 9.8% in Japan in 1998. Total electricity generation of NE Asia was 3302.74 TWh in 1997 and accounted for 23.62% of the world total.

Combustible renewables and wastes accounted for 9.1% of the TPES of NE Asia in 1998.

China and Russia ranked fifth and eighth, respectively, among the top ten exporters of coal in the world in 1999 (of which 6.73% is accounted for by China and 4.91% by Russia). Japan is the largest coal importer in the region and accounted for about one-fourth of world total coal imports in 1999. The largest crude oil producer in NE Asia, Russia in 1998 also ranked as the second largest crude oil exporter (7.1% of the world total) after Saudi Arabia (18.36% of world total). In terms of natural gas exports, Russia tops with 36.92% of the world total natural gas exports in 1998. Japan and ROK are net importers of natural gas in the form of liquefied natural gas (LNG), accounting for 12.65% and 2.53%, respectively of the world total in 1998. Only Russia exports electricity, amounting to 26 TWh in 1998, or 6.16% of the world total.

2.1.2 Future energy situation

Most of the projected increase in world energy demand (which is 57% between 1997 and 2020, at an average annual rate of 2%, to slightly more than 13,700 mtoe (IEA, 2000c)) will come from the developing regions (mainly China, South Asia, East Asia, Latin America, Africa, and the Middle East). They will account for 68% of the increase in world energy demand between 1997 and 2020. The current 34% share of developing countries in world

energy demand rises to 45% by 2020. Total primary energy demand of Asia grew from 24% of the world total in 1990 to 29% in 1997 or 2,771 mtoe. Of this amount, nearly two-thirds were by NE Asia (excluding Russia). NE Asia's (excluding Russia, DPRK, and Mongolia) total energy demand will increase at an annual average rate of 3.4% over the 1999-2020 period. China will lead the highest total energy demand growth rate at 4.7%, followed by ROK 2.8%, and Japan 0.9%.

In China, the largest oil consumer in developing Asia, oil demand is projected to increase by 6.1 million barrels per day from 1999 to 2020. While the proportion of ROK's transportation oil use increases slightly over the forecast years, non-transportation consumption is projected to account for 59% of the increase in oil demand from 1999 to 2020. Japan's demand for petroleum products is projected to increase by about 350 thousand barrels per day from 1999 to 2020, at an average growth rate of 0.3% per year.

The highest growth rate in energy consumption in NE Asia (excluding Russia, DPRK, and Mongolia) will occur for natural gas utilization, at 5.45% per year from 1999 to 2020. China will lead at 10.1% over the same projected period. Japan's natural gas utilization at 1.9% per year in the same period is higher than that of other energy sources. Natural gas utilization growth rate in ROK at 6.5% per annum exceeds slightly twice the world average.

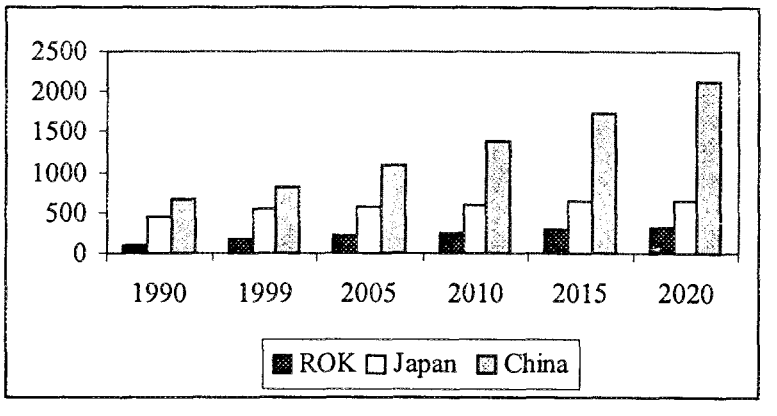

Figure 2. Total energy demand in NE Asian countries (mtoe)

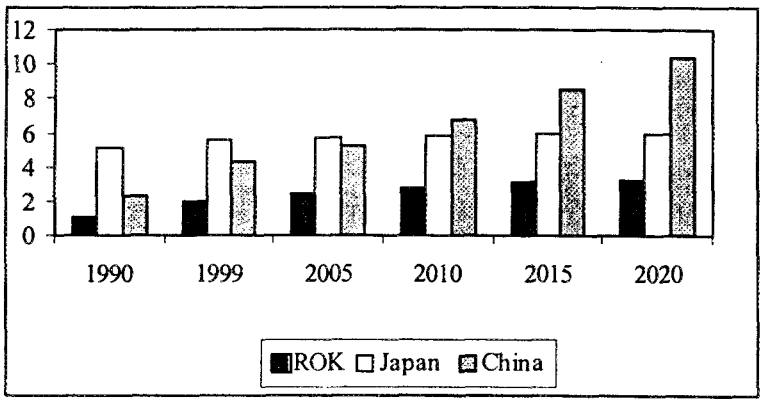

Figure 3. Oil demand in NE Asian countries (million barrels per day)

China, the world's largest consumer of coal, accounted for almost 23% percent of global coal consumption in 1999. This is expected to increase to 40% as coal use in electricity generation increases by 5.1% per year during the 1999-2020 period. Coal consumption in ROK would account for 25% of the projected increase in developing Asia outside China and India. Japan, which is the third largest coal user in Asia and the fifth largest globally, experienced strong growth in coal consumption during the first part of 2000 and has continued to be the world leading importer of coal and is projected to account for 24% of total world coal imports in 2020. The dislocations associated with political changes in the Former Soviet Union, especially Russia, have contributed substantially to coal production and consumption. In Russia, efforts have been aimed primarily at shutting down inefficient mines and transferring associated support activities.

China has ambitious plans to develop nuclear power as a source of energy for electricity generation. China had three nuclear power plants in operation in 1999, and by 2020, 6% of its electricity is projected to come from nuclear power plants, up from 2% in 1999. ROK, on the other hand, has the largest nuclear power industry among the developing Asian nations, producing 97.9 billion kWh of nuclear electricity in 1999. From 1999 to 2020, generation from its nuclear power plants is expected to rise slightly in absolute terms but remain steady at about 40% of total electricity use. An increase in the nuclear share of Japan's total electricity generation from 33% in 1999 to 38% in 2020 is also expected.

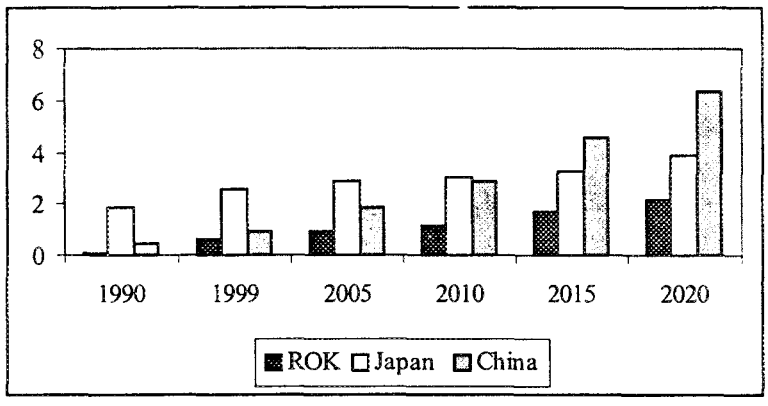

Figure 4. Natural gas demand in NE Asian countries (trillion cubic feet)

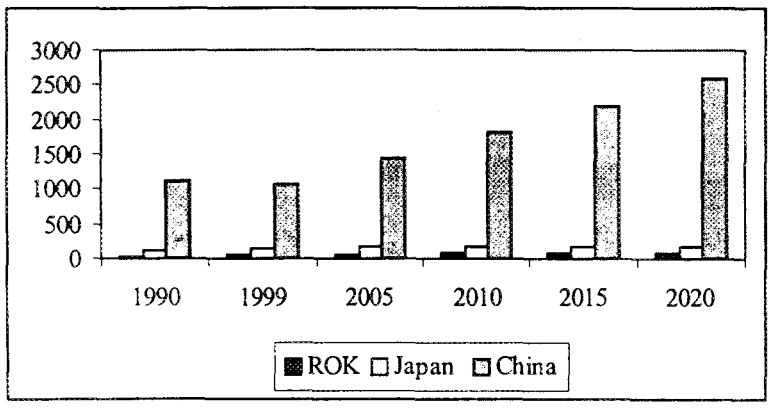

Figure 5. Coal demand in NE Asian countries (million ton)

China has projected a 5.1% annual growth in renewable energy use during 1999 to 2020. China's plans. to expand its electricity capacity through large-scale hydropower projects is progressing and it expects to export electricity over the next 20 years. China also plans to expand micro-hydroelectricity by 2010 and has set a target that 2% of the country's energy demand will be met by other renewables by 2015. In Russia, hydroelectricity accounts for 20% of total installed capacity. Only a few small non-hydroelectric renewable energy projects have been developed or are planned in Russia. In the meantime, hydroelectricity and other renewable energy sources in Japan will grow by 1.5% per year between 1999 and 2020. ROK shows the highest growth rate 7.9% over the same projected period for hydroelectricity and other renewable energy in NE Asia.

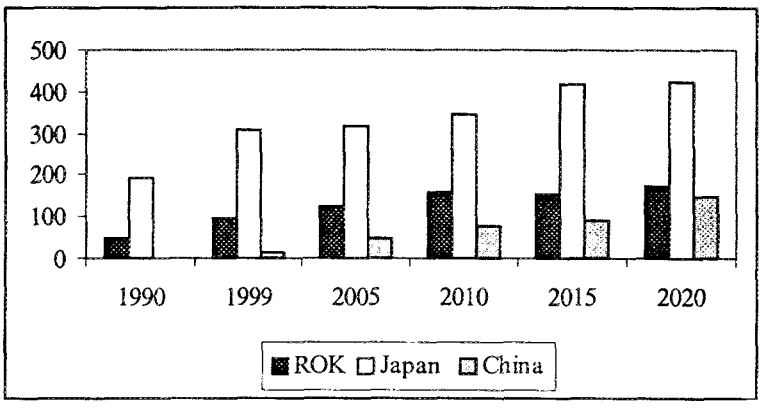

Figure 6. Nuclear energy demand in NE Asian counties (TWh)

2.1.3 Investments in energy infrastructures and role of the private sector

Energy infrastructure development, in particular for power generation, transmission and distribution, and oil and gas exploration and development, processing, transmission and distribution, requires huge investment. Latin America, East Asia, and South Asia have led the growth in private participation in energy sector projects. East Asia and the Pacific accounted for a third of the global investment in energy projects with private participation in 1990-1999, amounting to around US$60 billion (at 1998 prices). South Asia received private investments in energy infrastructures close to US$20 billion. Thus the whole of Asia practically hosted US$80 billion worth of energy investments by private sector.

Total investment in energy projects with private participation in developing countries boomed during the past decade, rising from less than US$2 billion in 1990 to US$46 billion in 1997. The high growth rate in electricity demand in developing countries resulted in the increased private sector participation and investments. However, as a result of the financial crisis in East Asia in 1997-1999, the investment figure fell to US$25 billion in 1998 and to US$15 billion in 1999. According to preliminary World Bank estimates, net long-term capital flows to developing countries declined by a fifth between 1997 and 1999. Most affected is East Asia, where private activity dropped from US$12 billion to US$3 billion as a result of the cancellation of many high-profile projects in crisis countries and reduced activity in China.

In China alone, a total of US$36.74 billion was invested in power sector development during 1990-1995 period. It was estimated that this figure could have reached US$48.82 billion during the 1995-2000 period. Even with a lower GDP growth rate than in previous years (i.e., 4.5% as projected by APERC, 1998), the investment demand in China's power

sector is expected to reach US$69 billion (at 1998 prices) during the 2000-2005 period. Construction of China's longest natural gas pipeline, 4,200 km from Lunnan gas field in the Tarim basin in western China to Shanghai, also started in April 2000, at an expected cost of US$40 billion. The five current proposals to import gas from Russia and Central Asia through a total of over 28,000-km of pipeline would cost some US$65 billion. China would also spend US$ 60 billion to US$100 billion over the next 25 years to construct nuclear power plants. GEF and World Bank planned to invest more than US$500 million for new renewable energy (non-hydroelectric) projects in China.

The investment environment in Russia remains depressed in comparison with other transition economies. Sustaining oil production depends heavily on attracting minimum investment of US$5 to US$7 billion per year. In gas, up to 85% of Gazprom's productive fields are in decline and need investment estimated at about US$2 billion per year for five years to maintain the production necessary for domestic and export markets and to settle domestic debts and tax arrears (IEA, 2000c). On the other hand, the total investment requirement for geothermal projects in Russia stands at around US$620 million.

In Japan, the bulk of the investments in the power sector are made by the ten private utility companies. Their annual investment was US$24.5 billion per year during 1985-1990 and US$41 billion per year during 1991-1995. From these total investments roughly 25% is spent on reinforcement of transmission and distribution, 26% on rehabilitation, 6% on nuclear fuel, and 43% on new generating capacity. The power sector's investment requirements are almost fully funded by domestic financial resources.

The electricity industry in ROK is dominated by Korea Electric Power Corporation (KEPCO), which owns and operates 86% of the country's generating capacity and all transmission and distribution facilities. KEPCO's power generation, transmission and distribution capacities have expanded very rapidly over the past two decades. This required huge investments of about US$4.2 billion per year in 1985-1995, of which about half is spent on transmission and distribution, and the other half on generating capacity.

In December 1995, the Korean Peninsula Energy Development Organization (KEDO), an international consortium led by the US government, signed a US$4.5 billion deal with DPRK for 2x1000 MW light water reactors, expected to be commissioned by 2003. ROK and Japan are providing most of the financing. In early 1996, Japan announced that it would contribute US$20 million to KEDO for fuel oil assistance. Fuel oil supply met its promised target of 500,000 tons in 1996 and is expected to continue at this level during the period 1997 to 2003.

In Mongolia, according to the WB/ESMAP, the priority investment needs in the energy sector (excluding upstream petroleum) for the next five years are in the coal sector (US$55-85 million), combined heat and power (CHP) (US$192-235 million), and downstream petroleum (US$10-15 million). The priority investments are in tune with current estimates in the indicative public investment program for the 1994-1997 period, averaging US$47 million per year. About one-third of these investments is being financed by the Asian Development Bank, the World Bank and donor countries.

2.2 Environmental Situation

The deterioration of air qualities resulting from emission of SO_2, NOx, and PM are widespread across the coal consuming countries, particularly in developing countries such as China, DPRK, and Russia, where coal accounts for 89%, 59%, and 16% of TPES, respectively. The developed countries, including ROK and Japan, have less problems of air pollution.

Aside from air pollution, problems of acid rain are also visible in many parts in Asia. The provinces of Guangxi, Gueizhou, and Sichuan in the southern part of China constitute the third largest area of acid rain in the world. According to the Chinese Research Academy of Environmental Sciences, 40% of China is affected by acid rain, causing US$1.6 billion worth of annual damage to crops, forests, and property. The transport and fate of sulfur in Asia is an area of increasing environmental interest and concern as countries receive growing amounts of sulfur from neighboring and even distant countries. As in Japan, a cross border effect of emissions is observed where SO_2 emissions from the coastline of China are believed to have caused acid rain.

China tops in SO_2 and NOx emissions. APEC estimates these to be about 20 million tons and 7.4 million tons, respectively in 1987 (APEC, 1997). APEC also estimated the SO_2 and NOx emissions in 1987 for Japan (1.1 million tons and 1.9 million tons respectively) and ROK (1.3 million tons and 0.9 million tons respectively). According to the Program for Asian Cooperation and on Energy and the Environment (PACE-E) executed by UN-ESCAP between 1993 and 1998, 45% of the total SO_2 emissions in China in 1994 came from energy transformation, including the power sector. The SO_2 and NOx emission in Mongolia was estimated by PACE-E/UN-ESCAP at 0.06 million tons and 0.05 million tons respectively. It is projected that SO_2 emissions in China would increase to 28.2 million tons in 2000 and 38.5 million tons in 2010, or by 3.5% per year during 1994-2010. Also by 2010, the share of energy transformation in China's SO_2 emissions will have increased to 57%. The power sector will also be the main contributor of SO_2 and NOx emissions in Mongolia.

Table 2. SO_2 and NO_x emissions from some Asian countries

	Year	SO_2 (mt/year)	NOx (mt/year)
China[a]	1987	20.00	7.40
Japan[a]	1987	1.10	1.90
ROK[a]	1990	1.30	0.90
Mongolia[b]	1993	0.06	0.05

Sources: [a]APEC (1997), [b]UNDP (1998)

While SO_2, NOx, and PM emissions from coal combustion pose threat to the local air quality in Asian countries, emissions of CO_2 bring the threat of global climate change. In terms of CO_2 emissions from fuel combustion and climate change, NE Asia consists of three largest CO_2 emitting countries: China, Russia, and Japan. NE Asia (excluding Mongolia) accounted for 26% of the world CO_2 emission in 1998. China's CO_2 emissions totaled 2893.2 million tons in 1998, increasing by 6.7% between 1990 and 1998. There was a striking reduction in global CO_2 emission between 1997 and 1998 (1.4%), largely explained by a drop in emissions from coal in China (250 million tons CO_2), followed by ROK (53 million tons CO_2), Russia (48 million tons CO_2), and Japan (32 million tons CO_2).

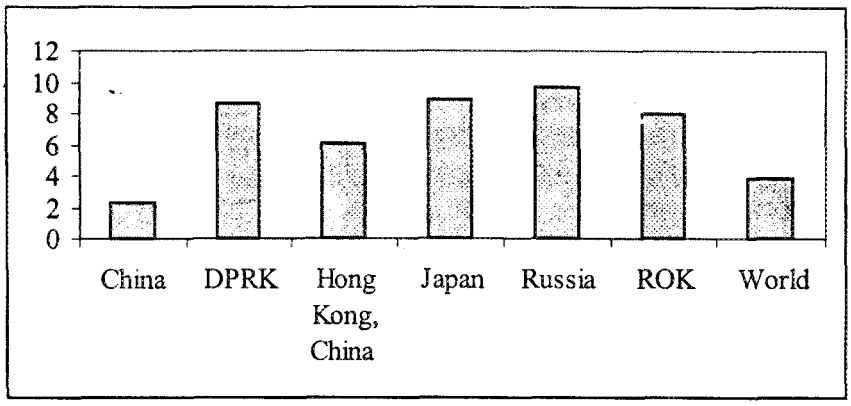

Figure 7. CO_2 emissions in 1998 (tons per capita)

Regarding per capita CO_2 emission in NE Asia, Russia tops, emitting 9.64 tons of CO_2 per capita in 1998, followed by Japan (8.92 tons of CO_2 per capita), DPRK (8.62 tons of CO_2 per capita), and ROK (7.97 tons of CO_2 per capita). China, having the highest total CO_2 emissions, emitted only 2.32 tons CO_2 per capita in 1998, which is far below than world average. The ALGAS study projects that CO_2 emissions in China would reach 4,840 million tons in 2010, while based on EIA projections of carbon emission, CO_2 emissions in Japan would total 1,282 million tons in 2010. Asia's total CO_2 emissions would reach 10,678 million tons in 2010, or grow by 3.9% per year between 1997 and 2010, again using EIA carbon emissions projections.

3. ENERGY AND ENVIRONMENTAL POLICIES

3.1 Energy Conservation and Efficiency

A study of the evolution of energy efficiency and conservation in seven developing Asian economies[1] confirms that the achievements in energy efficiency "are the results of steady economic growths with swift technological progress and strongly efficiency-oriented energy policies (Lefevre, et al., 1995)". In Asia, energy conservation and efficiency policies continue to evolve and have acquired a new dimension. Energy conservation laws were first introduced by oil import dependent countries in NE Asia (Japan and ROK) following the first global oil price shock in 1973 that caused sudden and dramatic trade imbalances and economic recession. In contrast, energy resource rich countries (China and Russia for example) lagged behind in formulating and implementing energy conservation strategies.

Energy conservation policies in the 1980s was characterized by a set of primary measures, including public education or awareness campaigns, energy audits and measurement of energy saving potential, and promotion of efficient technologies through research and development and demonstration projects. Notwithstanding, since early 1990s, energy conservation policies in many NE Asian countries have progressively advanced with the promulgation of energy conservation laws and the establishment of concrete programs such as demand side management programs. Pricing mechanisms such as time-of-day rates,

[1] *Includes China, India, Indonesia, ROK, Philippines, Taiwan, and Thailand*

seasonal rates or interruptible rates are common measures utilised in China. The command and control system is used in some developing countries. For example, many utilities in China use a quota or rationing system on electricity consumption to control consumer's load. Financial incentives include measures such as tax or import tariff reductions for energy efficient equipment, low-interest loans for efficiency retrofits, and subsidies or rebates to make up for the higher capital costs of energy efficient equipment. This measure is adopted in ROK to motivate customers to buy energy efficient equipment. Countries are also at different phases of DSM Programs. For example, ROK has established full-scale DSM programs.

The other policy elements of energy efficiency and conservation in Asia are:

- Promotion of cogeneration among industries to save energy and increase efficiency. China, have successfully implemented cogeneration projects.
- Exploitation of waste products to generate electricity to increase efficiency.
- Removal of subsidies and cross subsidies to make energy efficient technologies competitive.
- Development of energy service companies (ESCOs) which acts as channels for information and source of capital. China has already set up ESCOs and ROK has also expressed its intention to encourage ESCOs.

3.2 Increasing Utilization of Natural Gas

Natural gas consumption in NE Asia (including China, Japan and ROK) grew 5.65% per year in 1990-1999, faster than oil (3.94%), while coal consumption decreased slightly because of China. This trend will continue in the next ten years or so.

In NE Asia, China, will be the most important source of this high growth in natural gas consumption. Natural gas consumption in China in 1997-2010 is expected to grow 14% per year, and China will have overtaken Japan as the largest consumer of natural gas in the region by 2010. Earlier projections from APEC also show natural gas consumption growing fast in ROK. In contrast, natural gas production and consumption are decreasing in Russia, though Russia accounted more than 24% of world natural gas production in 1998.

In CEERD/AIT's recent survey of coal and natural gas competition in APEC economies, (which includes the four NE Asian countries China, Japan, Russia, and ROK) it was found that natural gas is competing closely with coal. More important, the competition between these two fuels is a complex process driven by interrelated factors, including:

- Availability of the resource;
- Relative prices both in the domestic and international markets;
- Environmental policies and regulations, including the international response to global climate change;
- Technological developments; and
- On going reforms in the electricity sector, which is the major user of coal and natural gas.

For example, as far as the first factor is concerned, NE Asian countries have wide disparities in energy resource endowment. Russia and China have high reserves of natural gas and Japan and ROK are dependent on LNG trade. Gas production in Russia and China can meet their demand but the economies outside the region, particularly Middle Eastern

economies and some Asian economies also play an important role in meeting the demand of Japan and ROK. The outlook for gas is also critical because there will be a larger gap between production and demand. The growth in NE Asian production will come from China, but the growth in consumption in this country will also be the highest. The share of ROK in the region's total consumption is projected to grow while that of Japan would decrease.

3.3 New and Renewable Energy Technologies

New energy technologies are more efficient, use low-carbon or carbon-free fuels, and are therefore environment friendly. Renewable energy systems can be a more economically feasible alternative than centralized options in remote rural areas (for example, PV and micro-hydro for rural electrification). In addition, they create investment and employment opportunities with the added benefit of reducing the import bill on energy equipment. Among the new energy technologies, new and renewable energy technologies (NRETs), offer the most promising prospect as a sustainable energy option.

In NE Asia, as well as in the rest of Asia, NRETs are in varying degrees of development. Selected technologies are already commercially available or locally manufactured in some countries, while others are being introduced, tested or demonstrated under local conditions. In many cases, however, the contribution of NRET to a country's energy mix remains insignificant.

The most promising NRETs include:

- Solar photovoltaics (PV) for lighting, water pumping, entertainment, telecommunications, battery charging, etc. In many developing countries, the solar panels are usually imported with the remaining parts of the system either locally manufactured or imported as well. Solar panel assembly is being done in China. Financing schemes are also provided in some countries to promote the use of PV particularly for rural electrification.
- Solar water heaters are commercially available in some countries with manufacturing already being done in a few of them (China). In the region's developing countries, solar water heaters are usually imported from Australia, Japan, USA and European countries;
- Small-scale hydropower systems are technologically mature and are economically competitive in selected niches (China, Mongolia);
- Solar cookers are manufactured in China;
- Biomass energy applications are prevalent in many developing countries. There are commercial applications of biomass-fired cogeneration facilities (China), biogas for lighting and power generation (China); improved cookstoves, ovens and furnaces using fuelwood, charcoal and agricultural residues; and gasifiers (China), among others;
- Wind pumps are already commercially available and manufactured in countries with favorable wind regimes;
- Wind-powered generators have been manufactured and installed in China; and
- Utilization of geothermal energy in Japan and Russia

3.4 Energy Market Reforms

Along with increasing concern for the environment, another trend that characterizes the 1980s and the 1990s is energy deregulation, including market restructuring or increasing

competition, pricing reforms, and privatization. Less role for government and increasing private sector participation are the two major issues of deregulation concept.

Beginning with the electricity sector, economies in Asia are at different stages of privatization and restructuring. Most have introduced some degree of competition in generation by allowing independent power producers to sell to established government utilities, most of which have attained the status of state-owned corporations. Many NE Asian countries have laid out plans to introduce competition in bulk power supply in the near term. China does not show indications of privatizing its electricity sector in the short- and medium-term, but have instituted reforms that merged its electric utilities into a state-owned corporation. China, moreover, has joined the other East Asian economies in introducing wholesale competition. Japan, already served by private electric utilities, has started to introduce retail competition. ROK's vertically integrated utility is also undergoing restructuring and privatization.

Major transitions have also taken place in the oil and gas sector, and national oil and gas monopolies have been the focused of these changes. In China, the government created two vertically integrated oil and gas firms in an effort to restructure the industry. Sector policies have been revised, and investment policies have been made attractive to domestic and foreign investors. Most governments in the region, however, do not fully permit a 100 percent private equity ownership of their hydrocarbon resources. Instead, they enter into different contractual arrangements to ensure a fair share of economic rent on their hydrocarbon resources. China employs production sharing contracts to develop its oil and gas resources while ROK use concessions.[2] The privatization trend is also sweeping the oil and gas downstream sector. In ROK, the national gas transmission and distribution company is slated for full privatization by 2002. ROK has also decided to fully deregulate the oil refining industry.

In NE Asia, Japan and ROK have introduced market-based oil pricing mechanism. In China, petroleum products prices remain regulated and controlled by the government and are heavily subsidized. Because oil is an internationally traded commodity, taxation or tariff duty is an issue. Taxation of oil products has become an instrument to meet fiscal, economic, social, and environmental objectives.

Electricity prices remain regulated by the governments in NE Asia. However, the transition to competitive electricity markets, which is envisioned by many countries in the region, is expected to free electricity prices in the long-term from government intervention. Because of the equity objectives of energy pricing, electricity prices or initial access costs will for some consumers remain regulated or subsidized to ensure that these consumers receive the service.

Unlike oil products and electricity, coal and natural gas remain largely energy commodities for power generation in several countries in the region. In most countries, including China, domestic coal prices have been market-based and follow international prices. Among the exceptions are Japan and the ROK, where a ceiling price is imposed on domestically produced coal, because of their limited production volume.[3]

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[2] The former does not transfer ownership of the resource to the developer, while the latter allow private ownership of the resource.

[3] *APERC (2000).*

Natural gas prices are largely regulated by the government with the objective of promoting gas exploration and development (producer prices) and its utilization (consumer prices).[4] Non-economic pricing prevails in gas rich countries like China, but in the region as a whole, gas pricing is converging to a market-based framework.

3.5 Rural Energy

In many developing countries worldwide, rural areas account for about half of their gross energy consumption. Majority of rural households in developing countries has energy consumption far below the minimum to meet the basic needs. Rural areas depend heavily on indigenous biomass fuels, mainly fuelwood and agricultural residues, and use rudimentary and inefficient technologies. In addition, on average, rural energy is used by households (85 per cent), agriculture (2-10 per cent), and small-scale rural industry sub-sectors and services (less than 10 per cent).[5] In NE Asia, except China, the commercial energy use to rural areas in developing countries is minimal. In China, about 70% population is using biomass for cooking and heating purposes. The annual consumption of biomass comprises 250 million tons of crop stems, and 80 million tons of firewood. If present biomass use were substituted by coal, an additional 200 million tons of carbon would be emitted in China.

In rural areas, the use of biomass fuels, which contribute the largest share of rural energy has several implications on sustainable development such as deforestation, health problems, and associated social implications on rural environment and livelihoods.

Investments in energy sectors of developing countries have focused more on modern energy sector and less on the larger traditional energy sector. Switching to modern energy forms is very expensive and beyond the means of rural people. However, there are energy efficient technologies that can be applied in rural areas (e.g., metering and billing, hybrid systems, small gas turbines, and fuel cells). Furthermore, improving the use of traditional energy and using renewable energy technologies and sources are very important in providing for a more sustainable energy supply in rural areas. Several programs have been undertaken to address the needs of rural areas such as participatory forest management; improved cookstoves on the demand side; and rural electrification programs for an example in China.

4. PROSPECTS OF CDM IN NORTHEAST ASIA

4.1 GHG Mitigation Potential in Selected NE Asian Countries

Since principles, modalities, rules and guidelines for the CDM have not defied yet, it is still uncertain what types of GHG mitigation projects would qualify under the CDM. According to the Article 12.5 of the Kyoto Protocol, potential CDM projects are expected to be those, which would remain unimplemented mainly due to the lack of financial resources in the absence of such mechanism. This implies that, GHG mitigation projects, which are not commercially attractive for investment in the absence of climate change benefits, would be promoted under the CDM. However, based on the trend of climate change negotiations so far, small scale GHG mitigation projects especially energy sector efficiency improvements and

[4] *See for example Pacudan (1998).*
[5] *WEC (1999).*

renewable energy projects will be given priority under the CDM (UNFCCC, 2000; Pronk, 2001).

A number of studies have been carried out to assess GHG mitigation potential from activities, which could fall under the CDM (e.g., energy sector supply and demand side energy efficiency improvement, renewable energy projects). Examples are the Asian Development Bank's Asia Least cost Greenhouse Gas Abatement Strategy (ALGAS) studies for China, Mongolia, Republic of Korea (ROK) and Democratic People's Republic of Korea (DPRK), the Pacific Northwest National Laboratory's study on China, and the First National Communications of ROK to the UNFCCC. Of these studies, the ALGAS provides with most detailed and comprehensive information on the potential of GHG emission mitigation through project activities in NE Asia.

Based on ALGAS studies, we estimate that a total amount of 36,539 million tons of CO_2 could be mitigated through energy sector supply and demand side options in eight Asian countries (i.e., China, Myanmar, Mongolia, Pakistan, Philippines, Republic of Korea, Thailand and Vietnam) during by the year 2020 (see Table 3). More than 90% of which (i.e., 33,661 million tons), is accounted for the NE Asia. The supply and demand side options are estimated to mitigate respectively, 19,160 and 17,379 millions tons of CO_2 emissions in NE Asia by 2020. It is interesting to note that the potential mitigation of GHG emissions from regret and no-regret options is almost same in the region.

Table 3. GHG Mitigating potential of demand and supply side options in selected NE Asian Countries during the 1995-2020 Period

Million tons of CO_2

	No-regret	Regret	Total
Demand side options			
China	15,122	0	15,122
Mongolia	44	22	65
Rep. of Korea	1,208	94	1,301
NE Asia[a]	16,373	115	16,488
ALGAS-8[b]	17,182	197	17,379
Supply side options			
China	0	16,690	16,690
Mongolia	37	2	39
Rep. of Korea	268	176	444
NE Asia[a]	305	16,868	17,172
ALGAS-8[b]	895	18,265	19,160
Both supply and demand side options			
China	15,122	16,690	31,812
Mongolia	80	23	104
Rep. of Korea	1,476	270	1,745
NE Asia[a]	16,678	16,983	33,661
ALGAS-8[b]	18,077	18,462	36,539

[a] *China, Mongolia and Republic of Korea.*

[b] *China, Indonesia, Myanmar, Mongolia, Pakistan, Republic of Korea, Thailand and Vietnam.*

Source: Derived based on information from ALGAS (1999).

Notes *Demand side options include efficient end-use appliances (e.g., efficient lighting, refrigeration, air conditioning, motors, industrial boilers, fans, stoves, vehicle engines, production technologies etc.); vehicle maintenance, mass transportation.*

Supply side options include efficient production technologies in the energy sectors (e.g., combined cycle power plants, Fluidized bed combustion technologies, integrated gasified combined cycle); fuel switching (coal to gas, oil to gas, fossil fuel to hydro or nuclear); renewable energy and reduction of transmission and distribution loss in electricity and gas networks.

The mix of supply and demand side, and regret and no-regret GHG mitigation options are shown in Figures 8 and 9 respectively. As can be seen from the figures, demand side options exhibit higher GHG mitigation potential than that of supply side options in China, while reverse would be case for Mongolia and ROK. About 80% of the total energy sector GHG mitigation would be obtained from no-regret options in Mongolia and ROK, while only less than a half of the total energy sector GHG mitigation would be possible from no-regret option in China. The results should be carefully interpreted here, as the types of GHG mitigation options considered across the countries are significantly different. Moreover, the same options could show significantly different costs across the countries or different locations of the same country as the project costs are influenced by several factors (Timilsina and Shrestha, 2000).

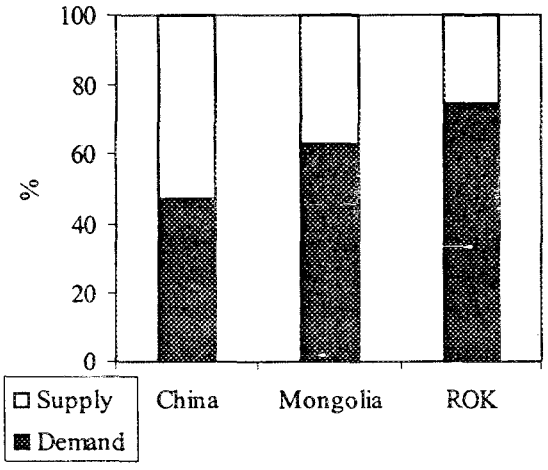


Figure 8. Mix of supply and demand side GHG mitigation options in NE Asia

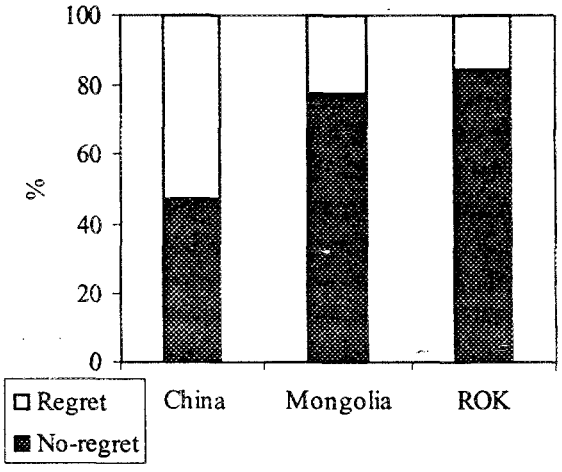


Figure 9. Mix of regret and no-regret GHG mitigation options in NE Asia

The mix of regret and no-regret options in total demand and supply side GHG mitigation potentials are presented in Figures 10 and 11, respectively. As can be seen from these figures, most demand side GHG mitigation options are no-regret types in NE Asia. For example, all demand side GHG mitigation options are no regret type in China, while no-regret options would account for 93% and 67% of the total GHG mitigation potential from demand side activities in ROK and Mongolia, respectively. On the contrary, all supply side GHG mitigation options in China are of regret types. However, almost all the supply side GHG mitigation options are no-regret types in ROK and Mongolia.

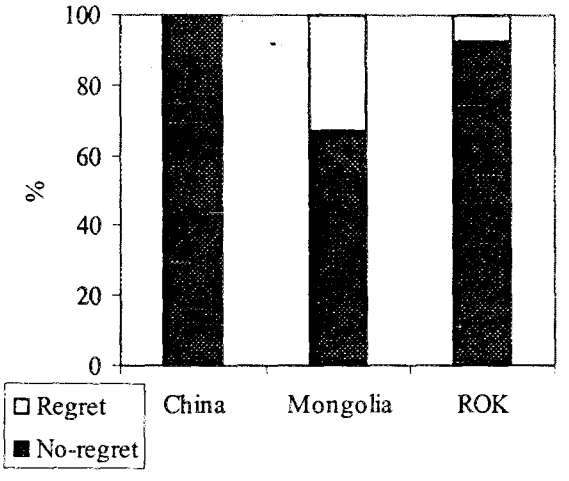


Figure 10. Mix of regret and no-regret options in total GHG mitigation potential from energy sector demand sector supply side activities in NE Asia

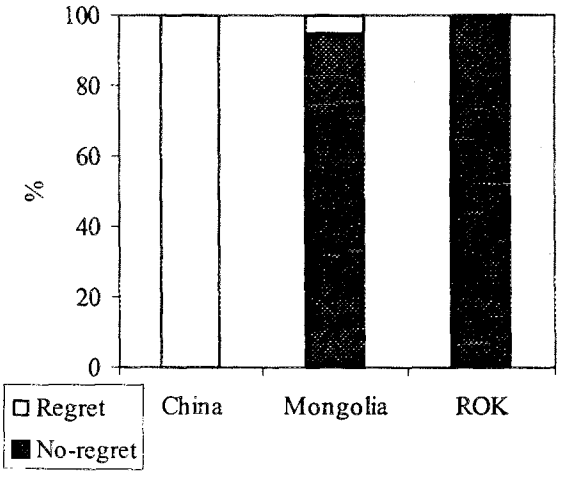
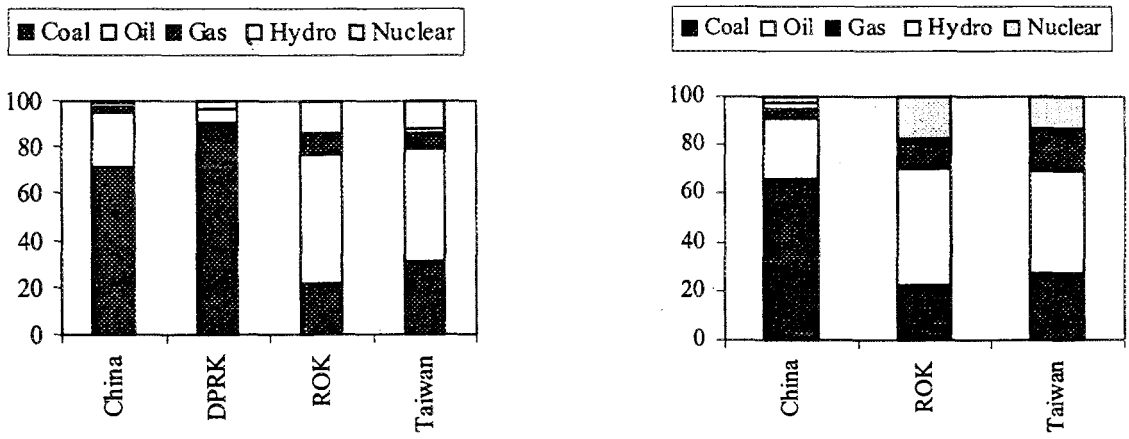


Figure 11. Mix of regret and no-regret options in total GHG mitigation potential from energy sector supply side activities in NE Asia

Besides the project level GHG mitigation activities, fuel substitution at the national level could be another CDM option especially to those countries where main fossil fuels (coal and oil) are mainly supplied through imports. It is interesting to note that 94% of coal and 87% of oil were supplied through imports in ROK in 1998, while oil was entirely supplied through imports in DPRK (see Table 4). It is expected that all oil and gas will be imported in ROK by year 2010. In Taiwan, almost all coal and oil were supplied through imports in the same year 1998 and trend would be the same for year 2010. Note that coal and oil together accounted for nearly 80% of the total energy supply in ROK and Taiwan (see Figure 12) in year 1998. The shares would remain higher then 70% in year 2010 also. Since, these countries have basically to import fossil fuels to meet their energy demand, they could now change their strategies to import less carbon content fuel such as gas instead of high carbon content fuels such as coal and oil in order to meet their energy demand. It could be theoretically possible to reduce GHG emissions through such policy shift under the CDM. However, whether this type of CDM is allowed or not in practice is still unknown.

There are however, a number of barriers to a massive substitution of coal and oil by gas. Timilsina and Lefevre (2001) argues that significant substitution of coal by other fuels under the climate change in countries where coal is pre-dominant in total energy supply (e.g., China and Mongolia), is less likely in practice. This is because domestic productions of other energy commodities are extremely lower as compared to coal in these countries. Moreover, feasibility of a large-scale fuel substitution would depend largely on number of factors such as relative movement of the fuel prices and price of certified emission reduction (CER) units generated from those activities. Since, the additional investments required to change the facilities and equipment in order to trigger a massive fuel substitution at the national could be enormous, the price of CERs would play an important role to make national level fuel substitution attractive under the CDM. Hence, further studies are mandatory to analyze the possibility of large-scale fuel substitution activities under the CDM in NE Asia.



(a) 1998 **(b) 2010**

Figure 12. Primary energy supply mix in NE Asian countries in years 1998 and 2010

Table 4. Net import as % of total primary supply

	1998[a]			2010[b]		
	Coal	Oil	Gas	Coal	Oil	Gas
China	n.e	17	n.e.	n.e.	43	19
DPRK	2	100	-	-	-	-
ROK	94	87	100	98	100	100
Taiwan	100	99	86	100	100	75

n.e. = net export

Source: [a]IEA (2000) and [b]APERC (1998)

4.2 The CDM Market in NE Asia

A number of studies have attempted to estimate the market size of CDM as well as other Kyoto Mechanisms (JI and CDM) at regional and global levels. Examples are: Zhang (2000); Halsneas (2000) and Ellerman and Decaux (1998), Weyant and Hill (1999). Halsneas (2000) estimates that the Annex B countries' total demand for mitigated carbon could be 621 million tons of carbon in 2010, whereas Ellerman and Decaux, (1998) this demand could be 1,312 million tons for the same year. Weyant and Hill (1999) summarize the findings of 13 studies mostly employing global level general equilibrium models on the cost of the Kyoto Protocol. These 13 models show varying sizes of markets for the three flexibility mechanisms under the Kyoto Protocol. For the purpose of demonstrating how big would the CDM market be for NE Asian countries, we present a simple estimation in Table 5.

As can be seen from Table 5, the total Annex B demand for GHG mitigation for year 2010 is estimated to vary from 621 to 1,332 million tons of carbon. As estimated by Timilsina and Shrestha (2000) the total Annex B demand for GHG mitigation for the first commitment period could vary between 11,385 to 24,053 million tons of CO_2. On the other hand, based on the ALGAS studies, we estimate that about 22,889 million tons CO_2 mitigation could be available from three NE Asian countries (i.e., China, ROK and Mongolia) by the end of year 2012. It is interesting to note here that 68% of the total Annex B demand (or the Kyoto demand) for GHG mitigation can be supplied from the NE Asia alone.

There is a continuous debate whether or not would the no-regret options (NR)[6] be considered under the CDM. Studies such as Timilsina and Lefevre (1999a,b,c) and Deshun (1999) argue against the inclusion of NR options under the CDM, while studies such as Renz (1998), Michaelowa (1998) argue for the inclusion of NR options under the CDM[7]. The UNFCCC (2001) has sidelined this issue probably because of its more political nature. Disregarding the debate, if no-regret options are excluded from the CDM, the total potential of GHG mitigation from the NE Asian countries would be reduced to a half (11,341 million tons of CO_2) in the first commitment period.

Table 5: An Estimation of CDM Market of NE Asia for the First Commitment Period of the Kyoto Protocol (2008-2012)

Demand for mitigation (Million Tons)*	
Total Annex B countries' demand for carbon mitigation in year 2010	621† – 1,312‡
Total Annex B countries' demand for CO_2 mitigation in year 2010	2,277 – 4,811
Total Annex B countries' demand for CO_2 mitigation for period 2008- 2012	11,385 – 24,053
Supply of mitigation form NE Asia (Million Tons)	
Total supply of CO_2 mitigation from NE Asian countries by year 2020#	33,661
Total supply of CO_2 mitigation from NE Asian countries by year 2012	22,889
Supply of CO_2 mitigation from NE Asian countries by year 2012 through NR CDM projects	11,341

*Timilsina and Shrestha (2000)
† Halsneas (2000)
‡ Ellerman et al. (1998)
# Excluding Russia, North Korea and Taiwan.

[6] *No regret options are those GHG mitigating options, which are economically feasible even without considering climate change benefits.*

[7] *Please refer to Timilsina and Lefevre (1999a-c, 2000a-b) for more detail account of regret and no-regret debate on CDM.*

Based on the information provided in the national communications, existing studies such as Halsnaes, 2000 estimate that Japan's demand for GHG mitigation to meet its Kyoto commitments could reach 71.2 million tons of carbon in year 2010. Assuming this value as an annual average mitigation requirement for the period 2008 to 2012, Japan's total demand for GHG mitigation for the first commitment period would be 1,425 million tons of CO_2. Ellerman et al. (1998) estimates that if no flexibility mechanisms are allowed, Japan could face a cost of US$584/tC through its domestic mitigation activities. It would cost Japan US$34.4 billion in year 2010 alone. Considering this figure as an average of the first commitment period, the total cost for Japan to meet its Kyoto commitment through the period 2008-2012 would amount to US$172 billion. On the other hand, if CDM is operational in the full fledge thereby creating a situation of global emission trading, the cost of carbon permit would reduce to US$24/tC. Hence, Japan could save US$156 billion or more than 90% of its expected mitigation cost in the absence of Kyoto mechanisms. This clearly indicates Japan's incentives for utilizing the flexibility mechanisms in meeting its Kyoto commitments. Similarly, based on Ellerman et al. (1998) it can also be estimated that China and Russia's gain from full fledge of operation of Kyoto mechanisms during 2008-2012 period would be US$31 and US$21 billion, respectively.

4.3 Some Possible Modalities of CDM for NE Asia

There could be different possible modalities for operation of Kyoto Mechanisms in NE Asia. Some of them are as follows: (i) bilateral cooperation between Japan and Non Annex I NE Asian countries for CDM projects, (ii) multilateral cooperation within the NE Asian region for JI and CDM projects, (iii) bilateral cooperation between Japan and Russia for JI projects and (iv) coopearion between Japan and Russia for emission trading. These modalities are briefly highlighted below:

(i) **Bilateral CDM projects:** Under this modality, Japan could have bilateral cooperation with Non Annex I NE countries, namely, China, DPRK, Mongolia and ROK to implement CDM in the latter.

(ii) **Multilateral CDM and JI projects:** Under this modality, Japan could implement multilateral CDM projects with Non Annex I NE countries. Large-scale energy sector projects such as natural gas pipeline projects between Russia and China or Mongolia, if economically and technically feasible, could be implemented under this category.

(iii) **Bilateral JI projects:** As Russia possesses a high potential of reducing GHG emissions through energy sector efficiency improvements, Japan could implement such projects in Russia under joint implementation schemes.

(iv) **Emission trading between Russia and Japan**: This is more likely cooperation between Russia and Japan. If Russia's hot air is allowed to trade, Japan could further be benefited through the trade of the Russian hot air. However, the issue of hot air is

[8] *No regret options are those GHG mitigating options, which are economically feasible even without considering climate change benefits.*

[9] *Please refer to Timilsina and Lefevre (1999a-c, 2000a-b) for more detail account of regret and no-regret debate on CDM.*

quite political. It is still uncertain how this issue would be resolved. Interestingly, this issue was not much highlighted during the Sixth Conference of Parties in The Hague last November (UNFCCC, 2001).

5. CONCLUSIONS AND FINAL REMARKS

This paper analyses the energy and environmental situation of NE Asia region comprising of China (including Hong Kong), Japan, the Republic of Korea (ROK), the Democratic People's Republic of Korea (DPRK), Russia, and Mongolia and discusses on the implications the clean development mechanism in the region. The region accounts for 27% of world's population and around 20% of global GDP. More than one-fifth of the world's total energy is produced in this region, while one-fourth of world's total energy is consumed. The region contributes one-fourth of global CO_2 emissions. As key energy-environmental policies, priorities have been given to energy conservation, fuel switching, promotion of renewable energy and restructuring of the energy sector.

The region has strategic importance for dealing with global climate change problem. Countries with the largest GHG mitigation potential with relatively cheaper cost (i.e., China) and with most expensive GHG mitigation options (i.e., Japan) are both located in this region. The region also hosts Russia whose actual GHG emission during the first commitment period is expected to be below its assigned amounts, thereby producing so called hot air. With these features, one could perceive significant benefits and market incentives for regional cooperation for climate change mitigation activities in the region.

It is interesting to note that developing countries in NE Asia (except DPRK) could supply 68% of global GHG mitigation demand during the first commitment period of the Kyoto Protocol. This indicates a huge market potential for the clean development mechanism. It is also estimated that China and Russia could have financial inflow of amounts US$31 and US$21 billion, respectively through GHG emission markets. On the other hand Japan could save US$156 billion or more than 90% of its for meeting its Kyoto commitments, through full fledge operation of Kyoto mechanisms. Strong regional cooperation and strategic alliance would, however, be necessary to tap these estimated benefits.

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Session III

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Perspectives of Energy Co-operation in Northeast Asia

Energy Co-operation between two Koreas — *Mr. Woo Jin Chung, KEEI*

Lesson from Energy Co-operation in Europe and its Implications for Northeast Asia — *Mr. E. Ulfstedt, Director, Energy Charter Secretariat*

Financing Energy Infrastructures in Northeast Asia — *Mr. M. Farhandi, Energy and Mining Sector, World Bank*

Energy Co-operation between Northeast Asia and the Middle East — *Dr. A. M. Al-Ghamdi, Economic Advisor to the Minister of Petroleum, Saudi Arabia*

– *Commentator: Dr. G. H. Hassantash, President, Institute for International Energy Studies, Iran*

Energy Co-operation between North and South Korea

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Abstract

In June 2000, the heads of South and North Korea met with each other for the first time in 55 years since the country was divided and announced the South-North Joint declaration which agreed upon fundamental principles for cooperation between two sides. This marked a historic occasion raising hopes of Korean people for ceasing the long antagonism. Since the declaration, many historical progress have been made such as exchanging two rounds of visits by separated families and performances by many artists in Pyongyang and Seoul. Though these social and cultural exchanges are very important in improving the relationship of two sides, inter-Korean cooperation in the economic area is the most efficient tool in building mutual trust between the two Koreas as well as in contributing to an integrated development of the Korean national economy. Actually, many economic issues have been discussed on the government-level of two Koreas and many companies of the South have mapped up the business plans in North Korea after announcing the joint declaration. The energy shortage of North Korea, however, would impede boosting and encouraging the economic cooperation between two Koreas. This situation implies that energy cooperation between two Koreas takes a priority over other investments and trades with North Korea.

In this paper, we discuss the direction of energy cooperation between two Koreas under the special political circumstance and its implications on the economy of the both Koreas and Northeast Asian energy market. We also explore possible areas of energy cooperation that generate mutual benefits and workable schemes, the problems and issues in realizing the energy cooperation.

1. Review on the economic issues between two Koreas since the inter-Korean summit

The joint declaration announced in the inter-Korean summit implies a direction of future relationship of North and South Korea. The main points of the declaration are,

first, to resolve the question of reunification by their own initiative and through the joint efforts of the Korean people. Second, to promote reunification in the direction of a confederation(the South's proposal) or a federation of lower stage(the North's proposal). Third, to promptly resolve humanitarian issues such as exchange visits by separated family members and relatives, and the question of former long-term prisoners who had refused to renounce Communism. Forth, to consolidate mutual trust by promoting balanced development of the North-South economy through economic cooperation and by stimulating cooperation and exchanges in civic, cultural, sports, public health, environmental and all other fields.

As indicated in the joint declaration, increased economic cooperation is of great importance for improving welfare of the entire Korean people as well as the peaceful integration or reunification of two political systems. Combining South Korea's capital and technology with North Korea's labor, economic cooperation between the two Koreas could generate mutual benefits and thereby, promotes balanced growth of the both economies. Taking advantage of inter-Korean cooperation, South Korean businesses can improve their competitive edge in the international market and technological transfer can take place to advance the North Korea industry. Moreover, when the South expands economic cooperation with the North by improving North Korea's industrial infrastructure, including railroads, roads, harbor, communication and power supply facilities, the Korean economy as a whole will be able to enjoy the benefits of the economies of scale as economic growth expands to the entire peninsula.

Since the announcement of the joint declaration, South and North Korea embarked on a joint project to connect the railway between Seoul and Shinuiju(Northern region of the North) and the highway between Munsan and Kaesung. The two Koreas also reached an agreement in four areas, including investment protection and prevention of double taxation which provides an institutional framework for facilitating inter-Korean economic exchange and cooperation. In addition, the two Koreas established the Inter-Korean Economic Cooperation Committee. Besides these cooperation on the government level, private company, Hyundai, has started a development of a large-scale industrial complex, approximately 400 million sq. yards, of land, around the city of Kaesung(Southwest of North Korea, just north of the DMZ).

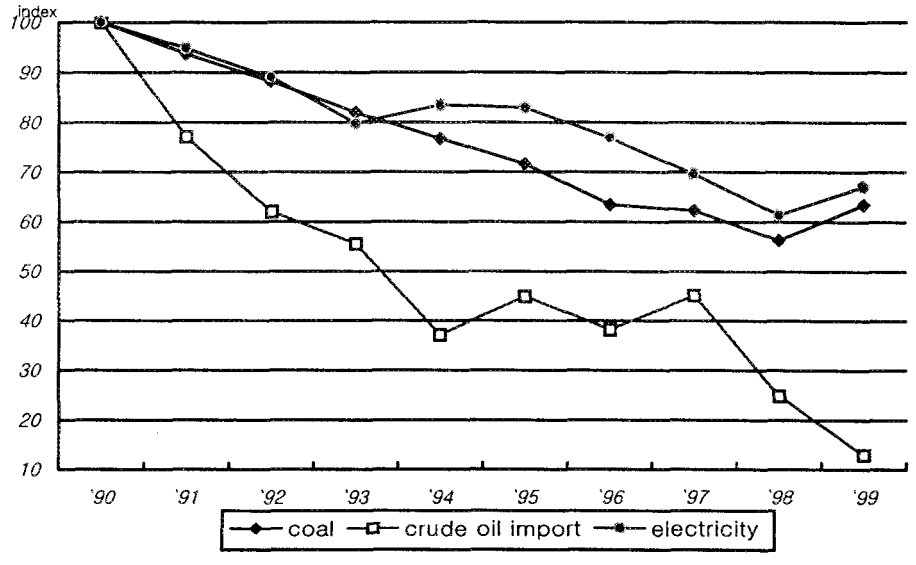
Since the beginning of this year(2001), the dialogues and many exchange programs between two Koreas have been slowed or provisionally stopped due to the negative environments of international politics over North Korea. The future economic cooperation of two Korea would depend greatly upon the political environments. It is anticipated, however, that the relation of two Koreas will be revived soon because the

new U.S. administration is forming more positive policy toward North Korea as time goes by, and many western countries have entered into diplomatic relations with North Korea.

2. North Korean energy situation

North Korea's current energy situation raises serious concerns about the stability of energy supply. The capacity of energy supply has fallen by around half from early 1990. Industrial production in North Korea is regularly interrupted by lack of energy supply, and factories are experiencing difficulties in operation due to irregular voltages as well as electricity shortage.

(Figure 1) Energy supply trends in North Korea



Source: The Korean Ministry of Unification, 2000

Energy supply requires infrastructure investments – in facilities that transport primary energy sources (e.g. pipelines for crude oil or natural gas, grid lines for electricity) and in facilities that convert primary energy sources to the forms suitable for end-uses (e.g., oil refineries, power plants). Lacking such facilities, provision of raw energy will not be able to meet energy needs in the short run. Currently, North Korea's energy facilities are not only insufficient in capacities but the situation is getting worse as the existing facilities keep deteriorating due to recent economic recessions. In order to revamp North Korean energy sector to make it compatible with South Korean counterpart, a

significant amount of cost will have to be expended.

<Table 1> Comparison of energy situations between two Koreas (1999)

	North	South	N:S(N=1)
Total enenrgy consumption(th.toe)	14,955	181,363	12.1
Anthracite production(th.ton)	21,000	4,197	0.1
Refnery capacity(th.BPSD)	70	2,508	34.8
Crude oil import(th.bbl)	2,325	874,090	376
Generating facility(MW)	7,387	46,978	6.4
Generation(billion Kwh)	18.6	239	12.9
Overseas dependency of energy(%)	10%<	97.30%	-

3. The direction and its implications of energy cooperation between two Koreas

As well known, the relationship of North and South Korea comprises politically two governments but historically and racially one nation. The South is forced to aid the North with energy to help escape from current economic hardship, based on a national homogeneity and eventually, to achieve a peaceful harmony and integration of two political systems. The aid of energy, however, is different from the humanitarian aids such as food and fertilizer which the South has often provided North Korea with. Most energy projects to increase energy supply capacity require huge costs that cannot stand comparison with cost magnitude for food or fertilizer aids, which may be burdensome to the South economy. And also, most energy projects need costly succeeding management such as energy procurement and maintenance of facility, contrary to the food and fertilizer aids. For this, the cooperation between two sides that reinforces the energy supply of North Korea to the extent that its economy revives is difficult to be realized, if it does not make economic sense of doing so. Therefore, two Koreas should try to cooperate in various energy fields on a commercial base not only for a restoration of North Korea economy but also for the benefits of the South, so that a balanced economic development of Korean peninsular is attained through a smooth energy supply.

Energy cooperation between two Koreas has various implications. First, it is presumed that the North will have difficulty to free itself from the current economic recession without implementing energy cooperation with the South, because the North is hard to induce foreign investors into energy industry under the current unstable political circumstances. The South's active energy cooperation with the North, on the other hand, would generate and lead foreign investments to the energy fields of North Korea.

Second, a large scale trade and investment between two Koreas could not be boosted and encouraged without solving energy scarcity in North Korea. This situation implies that energy cooperation between two Koreas takes a priority over other economic cooperation, constituting a position of great importance for establishing durable peace on the Korea Peninsula through active economic exchanges. Third, energy cooperation between two Koreas would prompt energy trades with Northeast Asian countries. The region of North Korea is the only land route of the South for importing energy from the continental Northeast Asia. Two Koreas all have a great potential to become the major consumers of the energy produced in the Northeast Asia because they should import almost all their energy requirements. Fourth, the stable politics and reasonable institution in the North are of great importance to attract foreign investors. North Korea would be forced to make institutions more marketable with more stable political system in order to attract the investors for the rehabilitation of energy industry. This implies that energy trade and investments with the South would accelerate the stability in politics and institutions of North Korea.

• Basic strategy

The following perspectives must be taken into account while pursuing energy cooperation. First, efforts should be made in the direction of minimizing the long run cost. While energy cooperation will be very costly for the present, it should also be remembered that energy cooperation lays a foundation for smooth formation of framework for general economic cooperation in the future.

Second, South and North must try to utilize each party's comparative advantage. Generally speaking, South is considered superior in capital and technology while North is considered having advantages in labor and land (i.e., low wage and low rent). Also within energy sector, North and South should try to utilize different geographic and environmental circumstances and different energy balance (demand and supply) structures.

Third, North and South should make efforts to pursue common interest by taking common stands against changing international circumstances. Existing diversity in Northeast Asia offers great economic potential. Korean peninsula, for being located in the middle of this region, is able to play the bridging role for Northeast and Southeast Asian energy markets. If North and South Koreas take advantage of such geographic merits and complement each other in utilizing comparative advantages, it will contribute to both party's energy sector development.

In the following table, we summarize basic framework of energy cooperation between

North and South Koreas.

<Table 2> Basic Framework of Energy Cooperation between Two Koreas

Directions	Contents
Preparation for Economic integration	- Optimization of energy supply structure in the Korean peninsula - Construction of energy infrastructure in preparation for general economic cooperation and integration - Integration of energy system
Utilization of comparative Advantage	- Combination of capital and technology (South) and land and labor (North) - Efficiency enhancement through utilizing structural differences in energy demand and supply and common use of energy facilities
Realization of common interests in Northeast Asian energy market	- Formation of a gateway for Northeast Asian energy resources - Joint Entry into Northeast Asian resource market

4. Possible areas of energy cooperation for mutual benefit between two Koreas

Two Koreas could cooperate economically with each other in energy sector, despite the significant differences in economic conditions. Wide gap in economic scale and different structure in energy supply and demand bear rather complementary conditions in energy sector. These, together with an area adjacency, could derive an efficient energy system for mutual benefits. Through rational trade deals, North Korea can enhance its energy supply capability and South Korea can achieve efficient and economical use of energy.

• The difference in energy structure between North and South Korea

The most urgent energy issue for North Korea is to secure energy supply and expand the energy infrastructures. In contrast, the South faces more advanced issues such as demand management, environment and site problems for energy facilities. In South, peak/off-peak gaps in energy demands are continually getting wider and the needs for peak facilities are growing accordingly. Construction of expensive facilities to meet specific peak season or peak time demand necessarily lowers operation rate and efficiency. Large-scale energy facilities are difficult to find new locations because of resistance from residents and also of high rent.

In addition, more stringent environmental regulation leads to higher cost and excess supply problems of high pollution fuels. In particular, South Korea is experiencing

difficulties in finding demands for its excessive domestic coal (anthracite) and heavy fuel oils, while they are the very needed and important energy sources for North Korea.

<Table 3> Differences in Energy Sector of North and South Korea

	South Korea	North Korea
Energy Industry	- Increasing seasonal differences in energy demand - Difficulty in finding sites for facilities - Rising environmental cost	- Lack of energy supply - Insufficient investment in construction and maintenance of energy facilities
Energy Supply & Demand	- Excess supply of anthracite coal - Excess supply of heavy oil products - Increasing peak demand for electricity and natural gas	- Declining coal production (lack of equipment) - Decreasing oil import with reduced support from FSU and China - Reduced electricity production due to lack of fuels and facilities

• Electricity sector

Electricity trade between two Koreas can generate mutual benefits by the non-coincidental load demands of two sides. The peak season of the South is summer whereas that of the North is winter. In the South, the gap of peak/off peak season in electricity demand is getting wider. The South can also transmit electricity to the North at night when the power facilities are at a low operation, then the North would save hydropower that, otherwise, should be run. The saving electricity at night can be used at daytime. In return for supplying electricity by the South, the North can supply electricity to the South during peak periods of the South. The amount of electricity the North transmits to the South does not have to be tantamount to that supplied by the South in order for such a trade to be economical for the South. This is because, from the South point of view, the electricity transmitted by the North entails high opportunity cost of investing in power plants as it will be used during the peak periods, while that transmitted by the South involves only variable costs including primary energy and operating costs.

Even greater benefits can accrue if the level of cooperation can be elevated to joint construction of power plants in North Korea. The South has to build dozens of power plants in the future. If some of these power plants were to be built in the North, the cost of construction would be much lower than the one in the South due to low costs of land, labor and/or other construction materials that North Korea is able to provide with. In addition, the cheaper energy sources for power generation such as bituminous coal and

heavy fuel oil are more accommodative in the North Korea. The power plants fuelled by such energies are operating at many places in the South. But they are difficult to be newly constructed because of public resistance and strict environment regulation, whereas social problems are presumed to be much less in building such plants in North Korea, Because there is no bituminous coal power plant and only an oil power plant in the North. In South, electricity demands are concentrated in the big cities of northern areas like Seoul while most power plants are located in the middle and southern region where electricity demands are comparably small. The expensive LNG power plants around the northern cities are forced to operate when the transmission lines are congested. Therefore, transmitting electricity to the South from the North would ease the congestion at the transmission lines of the northern area in the South, which can derive the electricity costs down. Sharing the electricity and adjusting the time of transmitting to each other between two Koreas at the joint power plants will enhance their operating rate, from which the both can enjoy low cost electricity.

• **Oil sector**

The demand of heavy fuel oil would grow stronger than that of any other energy sources, if the economy of the North Korea takes off. This is because the anthracite, the largest energy source in North Korea accounting for around 70% of total energy, is not and will not meet the requirement as the conditions of coal mines are getting worse. In South, on the other hand, the current surplus situation of heavy fuel oil will continue in the future as the demand of light oil products increases faster than that of heavy fuel oil, causing the supply and demand imbalance in refined products. Therefore, the South can afford to offer heavy fuel oil to the North at a low price with enjoying lower transportation cost, then the North does not have to expand the costly refinery for meeting the increasing demand of heavy fuel oil. We estimate the South can provide the North with heavy fuel oil, without expanding the current refinery capacity by the year 2010 or 2015, depending on the future demand of North Korea.

As the imbalance of light and heavy oil products is getting wider, the oil industry of the South will be forced to expand the cracking capacity until the year 2010 in order to meet their demands. This will become a significant challenge to oil industry of the South because the cost of cracking facility is very high, around 9 times as high as building crude distillation facility in the South. Two Koreas could yield beneficial outcomes, however, if they construct and operate jointly the cheaper crude distillate refinery in the North and supply much of light oil products refined to the South and heavy oil fuel to the North where its demand is expected to rise strongly. For the South,

the joint refinery would give the benefit of delaying a high investment for cracking facility for a long time and can enjoy the secondary benefit of low land cost and resolving the increasingly difficult problem of finding sites. For the North, the financing to build refinery would be eased substantially by the participation of the South, which contributes to the smooth conversion of its energy structure from coal to oil.

Joint refinery would not be required within a short time because current surplus situation of refinery capacity in South is projected to continue for some years. But two Koreas need to hurry up preparing to build refinery from now on to meet each future requirements because it take a long time to plan, search for location and construct refinery.

• LNG sector

LNG is an expensive energy and it requires huge investment in constructing the infrastructure such as pipeline and terminal to be supplied to consumers. The income of North Korea is not expected to rise enough to use the expensive LNG for a long time even if its economy stands to take-off now. Moreover, the densely populated cities and industry complex of North Korea such as Pyongyang and Nampo where LNG infrastructure would have economic efficiency are located in the Northern area of North Korea, while most cities are sparsely populated between Ilsan(around 20km from DMZ, the end point of LNG trunk line in South) and those major cities and industry complexes of the North, a distance of around 200km. This situation makes little economic sense for the projects of connecting the LNG pipeline from South to North.

But, two Koreas could make the some arrangements that provide mutual benefits in supplying LNG from South to North. For example, the project of connecting the pipeline from the South to the North is viable, if the North develops a large scale industry complex at the areas adjacent to DMZ and uses LNG in summer(and use other energy sources like the heavy fuel oil at other seasons) at this complex. The construction cost of pipeline would be comparably lower due to a short distance from the end point of trunk line of South to the complex. LNG can be supplied at a cheaper price since the South saves the cost of LNG storage tanks that otherwise need to be constructed to store LNG in summer to adjust a seasonal imbalance of demand and supply. In South, LNG is consumed very high in winter and very low in summer while it is evenly imported throughout the year from overseas.

• Anthracite coal sector

The government of South Korea has bought the anthracite coal from the producers at a

price that subsidizes the cost of production to support the miners and with few consumers, has been forced to store it. Around 10 million ton of anthracite coals are in storage in South, including 7 million ton of government stored coal. Therefore, the South could offer these coal at a very low price to the North where needed. In particular, the stored coal would significantly contribute to increase electricity supply within a short period because the current situation of electricity shortage in the North has been caused mostly by lack of coal for generations.

• The cooperation in Northeast Asian energy market

The participation of North Korea in pipeline natural gas(PNG) projects of east Russia-South Korea would provide opportunities for mutual benefits as well as enhancing the feasibility of the project. First, the routes of East Siberia or Far East-South Korea would be shorter and avoid the costly sea line that otherwise, should pass through for the South to import natural gas from East Russia. Second, the Northeast Asian PNG project requires huge sum of money and has the economies of scale. Therefore, additional consumption by participation of North Korea would enhance the economic feasibility of PNG project. Third, the PNG project could be more economical, if North Korea plays an important role in adjusting the demand and supply of natural gas with South Korea and/or other countries where the pipeline passes through. To the North, the natural gas pipeline would greatly contribute to the construction of infrastructure (trunk line) at a very low cost and without the pains of fund raising and consequently, a fast transformation into the advanced energy structure.

Without passing the North Korea, the South cannot trade the electricity with China, Russia and Mongolia. Therefore, the North is an important partner of the South for the electricity cooperation with Northeast Asian countries.

5. Workable schemes and issues in energy cooperation between two Koreas

In spite of the great potential for energy cooperation between the North and the South as discussed in this paper, it would be very difficult to actualize the mutually beneficial energy businesses between two Koreas in the near future. This is because the current economy of the North is actually at a situation of crisis with seriously aging infrastructures in most fields of industries as well as energy industry. In fact, what the North urgently needs is energy supply aids and restoration of obsolete energy facilities to escape from the economic hardship, rather than commercial trades with South Korea in the energy industry.

Current energy crisis of the North is not from the scarcity of energy facilities but from their low operation rate due to the aging of those facilities and insufficient providing with primary energy and spare parts. The power generations and refineries are estimated to run only 20-30% of their capacities in North Korea. This implies that the rehabilitation of the existing energy facilities and procurement of energy to run them are more contributory to escaping of economy crisis in North Korea rather than new energy facilities that takes a long time to construct. Therefore, the South and North should begin their energy cooperation with repairing and improvement of existing power plants, refineries and coal mines of North Korea and procurement of parts and energy sources to run them.

Beyond the political issues, most serious barrier facing South Koreas in energy cooperation with the North is how to finance the investment in the energy facilities of North Korea and recover the cost of the energy projects from North Korea. The foreign companies as well as the South companies usually invest in North Korea to manufacture commodities aiming at the outside market of North Korea. So, they recover their investment costs from out of North Korea. In the case of energy, almost all costs invested in North Korea have to be recovered within the North Korean market. This will discourage the a large scale investment to energy fields of North Korea due to its inability of repayments for huge cost invested in market or government under the current economic situation. This is and will be most significant issue that impedes the investment to energy industry of North Korea. And without resolving these problems, a large scale business will also be discouraged and the economic recovery of North Korea would be unattainable, and furthermore, this would affect to a political issues of Korean peninsular. Therefore, the North and South should try, first of all, to resolve the problem of financing and reasonable cost recovery of the investment of energy industry in North Korea for the political as well as economic matters. International banks and funds could play an important role to finance for improving energy infrastructure of North Korea. But they are volatile to the political environments and not expected to distribute enough for the rehabilitation of energy industry because there are too many economic sectors that need the international funds in North Korea.

In this paper, we are to suggest a few ways to cope with this difficult issue. First, South Korea begins with the power supply projects to North Korea in the limited regions where there are higher chances of cost recovery. These are the regions such as the foreign industry complex and special economic zone or South Korea's industrial complex in North Korea like the Kaesung complex which Hyundai is developing to attract the manufacturing factories of the South. This limited energy zone-or limited

economic zone- could attract investors for the power plants with the advantages of low costs of land and labor and the South can transmit electricity to the zone on a commercial base. This zone would become the strategic district that starts an engine of North Korea's economy. This way, however, requires the active policy of the North Korea government to concentrate the companies that can pay for the energy prices into a limited zone. Another way for cost recovery is to establish the, so called, "energy liquidation account" between two governments. This is to offset the energy costs invested in North Korea in a lump sum with the tax, other public costs such as rent and energy fee, royalties and many others that South Korean companies in doing business in North Korea have to pay to North Korea government every year. If liquidation money that North Korea should offsets is insufficient, the investor's cost could be recovered in account first and later, offsets the cost with a reasonable interest rate. The account can borrow money from international or South's banks. Recovering the costs for energy investments in the account, the investments for the energy infrastructures in North Korea are promoted and then, the investment activities of the South companies over the whole industries of North Korea would be encouraged. The more economic activities of South Korean company increases in the North through the stable energy supply, the larger the account fund and energy investments in the North are promoted. This way, however, requires the South companies doing business in the North compulsory participation in the account. The South companies should send the money that they have to pay to the government of the North to the account. Therefore, the law should be enacted to operate the account in the South as well as agreement between two Koreas. The foreign companies can join the account but need the agreements of government with the North and South, so that the companies of the agreement country doing business in the North have to participate in the account as the South companies do.

The ways for cost recovery discussed in this section would be more encouraged with the information exchanges between the companies that want to invest in the energy business and the companies that hesitate to invest in other business due to the energy problems in the North Korea. For this, the joint government agency is needed to assemble and arrange the companies that want to invest in energy and other business in the North. If the "energy liquidation account" is established, its operating agency would be suitable to do those kind of arrangements

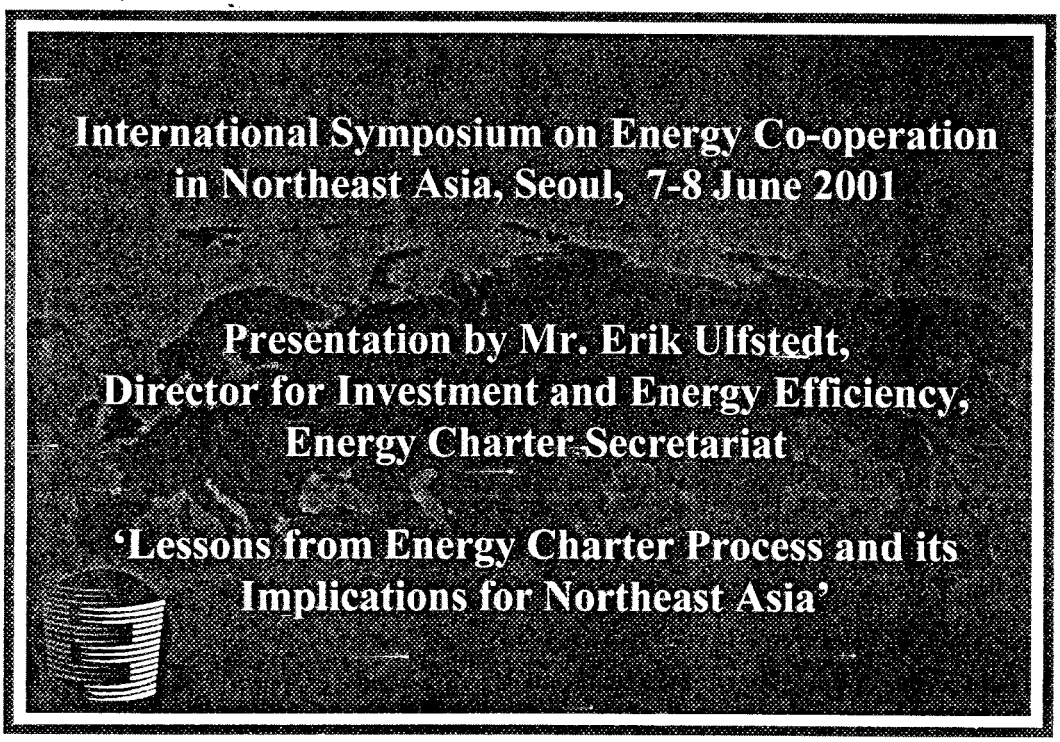
6. Conclusion

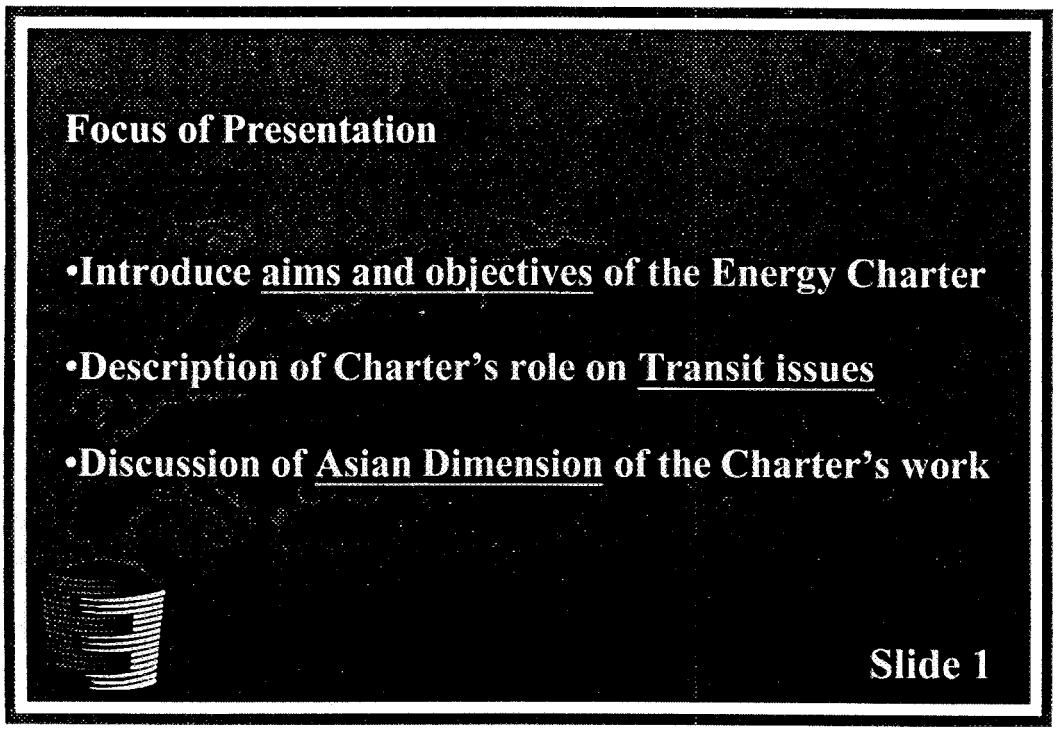
As have been sketched in the previous sections, energy is a cornerstone not only for the

economy revival of North Korea but also for encouraging the economic cooperation between the North and South. And furthermore, active energy trades and investments between two Koreas would significantly promote the reconciliation, peace and prosperity of Korea peninsula. But it is one of the most difficult tasks for two Koreas to implement because it requires huge investments and is considerably affected by the political circumstances toward Korean peninsular. This implies that energy cooperation between two Koreas is not the matters of only two Koreas and could not be implemented by two Koreas themselves. The potential of North Korea's energy market is great in the international energy business point of view because the demand of energy is anticipated to grow very fast and almost all growing energy have to be imported, if the economy of North Korea is to take off. To realize this potential, it is needed that international society, specially neighboring countries and international funds, participates in the rehabilitation of North Korea's aging energy infrastructures at an initial stage, so that North Korea starts an engine of economic take-off.

Two Korea will realize higher mutual benefits through the links of theirs energy cooperation to the Northeast Asian energy markets. The both sides can reduce the cost of building power plants and get more electricity through the grid interconnections and swapping electricity with Northeast Asian countries. With interconnecting of Northeast gas pipeline to the Korean peninsular, North Korea can facilitate the building of transmission line and promote the consumption of clean energy. The South can also reduce the import cost of gas by the shorter land route and further, adjusting the demand and supply with the North. On the other hand, most Northeast Asian energy projects will be more promoted and their benefits are enhanced by the participation of the North as well as the South.

For the benefits of North Korea itself, the North have to try to establish reasonable institutions and make the political system stable in order to induce investors and traders to the aging energy industry of North Korea.


International Symposium on Energy Co-operation in Northeast Asia, Seoul, 7-8 June 2001
Presentation by Mr. Erik Ulfstedt, Director for Investment and Energy Efficiency, Energy Charter Secretariat
'Lessons from Energy Charter Process and its Implications for Northeast Asia'

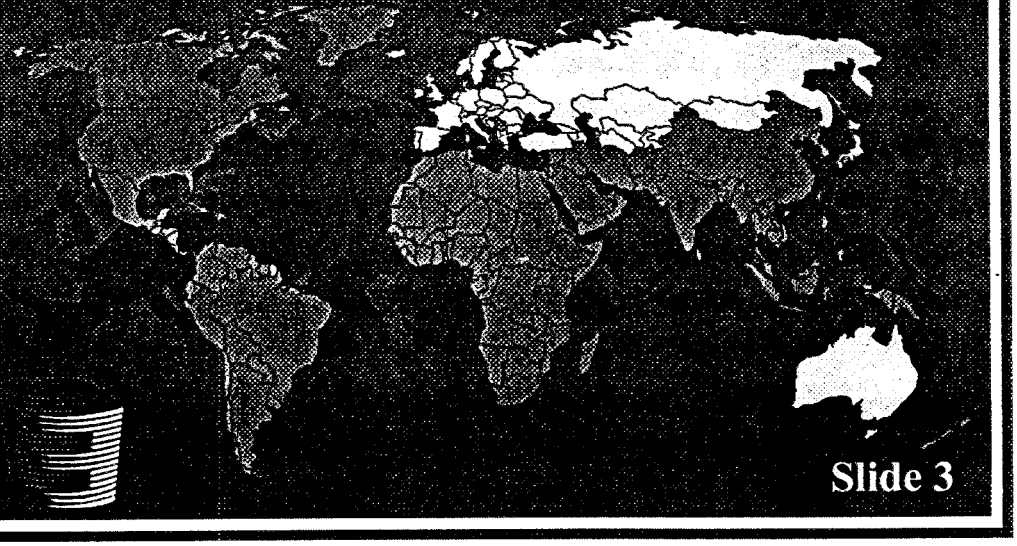

Focus of Presentation
•Introduce aims and objectives of the Energy Charter
•Description of Charter's role on Transit issues
•Discussion of Asian Dimension of the Charter's work
Slide 1

Origins of the Energy Charter:

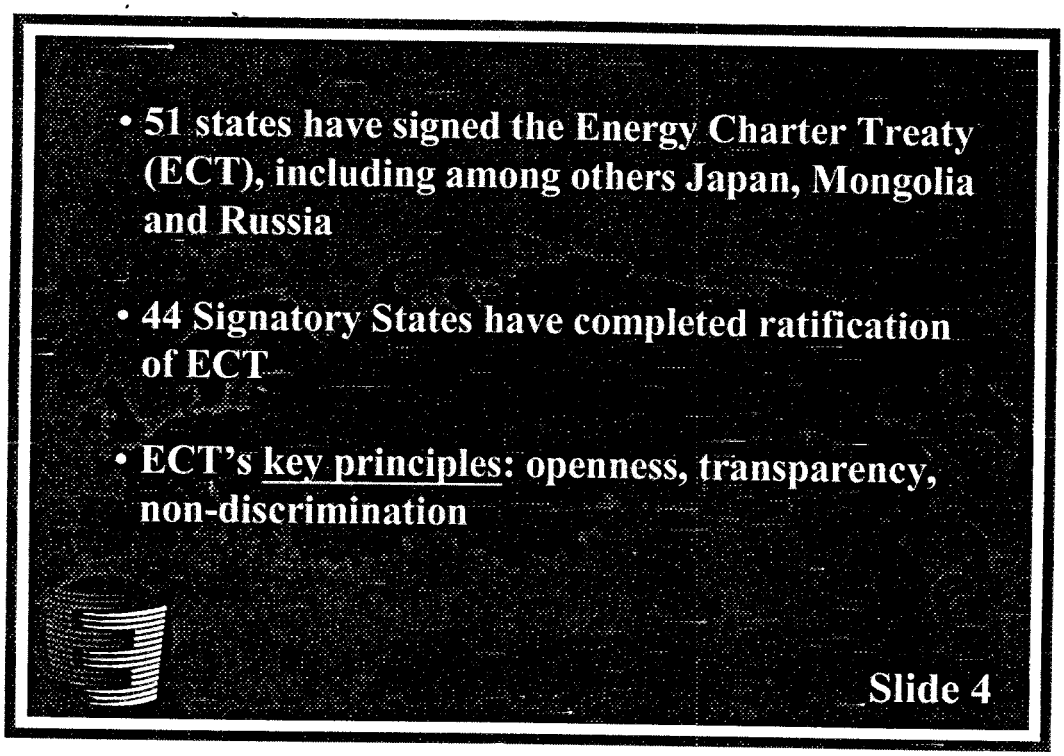
- New opportunity for East-West energy cooperation post-USSR
- Aim: to overcome absence of international legal framework (e.g. for foreign investments) in CIS states

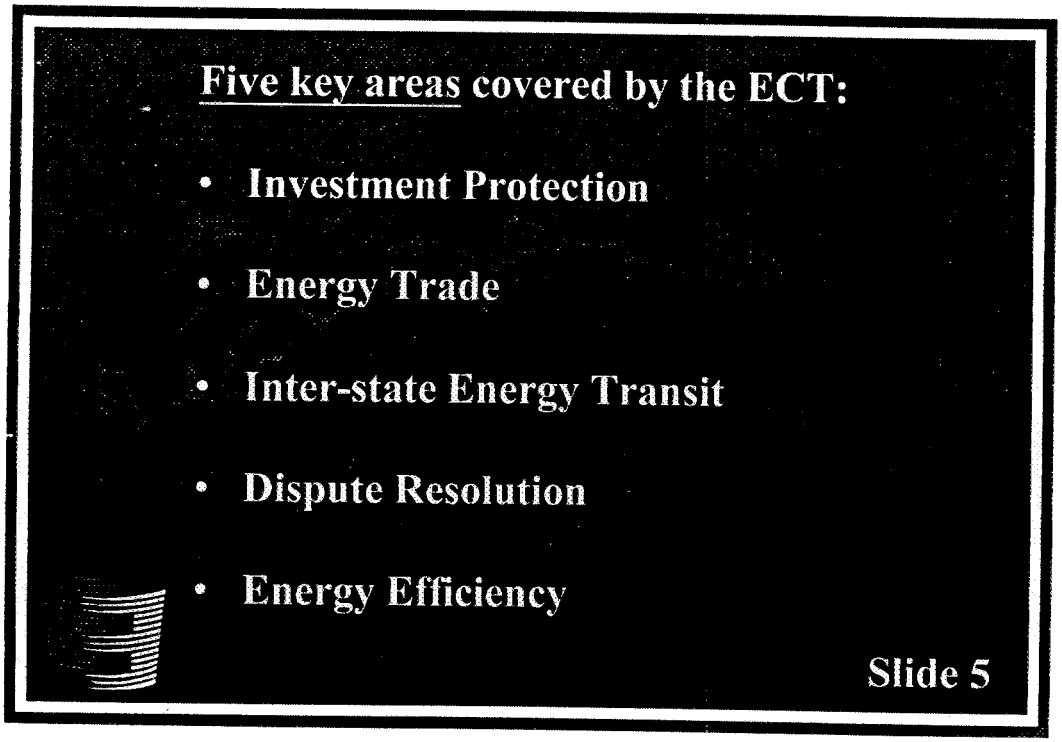
Slide 2

Member States of the Energy Charter Process



Slide 3


• 51 states have signed the Energy Charter Treaty (ECT), including among others Japan, Mongolia and Russia
• 44 Signatory States have completed ratification of ECT
• ECT's key principles: openness, transparency, non-discrimination
Slide 4


Five key areas covered by the ECT:
• Investment Protection
• Energy Trade
• Inter-state Energy Transit
• Dispute Resolution
• Energy Efficiency
Slide 5

- Participation in Energy Charter conveys strong political message
- Enhances national investment climate as perceived by international community
- Since 1998, focus placed on implementation of ECT's provision

Slide 6

Implementation on Investment Issues:

- Monitoring phase-out of non-conforming measures
- Country Reviews of Investment Climate
- Market Restructuring: reports and recommendations (e.g. on tackling non-payments)

Slide 7

Implementation on Energy Efficiency:

- Energy Charter provides policy forum for information exchanges
- In-Depth Energy Efficiency Reviews of Slovakia, Lithuania, Poland and Hungary

Slide 8

- Energy Charter not only a legal foundation for cooperation
- Also serves as a policy forum for exchanges among its member states

Slide 9

Energy Transit:

- Growing consensus after 1994 that ECT's transit rules should be expanded
- Legacy of transit-related problems in the former USSR
- Aim – to establish clear 'rules of the game' for transit flows

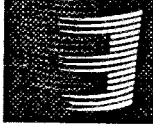
Slide 10

- Energy Charter Transit Protocol: Negotiations launched in early 2000
- Key features:
  -No interruptions of transit
  -Reasonable, objective transit tariffs
  -Non-discriminatory access to available capacity
  -Due regard for supply needs of transit states

Slide 11

Expansion of the Energy Charter:

- An open process – not limited to Europe
- «Asian Dimension» - Russia, Japan, Australia, Mongolia, Central Asian states are members



Slide 13

Observers:

- United States, Canada
- Algeria, Morocco, Tunisia
- Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE
- BASREC, BSEC, EBRD, EIB, IAEA, IEA, OECD, UN-ECE and the World Bank

Dialogue with P.R. of China (PRC):

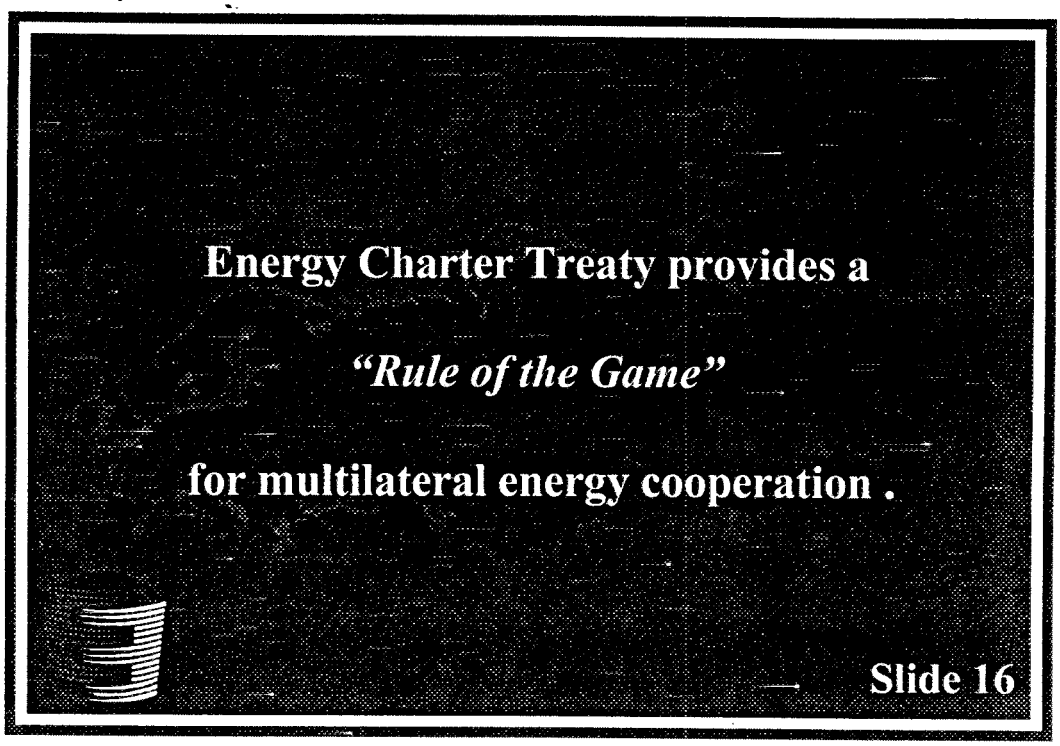
- Clear interest of Energy Charter in closer ties with PRC
- ECT translated into Chinese
- Workshop on ECT in Beijng in July 2001, together with State Developing Planning Commission of PRC

Slide 14

How ECT can contribute to energy security in Northeast Asia?

- provide legally favourable environment for investment in transitional economy countries
- Serve as a basic rule of cross-border transportation of energy

Slide 15


Energy Charter Treaty provides a
"Rule of the Game"
for multilateral energy cooperation .
Slide 16

Financing Energy Infrastructures in Northeast Asia

M. Farhandi
Energy and Mining Sector,
The World Bank

I. Overview

A. Size of the Required Investment

___Assessment Complexities

- Estimating the size of the required investment goes beyond forecasting GDP, evaluating elasticity of demand, and even identifying the investment needs of individual countries in the region.

- Future investment need is influenced by factors such as national energy policy on security/diversification of supply, extent of competition, the role of the private sector, and the development of domestic capital market.

___Range of Values

- According to one estimate, the required investment for the power sector alone in the region, for the 15 year period between the pre-crisis and 2010, would have been about US$1 trillion.

- The Bank data shows that for the period 1990-1996 the total investment in East Asia region in those energy projects with private sector participation was slightly over US$60 billion, of which about 80% represented greenfield projects. The investment peaked in 1996/1997, to about US$12 billion per year.

___Conclusion

- By any measure, the future investment needs of the region for energy infrastructures to meet its growing demand would be substantial.

B. Regional Context

Uncertainties Over Economic Prospects

- Investors' confidence is still low, in part due to slow pace of restructuring in corporate and financial sectors.
- Total public debt is high, ranging from about 120% of GDP in Japan, to 40% in Korea and 30% in China.
- The slow down in global economy will further constrain the recovery, given the region's heavy dependence on export to US and Japan.
- On the positive side, many of the adverse macroeconomic factors which contributed to the crisis, are either no longer there or have been significantly reduced.

GDP Growth

- Over the next two years, China's GDP is estimated to grow at 7%-8% per year, ROK's at 4%-5%, Japan's at 1.2%-1.7% and Mongolia's at 1.2%-3.3%.

Mitigating the Adverse Impacts

- Accelerating the restructuring of the corporate and financial sectors, deepening trade reforms and regional integration, and managing the public sector debt prudently will be the key factors in mitigating the adverse impacts of these vulnerabilities and leading to a broad-based recovery.

II. Developing the Enabling Framework

A. How Best to Meet the Required Investment Needs--Given its Large Size and the Regional Vulnerabilities?

___Cooperation Between Public and Private Sectors

- Central to meeting this investment need is the close co-cooperation between the public and the private sectors---because public sector alone cannot (and should not) finance this size investment, and, in most countries of the region, the private investors would not venture alone due to perceived or real risk and due to the government's role in the sector.

- And, there is a lion's share of investment needs that could be met by the private sector: although the net flow (for all sectors) of private funds rose from US$44-US$244 billion during the period 1990-1996, despite this tremendous growth private investment for the period represented only 15% of the total investment in infrastructure in developing countries.

___Capital Inflow

- The issue is not whether the global capital market has the capacity to meet this investment need, but how to facilitate the inflow of that capital into the region in a manner which is economic and sustainable.

___Enabling Framework

- The key to closer cooperation between the public and the private sectors is to develop the enabling framework that promotes the flow of private capital into the region in an economic and sustainable manner.

- This requires (a) improving the policy framework; (b) dealing appropriately with risk allocation and management; and (c) developing sound financing structure.

B. Improving Policy Framework

___High Cost of Inadequate Policy Framework

- The economic cost associated with lack of a policy framework which allows the entry of private investors into energy infrastructure services is very high.

___Key Elements of a Sound Policy Framework

- The basic criteria for a sound policy framework to attract private investors on an economic and sustainable basis is to meet the interests of government (acting on behalf of the public), investors, sponsors, lenders, civil societies and other stakeholders.

- The framework should therefore include clear policies on: (a) transparency, on part of both the government and the investors, including public disclosure of the relevant information; (b) pursuing stable macroeconomic courses, including liberalizing the capital market; (c) establishing good legal and regulatory framework; and (d) addressing issues of concern to the private investors, such as foreign currency availability and convertibility, ownership requirements, asset security, rational pricing policy for energy products, dispute resolution mechanism, and adequacy of institutional capacity to coordinate inter-governmental activities related to the investment.

C. Dealing with Risk in Energy Infrastructure Projects

___Nature of Risks

- While private sector participation reduces the budgetary constraints on the governments and leads to developing new energy infrastructures, in many developing countries this does not translate into transfer of the corresponding risks to the private investors. Significant residual risk remains with the government, in form of real and/or contingent liabilities, often eroding the value-added brought about by the private investors participation.

- These risks can broadly be classified into Political and Regulatory Risks; Demand and Construction Risks; Payment and Exchange Risks; and Implied Risks.

- The development of appropriate policy framework discussed in previous section helps significantly to reduce these risks

___Need for a Risk Management Framework

- To ensure the sustainability of the private participation in the sector, there is a need for sound policies on risk allocation and management.

___Principles of Risk Allocation

- Some of the countries in East Asia region have had to bear the heavy cost of an "imbalanced" risk allocation. In many industrialized

countries the private investors take virtually all the risks. Although risk sharing in some of the countries of the region is warranted, the risks need to be allocated appropriately.

- The principle of risk allocation involves two key criteria (a) allocating the risk to the party which has control over the risky outcomes; and (b) allocating the risk to the party which has the ability to bear the risk at the lowest cost.

- Tradeoff exist in weighing the benefits on whether to allocate the risks to those who can control the risky outcome, or to those who can bear them with the least cost.

C. Dealing with Risk in Energy Infrastructure Projects (continued)

___Some Suggested Risk Allocation Guidelines

- Political and Regulatory Risks: Generally, the common political risks remain with the governments. The regulatory risks are more difficult to allocate and need to be assessed on a case by case basis to determine whether it would be more beneficial to be born by the government or by the investors.

- Demand and Construction Risks. The construction risks should in general be born by the investors. In many cases, the demand risks should also be born by the private investors.

- Availability and Convertibility of Foreign Currency. These should generally be born by the governments.

___Managing and Budgeting for Risks

- Governments need to consider how to measure the risks and incorporate them into account and budgets. In this regard, government guarantees need to be identified and listed.

- Expected losses need to be calculated and incorporated in the accounts and the budgets.

D. Structuring and Mobilizing Financing

___Energy Infrastructure is Different

- Energy infrastructure projects usually have a long gestation period, and require large upfront investments that takes 20-30 years to recover. Over such a long period, the investors are exposed to a variety of risks.

- Energy infrastructure projects usually include substantial foreign financing, and thus carry the exchange risks.

- The energy infrastructure provides the essential services to the consumers (electricity, gas), and therefore price changes are usually politically sensitive. Pressure by consumers to keep the prices low, frequently leads to a price level which is below the cost recovery.

___The Newly Emerging Financing Mechanisms are Different

- Many of the energy sector entities have opened up to private investors, resulting in shift in ownership and in development of competitions, which in turn have altered the financing structure.

- The sector entities have also shifted the source of their financing, from public to private, and in some of the countries from foreign to local.

- In addition to traditional sources of funding (i.e., equity, commercial bank loans, export and supplier credits, governments, multi-nationals and bilaterals), there are now new financing sources such as insurance companies, pension funds, as well as various international and domestic bond markets.

___The Principle of Financing Structure

- Irrespective of the type of financing, the structure of financing should be based on the principle that the long-term consumer prices should cover the capital and the operating costs of supplying energy to the consumers.

III. Country Specifics

A. China

Energy Consumption and Growth

- China presently consumes about 8.5% of the world total energy consumption, but yet its per capita energy consumption is only 7% of that of U.S. Electricity consumption is expected to grow at 5.5% per year for the next 20 years. Future energy consumption is expected to increase substantially.

- The mix of primary energy is expected to continue to be governed by national energy policy, with coal continuing to play a major role. The development of hydro and nuclear would likely stay in the hand of the government, thus being developed at a relatively slower pace because of the heavy cost involved and government's financial constraints.

Sector Reform

- Progress to date in sector reform in both oil and gas, and in the power sectors have been substantial, but it still needs long way to go as there is a need for new generation of reforms.

Investment Needs and Source of Financing

- The size of future investment requirements will be large in all sub-sectors, with electricity alone being estimated at US$8 billion a year to meet the demand.

- Two obstacles exist in attracting private investors; (a) unclear legal framework; and (b) provincial governments guarantees are not acceptable to many of the private investors.

- The financing of energy infrastructures in China will be dominated by the public sector (directly or indirectly) in the medium term, but will gradually shift to the private sector over the next 20 years. Further, because of the private investors' preference for quick pay back, nuclear, hydro and clean coal technology will not attract major private funding.

B. Japan

National Energy Policy

- Japan's energy policy is driven first by national strategy and then by financial considerations. The thrust of the strategy is based on security of supply, diversification and environmental impacts.

Source of Financing

- Japan's source of funds for meeting its future energy investment needs is virtually all from internal resources, namely the utilities' internal cash generation and corporate-based borrowing. This represent an ideal way to fund energy projects in that there is a heavy reliance on the domestic capital market, and the costs of services are fully recovered from the consumers.

C. Republic of Korea

Energy Consumption

- Korea consumes about 2% of the world total energy consumption and its per capita consumption is half of that of US. Electricity demand is expected to increase at about 3% per year for the next 20 years.

- Korea's energy policy is based on least-cost supply options, but it is also heavily influenced by security, diversification, and environmental considerations. Korea's energy strategy should be commended with respect to environmental consideration, given that the county has been willing to make huge investment in infrastructure solely based on imported LNG, in order to introduce cleaner fuel into the country.

Sector Reform

- The legislation for restructuring Kepco was passed last November, and this should pave the way for planned privatization of the thermal power plants this year.

Source of Financing

- Financing of energy projects in Korea has shifted significantly over the past 10 years, from government and government-based borrowing to corporate-based commercial borrowing, and particularly shifting to the domestic market. This trend is expected to continue.

D. Democratic People's Republic of Korea

Energy Sector

- DPRK relies on coal and hyrdo for most of its commercial energy needs. It has one of the highest energy intensity in the region, at about 71,000 btu /$(1990), compared with 34,000 for China, 17,000 for ROK, and 14,000 for US. Its electricity generation is half coal-based and half hydro-based, although with coming on stream of KEDO project this proportion would obviously change.

Source of Financing

- DPRK needs substantial investment for rehabilitation and retrofitting of its energy infrastructures. However, financing may be difficult as the domestic market resources may not be sufficient and the external financing is not easily available. Once the political situation permits, during the initial years the DPRK's investment needs may have to be met mainly by the multi-nationals and bilateral financial assistance.

E. Mongolia

- Mongolia's investment needs for the next several years continue to be dominated by major rehabilitation and efficiency improvement of its existing energy infrastructure, particularly its combined heat and power units which are critical to the country's energy supply.

- Mongolia has taken several key steps towards rationalizing the pricing structure of energy products, restructuring the sector and moving towards attracting greater private sector participation . However, the public sector is expected to continue to play the dominant role either by providing direct financing or facilitating the sector's borrowing by guaranteeing the loans.

IV. The World Bank Group Financing Instruments

___IBRD Loans

- Investments
- Structural Adjustment
- Sectoral Adjustment
- Adaptable Programming Loan
- Partial Risks and Partial Credit Guarantee

___IDA Credit

___IFC Loans

___MIGA

V. Closing Remarks

- The energy consumption in Northeast Asia is expected to grow significantly over the next 20 years, even under a conservative scenario.

- The investment needs for energy infrastructures in the region would be huge by any standard—estimated to be US$70-US$100 billion per year.

- This size investment would have to be met by a combination of public and private sector participation, gradually moving away (over the next 20 years) from significant public participation presently seen in countries such as Mongolia, DPRK, and China, towards full private sector involvement such as those in Japan.

- In mobilizing the financing to meet the required energy investment needs, the goal can best be achieved through development of solid policy framework (including competition), appropriate policies for risk allocation, and a rational pricing structure based on which the long-term consumer price pays for the total capital and operating costs of supplying energy to consumers.

- During this period, the newly emerging financing mechanisms would increase the role of the commercial banks and institutional investors to cover the debt portion. More IPPs (with appropriate risk sharing arrangements), issuing of the shares to the public, and industrial cogeneration would increasingly cover the equity portion.

- The new financing mechanisms would also tend to shift away from nuclear, hydro and clean coal technology, towards thermal generation, namely gas when available, and then coal and then oil. This is because of the high capital costs, long construction time, heavy safety and environmental regulations and resettlement issues usually associated with these projects. Thus, it is expected that nuclear and hydro would remain in the hand of the government in Japan, Korea, China, and DPRK.

- Therefore, by default, coal, natural gas (to the extent available or economically imported to the region), and oil will play the dominating role in the region's energy supply; that is, to the extent that the private investors are involved.

East –West Asia and the Oil Link

Dr. Ahmed Al Ghamdi
Economic Advisor to the Minister of Petroleum,
Saudi Arabia

It is obvious that oil is vital to the economic development and prosperity of oil exporters of West Asia and oil importers of the East. Oil is a common factor, which both sides share and links them closely together. As such. It is important and helpful that they can meet on such an occasion as this and engage in a frank and hopefully constructive dialogue. There is a strong mutual interest and the two sides need to hear and understood each other's point of view.

I will try in this presentation to cover some key issues related to the oil link between West Asia and East Asia and the importance of these links today and in the future.

Asia is the main producing and second consuming continent of oil. Production of oil is mainly concentrated in West Asia while consumption is in the East. Each oil producing and oil consuming nation in Asia is a trading partner of the other. To day the countries of Asia consume more than 20 MBPD or about 20% of world's total production, and most of it is supplied by Asian countries of the Gulf. Oil exports from these countries to the rest of Asia have been growing steadily over the years as a result of growth in demand of these countries. It is likely that growth in demand for oil in Asia will continue as a result of the expected high level of growth in the economy of this continent, and improved living standards. It is estimated that demand of Asian countries will be about 30 MBPD in the year 2010. It will, therefore, be the major consuming continent in terms of oil consumption.

In the production side, Asia is producing about 25 MBPD, about 40% of the world's total, with about 4 MBPD spare capacity and about 66% of world's reserves.

Most of that is concentrated in the Gulf countries with economies of very similar productive structure, where oil sector generates most of export receipts and budget revenues. The strong performance of this sector in the Gulf countries has a positive impact on imports from their major trading partners including those of East Asia. Growing demand on these markets for Gulf countries hydrocarbon resources has played an important role in sustaining the pace of growth in the Gulf countries economies.

East-West Asia trade has grown significantly in the last twenty years. West Asia imports from the East increased dramatically over the same period for the fact that West Asia suppliers were successful in maintaining competitive prices. However, analysis of trade flow between the two areas indicates that, the West imports from the East are rather diversified. They include vehicles, electricity machinery, household equipments, textiles ... etc. Growth in the West imports from the east has had a positive counter-cyclical impact on the East business at a time when domestic demand was slumping. This demonstrates the interdependency of the two sides economies.

The West exports, on the other hand are dominated by crude oil and petroleum products. Statistics indicates that, there is a growing dependency of the East Asia on crude oil imports from West Asia. The picture is not very different with regards to imports of oil products, LPG and other petrochemical feed stocks. Imports of crude oil and petroleum products are constantly targeted in some countries of East Asia with taxes of different types and forms. The ever rising of such taxes brings about an unstable outlook for demand that may impair the financial ability of oil producing countries of the West to invest in improving production capacity. Signs indicates that some countries in East Asia will continue to raise domestic taxes on petroleum products every time they need extra revenues under the excuse of protecting the environment or national security. That will affect demand negatively worsening the terms of trade between East and West Asia and harmful to the economic development of West Asian countries. Further more, such high taxes could lead to a situation in which oil exporters may not be able to raise the needed capital for capacity expansion and to uncertainty about the future of oil demand.

The issue of environment must be addressed in an evenhanded manner. That is to say, the interests of developing countries in general are not compatible to those of consumers in the developed countries. The measures proposed by the rich countries are too expensive to be adopted by the poor. The tow side must debate the problem openly to find some common ground that has global acceptance.

Oil producing countries of West Asia have been trying to develop broader based economies less vulnerable to fluctuation in the oil markets. That requires huge investments, access to new technology. Reviewing foreign direct investment of the developed countries of East Asia indicates that the share of West Asian countries is quite marginal and does not commensurate with the importance of the two sides trading relationship. Oil producing countries of West Asia do not apply pressure on their trading partners, and they have been proven to be dependable partners. They look for a partnership that is based on balanced mutual benefits that goes beyond trade figures.

The proven oil reserve of the producing countries of West Asia is estimated to be more than (65) percent of the world total. It is also estimated that, proven gas reserves are about (33) percent of the world total. This clearly shows the importance of this region in supplying the future global demand including that of East Asia. The shares of crude oil production in the producing countries are below their proven reserve ratio, indicating the greater weight that one can attribute to their reserves in meeting the future global demand for crude oil. These countries produce about (27) percent of the total world's production while their consumption is equivalent to about (4) percent of the total world's consumption of crude oil. This makes this region of the world as the most promising source of supply for the future global demand for crude oil.

East Asia has been, and will continue to be a high-energy demand growth area in the future. The rate of oil dependency in this region will increase with stagnant domestic production of around 7-8 MBPD. Meanwhile, the export availability of Asian crude is forecasted to decline over the coming years, mainly because of the flat regional crude oil production and rising internal demand within the oil producing

countries. Over the last 6 to 7 years, new concerns about energy security have been expressed, resulting from rising oil demand in Asia. So, the main focus of policy in these countries has been on security of energy supplies. This has been achieved mostly through term purchase contracts with West Asian and other Asian suppliers, equity participation, and the establishment of strategic oil stock.

Oil rich countries of West Asia will continue to be the vital and strategic source of supply to East Asia in the future. The importance of their oil becomes more pronounced by the fact that alternative sources of energy supply from Central Asia has not been realized. Currently oil is regarded as the most important source of energy for the Asian countries and expected to remain substantial.

Events have shown that concerns about potential dependency on West Asian producers to be completely misplaced. Replacing imports of oil from these countries is un reasonable and will require too much capital. However, increased dependency on West Asian oil will require additional investment in the Gulf countries because of their abundant oil reserves.

While long-term security of oil supplies is a concern for the consuming countries of East Asia, a permanent and secured outlets for oil and related products is also of great concern to the oil producing countries of West Asia. The link in this matter between the two sides is so strong and important, and more efforts have to be made towards some degree of the development of reciprocal interest in oil and other areas.

Therefore, it is essential for the oil consuming countries of East Asia to make their energy, trade and investment linkages with the oil producing countries of West Asia stronger, durable and a two-way dependency with clear reciprocal benefits. It is in the interest of both sides to review their important reciprocal dependency constantly not only to maintain it, but also improve and broaden it.

The oil producing countries of West Asia have been and will continue to maintain moderate positions in international relations. In OPEC, member states of the Gulf have been and will continue support of security of supply and stability of price.

With regard to security of supply to East Asia, Saudi Arabia is committed to supply its consumers in East Asia with their oil needs. To day Saudi oil exports to Asia is more than (4) MBPD which is about (65%) of Saudi total exports. It is prepared to cooperate further by entering into long term contracts with its customers, which is considered to be the best way for securing supplies as will as demand. Saudi Arabia with the cooperation of other states in the Gulf will not allow shortage of supply in their continent. Needless to say that Saudi Arabia has about 2.5 MBPD of excess capacity, and capable of handling any new increase in capacity and exports.

Saudi Arabia has had excellent relations with oil producers in the West Asia, OPEC or non-OPEC, and with all consuming countries including those of East Asia. It has played a moderating role in the oil market initiating and supporting the dialogue in oil matters. To that extent, His Royal Highness the Crown Prince in his welcoming speech to the delegates of the 7th International Energy Forum called for the establishment of a permanent secretariat for the Forum to work towards promoting a continuous dialogue between Energy producers and consumers. Fostering the concept of dialogue between energy producers and consumers as well as dialogue between governments and industry, and promoting the role of stable and transparent energy markets are among the objectives of the proposed secretariat. The establishment of a permanent secretariat for the Forum will strengthen the dialogue and co-operation between all concerned parties, and ensuring the continuity of the dialogue. We believe that this Secretariat could hold great opportunities to advance the dialogue if effectively exploited and on wide range of issues affecting the world energy market and economy in matters related to cooperation, understanding and transparency in the field of energy.

International Symposium on

Energy Co-operation in Northeast Asia

7-8 June 2001. Sherton Walker Hill Hotel, Seoul, Korea

Session IV

Chair: Dr. Hyun-Joon Chang, President, KEEI

Implementation of Energy Co-operation in Northeast Asia

Roundtable discussion for energy co-operation in Northeast Asia

- Panel:

- Country representatives: Korea, China, Japan, Russia, Mongolia
- International Organisation: UN/ESCAP, Energy Charter Secretariat, World Bank, AIT

Wrap-up

Closing

Curriculum Vitae

Session Chair

DR. BONG-SUH LEE
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Dr. Bong-Suh Lee was appointed Chairman of Kukje Hwajae Insurance Co. Ltd. on August 3, 1996

Previously, Dr. Lee served as Vice President at Asian Development Bank until July 1998. Before that, he served as Minister of Trade and Industry of Government fo the Republic of Korea during 1990-1991 and Minister of Energy and Resources from 1988-1990. he was Vice Minister of Energy and Resources from 1983-1988.

Dr. Lee began his career at the Federal Reserve Bank of Philadelphia in 1962 and worked with the World Bank from 1985 to 1971,first in the EDI then as an Economist for the India Desk From 1971 to 1973 Dr. Lee served as Economic Secretary to the Prime Minister of the Republic of Korea and as Administrative Coordinator(with the rank of Assistant Minister)from 1973-1978 at the Administrative Office of the Prime Minister's Office. Dr. Lee served as Deputy Vice-Minister at the Minister of Energy and Resources (1978-1982) and as Economist Secretary at the Office of the President in 1983.

Dr. Lee was born in South Korea in 1936. He graduated from Wharton School, University of Pennsylvania with a B.S Finance in 1959 and received a Ph. D. in Economics from Harvard University in 1965.

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Education

1959 - 1965	Harvard University Ph. D. in Economics	
1955 - 1959	University Pennsylvania, The Wharton School Bachelor of Science in Finance	

Experience

1998 - Present	Kukje Hwajae Insurance Co. Ltd. Chairman	Seoul, Korea
1993 - 1998	Asian Development Bank Vice President(West): in charge of operations for 13 developing member Countries of South and Southeast Asia	Manila, Philippines
1992 - 1993	Korea Energy Economics institute/ Korea institute of Economy and Trade Adviser	Seoul, Korea
1990 - 1991	Ministry of Trade and Industry Minister	Seoul, Korea
1990	East-West Center Research Fellow	Honolulu, Hi, USA
1983 - 1990	Minister of Energy and Resources Minister(1988-1990); Vice-Minister(1983-1988)	Seoul, Korea
1983	Office of The President Secretary Economic Affairs.	Seoul, Korea
1978 - 1982	Minister of Energy and Resources Deputy Vice-Minister	Seoul, Korea
1971 - 1978	Office of The Prime Minister Principal Secretary for Economic Affairs.	Seoul, Korea
1968 - 1971	World Bank Economist for the India Desk	Washington DC, USA
1965 - 1968	World Bank - Economist Development Institute / Research Staff	Washington DC, USA
1962 -1964	Federal Research Bank of Philadelphia Research Assistant	Philadelphia, PA, USA

Additional Information

Born in seoul, Korea on 24 February 1936; married with three children

Curriculum Vitae

Dr. Ralph Wahnschafft
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Dr. Ralph Wahnschafft is an Economist with interest in international affairs and economic cooperation and energy and environmental policies. Dr. Wahnschafft currently works at the Energy Resources Section of the Economic and Social Commission for Asia and the Pacific (ESCAP) of the United Nations, based in Bangkok, Thailand.

Dr. Wahnschafft has worked with the United Nations over a period of 15 years in different functions and duty stations, initially in Africa, later in the Middle East, and currently in Thailand, which hosts the United Nations Regional Commission's Secretariat for the entire Asia and Pacific Region. During his work with ESCAP's Energy Resources Section,

Dr. Wahnschafft has specialized in studies and projects related to energy conservation and promotion of energy efficiency, in particular related to energy end uses in industries, commercial buildings, households and appliances. In his current function, Dr. Wahnschafft provides advisory services, arranges and services national and international meetings, seminars and group training events.

Dr. Wahnschafft has on various occasions published technical papers on selected energy-environment policy issues. He also worked on several recent energy related publications of his office which can be found on the ESCAP web site (www.unescap.org/
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1999 - Project leader, Low Carbon Development Future of China";
1997 - 1999 Project leader, Long Term Energy Strategy of China";
1996 - Deputy Director of the Executive Office of the China Green Lights Program, in charge of the design and organization of the program, one of the key national energy conservation program for the Ninth-Five-Years' Plan period for the whole country;

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1984	Director, Industrial Finance Division, Industrial Policy Bureau
1985	Director, General Affairs Division
	Machinery and Information Industries Bureau
1986	Director, General Coordination Division, Minister's Secretariat
1987	Director-General, International Economic Affairs Department
	International Trade Policy Bureau
1988	Director-General, Petroleum Department, Agency of Natural Resources and Energy
1989	Department Director-General, Machinery and Information Industries Bureau
1990	Director-General for Commercial Affairs
1991	Director-General, Basic Industries Bureau
1992	Director-General, Machinery and Information Industries Bureau
1993	Director-General, International Trade Policy Bureau
1994	Vice-Minister for International Affairs
1996	Advisor to MITI
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1996	Advisor to the President, The Bank of Tokyo-Mitsubishi, Ltd.

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Dr. Stanislav Z. Zhiznin- Senior Counselor of Department of Economic Cooperation of Ministry of Foreign Affairs of Russia. His responsibilities - international aspects of the energy policy of Russia (IEA, OPEC, energy cooperation within G-8, Global Energy Forums, Energy Charter Conference, Energy Dialogue with EU, Caspian region petroleum issues, APEC energy issues and others). Diplomatic carrier –since 1977. Experience in international energy policy issues- since 1989. Member of the experts group for designing international part of Energy Strategy of Russia.

Education- Kharkov Aviation Institute (energy unit engineer), Diplomatic Academy (international economic relations), Ph.D. in world economy.

Author of the book "Energy Diplomacy of Russia" (1999), chapters in the books "New Energy Policy of Russia (1995)", "Energy Security of Russia (2000)", "Oil aspects of Energy Security of Russia (2001)" and more than 40 articles on international energy problems including "Russia on gas markets in North-East Asia"(1998), "Energy Security in Asian Pacific Area"(2000), 'Gas Priorities of Russian Diplomacy"(2000), "Russia in World Oil Markets"(2000).

Lecturer in the Diplomatic Academy of the Ministry of Foreign Affaires of Russia (the course "Energy Diplomacy of Russia") and in the Academy of State Service at the President of Russia (the course "Strategic Priorities of Russia in the World Energy and Diplomacy").

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Education

1979-1986	Society researcher, Bachelor of Social Science Institute of Trade Unions, in former GDR(Germany)
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Work Experience

2001-	Chairman Committee on the Promotion of Foreign Investment
2000-	Vice-Chairman North-East Asian Association
2000-	President of Mongolian Banker's Association
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1999-2000	Vice President Committee on Social and Economic Question of IPU
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1999	Chairperson Asia-Pacific Group of IPU

1996-2000	Member of the State Ikh Khural Parliament of Mongolia
1993-1996	President, CEO "Bodi International" Holding co., Ltd and Golornt Bank
1992-1993	Leader of the World Students' Youth Center of Mongolians
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1990-1992	Deputy People's Great Hural of Mongolia
1989-1991	Deputy Chairman, Secretary General Mongolian Students' Union
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Education

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Work Experience

1968-	Professor, Department of Economics State University of New York
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Graduated from Irkutsk Technical University with Master degree in Computer Management and Large Scale Energy Systems.

Join Siberian Energy Institute of the Russian Academy of Sciences, Siberian Branch in 1982. Received Ph.D. degree in 1993. Head of laboratory. Area of scientific interests: energy systems development in Asian regions of Russia and in NEA countries, environmental issues, economic evaluation, modelling.

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EDUCATION

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EXPERIENCE

2001 - currently	: Chairman, Dong-Duk Engineering Company.
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1971.1 - 1974	: Manager, Thermal Power Generating Div. KEPCO.
1964.10. - 1971	: Assistant Manger, Thermal Power Plants and Power Generating Div. KEPCO.
1957. 4 .	: Joined Korea Electric Power Corporation. Worked in the field of power transmitting, distribution and thermal power plants.

OTHERS

License	: Professional Engineer, Electric Power Generation, Transmission & Distribution
1995 ~ currently	: Vice Chairman Korea Pan-Asian Natural Gas Pipeline Association
1996 ~ 1998	: Chairman, The Korea Society for Energy Engineering
1998 - currently	: Chairman, North-East Asia Energy Forum, Korea.

CURRICULUM VITAE

GOVINDA RAJ TIMILSINA

Center for Energy-Environment Research & Development (CEERD), Energy Program, Asian Institute of Technology
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Nationality : Nepalese
Date of Birth : 15th January 1966

ACADEMIC QUALIFICATION

- **Doctor of Engineering** (Energy Economics and Planning), Asian Institute of Technology, Bangkok, Thailand, April 2001.
- **Master of Engineering** (Energy Economics and Planning), Asian Institute of Technology, Bangkok, Thailand, August 1994.
- **Bachelor of Engineering** (Electrical), Motilal Nehru Regional Engineering Collage, Allahabad, India, July 1990.

WORK EXPERIENCE

1. Project management and coordination as well as working as a key scientific researchers in research and consultancy projects across a board range of energy, environment and climate change policies at national and regional levels in Asia and the pacific region.
2. Energy data and market analysis, energy demand and sypply forecasting using both econometric as well as end-use accounting approaches.
3. Development and implementation of a number of models for energy and environmental policy analysis such as General Equilibrium Models; energy supply forecasting models (e.g., EFOM, MARKAL, WASP); energy demand forecasting models (e.g., MEEDES, MAED), Energy System Model (ENPEP, LEAP); statistical tools (e.g., SPSS), optimization tools (e.g., XA, and LINDO).
4. Establishment, management and administration of a regional energy and environmental database, namely, Database for Variable Output/Input Data (DBAVOID), for 22 countries of Asia and the Pacific region.
5. Project feasibility studies (economic and financial analyses) and evaluation; preparation of project proposals and bidding documents.
6. Design and implementation of energy and environmental surveys for collecting data and information to maintain the energy and environmental database, and to provide with inputs to a number of project activities.
7. Instruction of courses on energy data analysis, energy demand analysis and forecasting and energy price theory for graduate students and supervise thesis and dissertation works.
8. Design and implementation of short-term training courses on energy-environment and climate change policies.
9. Writing academic papers for publications in the peer-reviewed international journals and for presentations in the international conferences and workshops.
10. Serving as a consultant and resource person for a number of international organizations including Asian Development Bank (ADB), World Bank, Economic and Social Commission for Asia and the Pacific (ESCAP), Food and Agricultural Organization (FAO), International Atomic Energy Agency (IAEA) and United Nations Environmental Program (UNEP) in the field of energy-environment and climate change policies.

WORK HISTORY

August 1997 to Date:

Employer : Asian Institute of Technology (AIT), Bangkok, Thailand
Position : Senior Research Associate
Responsibility : Working as a scientific researcher on research and training activities in the field of energy, environment and climate change and working as an instructor for post graduate students at Energy Program, AIT.

Key Assignments:

1. Feasibility Assessment of Nuclear Power Projects under the Clean Development Mechanisms in Selected Asian Countries, **IAEA**, Oct. 1999 - Continue.
2. Energy Sector Development for the Islamic Republic of Iran, **World Bank**, September 1999 - Continue.
3. Environmental Implications of Power sector Restructuring in Asia, **International Atomic Energy Agency (IAEA)**, Oct. 2001 – April 2001.
4. A Survey on Potential for Energy and Environmental Cooperation in South Asia and Indo-China Region, **New Energy Development Organization, Japan**, Jan. 2001 – April 2001.
5. Regional Workshop on Economic Analysis of the Key Issues of the Buenos Aires Plan of Action (BAPA), **Asian Development Bank (ADB) and United Nations Development Program (UNEP)**, Oct. 2000.
6. Sub-regional/National Workshops on Issues before COP-6 under RETA 5861 in Manila, Islamabad, Colombo, Kathmandu, Kuala Lumpur, Dhaka and Jakarta, **ADB and UNEP**, July – Sept. 2000.
7. Clean Technologies in Selected Industries in Asia: Current Status and Potential for Technology Transfer, **ADEME, France**, Oct. 1999 – Dec. 2000.
8. Training on Climate Change Science, Mitigation Policies and International Response for the **Ministry of Energy (MoE)**, Iran, Nov. – Dec. 1999.
9. A Survey of Environmental and Energy Conservation Policies and Technologies in Asia, **NEDO, Japan**, Dec. 1999 – May 2000.
10. Energy Sector Policy Review of the Developing Member Countries of the Asian Development Bank, **Asian Development Bank (ADB)**, Jan. - May 1999.
11. Pricing Incentives in a Renewable Energy Strategy in Thailand, **National Energy Policy Office of Thailand**, Oct. 1997 – Sept. 1998.
12. Asia Least Cost Greenhouse Gases Abatement Strategies (ALGAS), **ADB**, Aug. 1997 – Dec. 1999.
13. Coal and Natural Gas Competition in APEC Economics, **Asia Pacific Energy Research Center (APERC)**, Sept. 1998 – August 1999.
14. Thailand Energy Strategy and Policy Study, **National Energy Policy Office of Thailand**, Mar. 1998 – Jun. 1999.

August 1994 to July 1997:

Employer : Asian Institute of Technology, Bangkok
Position : Research Associate
Responsibility : Energy and Environment Database development and management under the framework of various projects of international organizations (UN, ESCAP, ADB, World Bank).

Key Assignments:

1. Wood Energy Today for Tomorrow, **Food and Agricultural Organization (FAO)**, Jan. – Dec. 1997.
2. Wood Energy Today, **FAO**, Jan. – Dec. 1996.
3. Programme for Asian Cooperation on Energy and Environment (PACE-E), Sub-activity EEP-1: Energy Survey Methodology Design and Sub-activity EEP-2: Inter fuel Substitution Analysis and Modeling in Asian Developing Countries, **UNESCAP** and **UNDP**, Jan. 1994 – Dec. 1997.
4. Third Regional Training on Wood Energy Planning, **Regional Wood Energy Development Program in Asia (RWEDP)/FAO**, Aug. 1997.

5. Training Workshop on Energy and Environmental Database (DBA-VOID) for Asian and the Pacific Countries, **Asian Institute of Technology (AIT)**, April-May 1997.
6. Second Regional Training on Wood Energy Planning, **RWEDP/FAO**, Sept. 1996.
7. Training on Energy Economics and Planning for the Ministry of Industry, Mines and Energy of Cambodia, **AIT/ADB**, Aug. 1996.
8. Energy Policy Analysis and Planning to the Year 2020: Energy Master Plan in Malaysia (MAL/93/001), **Economic Planning Unit, the Prime Minister's Office, Malaysia,** Aug. 1994 – Dec. 1995.
9. Energy Demand Analysis in 12 Asian Countries, **World Bank**, March – Sept. 1995.
10. Regional Workshop on Energy Surveys, **UNDP/ESCAP/AIT**, Sept. 1994.
11. Training Workshop on Energy Database and Sectoral Demand Analysis and Long term Forecast for Asian and the Pacific Countries, **AIT**, August 1994.

Feb. 1992 to Jan. 1993:

Employer	:	Nepal Electricity Authority, Distribution & Consumer Service Directorate, Technical Service Department, Kathmandu, Nepal.
Position	:	Engineer/System Planner
Responsibility	:	Electricity Distribution System Planning and Design, Preparation of Equipment's Specification, Evaluation of Bids and Feasibility Study Reports etc.

Oct. 1990 to Feb. 1992:

Employer	:	Nepal Telecommunication Corporation, Network Planning Department
Position	:	Engineer/Network Planner
Responsibility	:	Detailed Demand Forecasting, Outside Network Planning & Design, Cable Network Project Implementation etc.

COMPUTER EXPERTISE:

Computer Basics:	MS Office, FORTRAN, PASCAL.
Specific Software:	Computer software for economic analysis (e.g., GAMS, Time Series Analysis, SPSS, XA, and LINDO); Software related to energy planning (EFOM-ENV, MEEDES-ENV, DBA-VOID, ENPEP, WAPS, DECADES, DECPACK)

PUBLICATIONS

INTERNATIONAL JOURNAL

Timilsina G. R. and T. Lefevre, Financing Solar Thermal Technologies under DSM Programs: An Innovative Approach to Promote Renewable energy, *International Journal of Energy Research*, Vol. 24, pp. 503-510, 2000.

Timilsina G.R., T. Lefevre and S. Shrestha, Techno-Economic Databases for Environmental Policy Analysis in Asia: Requirements and Barriers, *Pollution Atmospherique*, pp. 79-88, October 2000.

Timilsina G. R. and T. Lefevre, Reducing GHG emissions from the Power Sector in Developing Asian Countries: An AIJ Prospective, *World Resource Review*, Vol. 11, No.1, PP. 115-131, 1999.

Timilsina G. R. and T. Lefevre, Government Policies and Strategies for Developing and Promoting Renewable Energy in Asia: An Overview, *Renewable Energy*, Vol. 16, PP. 2648-2651, 1998.

Shrestha R.M. and G. R. Timilsina, A Divisia Decomposition Analysis of NO_X Emission Intensities for the Power Sector in Thailand and South Korea, *Energy The International Journal,* Vol. 23, No. 6, PP. 433-438, 1998.

Shrestha R.M., G. R. Timilsina, P. Khummongkol, W.K. Biswas and S. Sinbanchongjit, "CO_2 Mitigation Potential of Efficient Demand-Side Technologies: A Case of Thailand, *Energy Sources*, Vol. 20, No. 3, PP. 301-316, 1998.

Shrestha R.M. and G. R. Timilsina, SO_2 Emission Intensities of Power Sector in Asia: Effects of generation Mix and Fuel Intensities Changes, *Energy Economics,* Vol. 19, No. 3, 1997.

Shrestha R.M. and G. R. Timilsina, Factors Affecting CO_2 Intensities of Power Sector in Asia: A Divisia Decomposition Analysis, *Energy Economics,* Vol. 18, No. 4, 1996.

Lefevre, T. and G. R. Timilsina, Factors Affecting Inter-Fuel Substitutions in Energy Demand in Asia, *ASEAN Energy Journal,* Vol. 1, No. 1, 1997.

Shrestha R.M. and G. R. Timilsina, Productive Efficiency of Electric Utilities in Asia: A Comparative Study, *Revue de Énergie,* Sept. 1995.

Shrestha R.M. and G. R. Timilsina, The Additionality Criterion for Identifying Clean Development Mechanism Projects under the Kyoto Protocol, *Energy Policy* Forthcoming.

Timilsina G. R. and R.M Shrestha, A General Equilibrium Analysis of Economic and Environmental Consequences of Carbon Tax in a Developing Country: Case of Thailand, *Environment and Development Economics* (Submitted)

Timilsina G. R. and R.M Shrestha, Effects of Unilateral Clean Development Mechanism in a Developing Country: A General Equilibrium Analysis of Thai Economy, *Environment and Resource Economics* (Submitted)

Timilsina G. R. and R.M Shrestha, Carbon Tax with Alternative Schemes of Revenue Recycling Schemes: General Equilibrium Analysis of Developing Economy, *Journal of Policy Modeling* (Submitted)

Timilsina, G.R. and R.M Shrestha, General Equilibrium Effects of a Demand Side Management Program under the Clean Development Mechanism in a Developing Country, *Energy Economics,* (Submitted).

INTERNATIONAL MAZAGINE

Timilsina G. R., The COP6 and the Challenges to Further Negotiations, *Asian Energy News*, Vol. 12, No. 10, 2000.

Timilsina G. R. and T. Lefevre, S. Shrestha and S.K. Niom-Uddin, An Overview of Environmental Policies and Regulations in Selected Asian Countries, *ASEP News Letter*, Vol. 16, No. 2, 2000.

Timilsina G. R. and T. Lefevre, New and Renewable Technologies in Asia, *Renewable Energy World*, Vol. 2, No. 4, pp. 137-146, July 1999.

CONFERENCE PROCEEDINGS

Timilsina G.R., Implications of the Negotiations in the COP-6 on Fuel Supply for Power Generation in Asia, *Annual Workshop on Power Market Reforms in Asia 2001,* 13-14 Feb. 2001, Bangkok, Thailand.

Timilsina G.R. and T. Lefevre, Potential and Opportunities for Technology Transfer in Developing Asian Countries under the Climate Change, *Regional Workshop on Climate Change: The Challenges and Opportunities*, 1-2 Feb. 2001, Bangkok, Thailand.

Timilsina, G.R. and R.M. Shrestha, Promotion of Renewable Energy in Asia under the Climate Change, *Fifth Asia-Pacific Environmental NGO Conference*, 22-24 Sept. 2000, Agra, India.

Timilsina G.R. and T. Lefevre, Analysis of Key Issues of the Clean Development Mechanism under the Kyoto Protocol: A Survey, *Second Coordination Meeting on "The Role of Nuclear Power and Other Energy Options in Meeting International Goals on Greenhouse Gases Emission Reductions"* 4-8 Sept. 2000, Vienna.

Timilsina G.R. and T. Lefevre, National Energy Planning and Technological Choices in Developing Asian Economics: The CDM Scenario, *Proceedings of the Workshop on Clean Development Mechanism under the Kyoto Protocol,* Asia Pacific Energy Research Center, 12-14 July 2000, Tokyo, Japan.

Timilsina G.R. and T. Lefevre, Analyzing the Impacts of the Clean Development Mechanism in Non-Annex I Economics: A General Equilibrium Framework, *Proceedings of the Joint EMF, IEA, IIASA International Conference,* 20-22 June 2000.

Timilsina, G.R. and R.M. Shrestha, A General Equilibrium Analysis of Carbon Tax in a Developing Country under Alternative Schemes of Tax Revenue Use: Case of Thailand, Paper to be Presented at the *23rd Annual International Conference of the International Association of Energy Economics*, Sydney, Australia, 7-10 June, 2000.

Timilsina G.R., Efficient Design of the Clean Development Mechanism under the Kyoto Protocol: Approaches to Reduce the Overall Cost of Producing CERs, *International Workshop on the Clean Development Mechanism*, 26-27 January 2000, Tokyo.

Timilsina G.R. and T. Lefevre, Clean Development Mechanism under the Kyoto Protocol: Issues of Project Identification and Credit Sharing, *Proceedings of the International Conference on Clean Energy Asia 1999*, 3-4 November 1999, Shangri-La Hotel, Singapore.

Timilsina G.R. and T. Lefevre, Developing Techno-Economic Database for Environmental Policy Analysis in Asia, *Proceedings of the Techno-Economical Databases on Production Processes and Related Emission Abatement Options*, 28-29 October 1999, Angers, France,

Timilsina G.R. and T. Lefevre, Environmental Implications of Power Sector Restructuring in APEC Region, *Proceedings of the APERC 1999 Mid-Year Workshop*, 30 Sept- 1 Oct, 1999, Tokyo, Japan.

Timilsina G R and T. Lefevre, Flexibility Mechanisms for Climate Change Policy under the Kyoto Protocol: Critical Issues and Recommendations' *Proceedings of the Workshop on Flexibility Mechanisms and Climate Change Policy in Asian Countries: Experiences and Technology Response from EC Research*, Asian Institute of Technology, Bangkok 14-15 January 1999.

Timilsina, G.R., T. Lefevre and M. Cabrera, Renewable Energy Technologies in Rural Energy Supply: ASEAN Experiences, in Shrestha J.N., T.R. Bajracharya and B. Vaidya (eds.) *Proceedings of the International Conference on the Role of Renewable Energy Technology for Rural Development*, 12-14 October1998, Kathmandu, Nepal, PP. 120, 1998.

Lefevre, T. and G. R. Timilsina, "The Evolution of Petroleum market in Thailand: An Overview", Paper presented on *"Thailand 2000: Petroleum Refining & Marketing Conference, 11 & 12 March 1996,* Pattya, Thailand, 1996.

Lefevre, T., G. R. Timilsina, J. Todoc, R. Pacudan and S. Acharya, Status of Wood Energy Data in Asia, Paper presented on *International Energy Agency Workshop on Biomass Energy: Key Issues and Priority Needs, 3-5 February, 1997*, Paris, France, 1997.

Lefevre, T., G. R. Timilsina, The Modeling and Data Issues of New and Renewable Energy Systems, Paper presented on the *Asia Pacific Energy Research Center Workshop on Methodologies and Data for Energy Demand Supply Outlook, 17-19 March, 1997*, Tokyo, Japan, 1997.

Lefevre, T., G. R. Timilsina, The Role of Gas in Interfuel Competititon in Asia Under the Environmental Consideration, *PECC Energy Forum*, 2-4, November, 1997, Seoul, Republic of Korea.

Lefevre, T., G. R. Timilsina, Overall Energy -cum- Electricity Situation in ASEAN: A Historical Analysis, *Workshop on Energy and Electricity Planning for Cambodia, Laos and Vietnam*, 20-31 October, 1997, Hanoi Vietnam.

Timilsina G. R. and T. Lefevre, Environmental Implications of Petroleum Products Pricing in Thailand, Proceedings of the *"Second ASEAN Renewable Energy Conference,* 6-9 November, 1997, Phuket, Thailand.

BOOKS AND TECHNICAL REPORTS

Timilsina, G.R., A General Equilibrium Analysis of Greenhouse Gases Mitigation Policy Option in Thailand, *Doctoral Dissertation*, Energy Program, Asian Institute of Technology, Bangkok, April 2001.

Timilsina, G.R. and T. Lefevre, Assessment of the Potential for Developing Nuclear Power Projects under the Clean Development Mechanism in Asia, Part 1: Mythology, Center for Energy-Environment Research & Development (CEERD)/ AIT, May 2000.

Lefevre, T., G.R. Timilsina, J. Todoc, P. Cozalez and M. Niom, A Survey of Environment and Energy Conservation Policies and Technologies in Asia, CEERD/AIT, May 2000.

Lefevre, T., G. R. Timilsina and J. Todoc, The Role of Wood Energy: Regional Study for Asia, Food and Agriculture Organization (FAO), *Report No. FOPW/97/2*, FAO, Rome, November 1997.

Lefevre, T., G. R. Timilsina and J. Todoc, Power Sector in Thailand: Market Prospects and Investment Opportunities, Energy Planning Central Consultant Team, Asian Institute of Technology, Bangkok, 1996.

Timilsina, G. R., Economic Instruments for Greenhouse Gas Emissions Mitigation, Unpublished Special Study Report, Asian Institute of Technology, Bangkok.

Lefevre, T. and G. R. Timilsina, Guide Book on Energy Survey, Programme for Asian Cooperation on Energy and the Environment (PACE-E), United Nations, New York, 1995.

Lefevre, T., G. R. Timilsina and S. Acharya, Methodological Manual of Energy Environmental Database, DBA-VOID, Programme for Asian Cooperation on Energy and the Environment (PACE-E), United Nations, New York, 1998.

Lefevre, T., G. R. Timilsina, X. Chen and B.D. Thanh, Guide Book on Energy Environmental Planning, *Synthesis Report of UNDP/ESCAP/AIT Regional Workshop on Economic Sustainability and Environmental Betterment through Energy Saving and Fuel Switching in Developing Countries*, United Nations, New York, 1996.

Lefevre, T. and G. R. Timilsina, Sectoral Energy Surveys in Asia and the Pacific Region, *Synthesis Report of UNDP/ESCAP/AIT Regional Workshop on Energy Surveys*, Bangkok, 1994.

WORKING PAPERS

Timilsina, G.R., A Survey of General Equilibrium Models for Greenhouse Gases Mitigation Policies, *Energy Program Working Paper*, Asian Institute of Technology, December, 1998.

Timilsina, G.R., Role of Revenue Recycling Schemes in Selecting a Tax Instrument to Reduce CO_2 Emissions: A General Equilibrium Analysis, *Energy Program Working Paper*, Asian Institute of Technology, May 2000.

Timilsina, G.R., Economy-Wide Impacts of Selected Implimentation of Supply Side GHG Mitigation Options under the Clean Development Mechanism in Thailand, *Energy Program Working Paper*, Asian Institute of Technology, October 2000.

MEMBERSHIP

: International Association of Energy Economics (IAEE)

Session Chair

Curriculum Vitae

Name in Full	:	Eui-Soon Shin
Date of Birth	:	June 9, 1950
Place of Birth	:	Seoul , Korea
Nationality	:	Republic of Korea
Home Adress	:	#401-102, Woosung Apt., Echon-1 dong, Yongsan-gu, Seoul 140-031, Korea Tel) (82-2) 798-5675
Office Address	:	Department of Economics, Yonsei University 134 Shinchon-dong, Seodaemoon-gu, Seoul 120-749, Korea Tel) (82-2) 2123-2476 Fax) (82-2) 393-1158

Education

1968. 3 - 1972. 2	Dept. of Economics, Yonsei University (B.A.)
1975. 9 - 1977. 6	Dept. of Economics, University of Washinton (M.A.)
1977. 6 - 1980. 6	Dept. of Economics, University of Washington (Ph.D.)

Experiences

1980. 7 - 1981.7: Postdoctoral Research Fellow, Social Science Division & Environmental Quality Lab., California Institute of Technology

1981. 8 - Present: Assistant, Associate, and Full Professor of Economics, Yonsei University

1984. 9 - Present: Director, Energy and Resources Program, Institute of East and West Studies, Yonsei University

1988. 9 - 1989. 8: Visiting Associate Professor, Department of East Asian Studies, Brown University

1991. 6 - 1991. 8: Fellow, Environment and Policy Institute (renamed,

	Environment Programme) East-West Center, USA
1993. 6 - 1995. 6	President, Korea Resource Economics Association
1995. 3 - 1996. 8	Associate Dean, Graduate School, Yonsei University
1996. 2 - 1997. 12	Advisory Committee Member, Ministry of Trade and Industry
1996. 9 - 1998. 8	Chairman, Department of Economics, Yonsei University
1999. 1 - 1999. 8	Visiting Scholar, Department of Economics, Harvard University

Awards

1983.5	Yonsei University Faculty Award for Distinguished Research
1994.3	24th ECONOMIST Award from the Mae-il Economic Daily Newspaper

Selected Research and Publication List

"The Impact of the First Oil Crisis on Energy Demand in Korea", *Energy Economics*, Vol.14, No.4, October 1982, pp. 259-267.

"Functional Separability, Derived Demand, and the Elasticities of Substitution," *Korean Economic Review*, New Series, Vol.1, December 1985, pp. 87-101.

Energy Policies in Korea and Japan, edited with Dalchoong Kim, Yonsei University Press, September 1986.

Natural Resource Economics (in Korean), Pak-Young Publishing Co., February 1988 (Revised, 1990).

Energy Demand and Factor Substitution in Korea (in Korean), E. Shin and et al., Korea Resource Economics Association, June 1990.

Environmental Policy and the Sharing of Pollution Control Costs (in Korean), Korea Economic Research Center, Korea Chamber of Commerce and Industry, March 1991.

Policy Instruments for Environmental Improvement (in Korean), Coauthored with Jeong-Jeon Lee, International Trade and Business Institute, May 1991.

"Water Use Conflicts in the Seoul Metropolitan Region",in James E.Nickum and K.William Easter eds., *Metropolitan Water Use Conflicts in Asia and the Pacific*, Westview Press, 1994, pp.113-129.

"Application of Transaction Cost Economics to the Analysis of Water-Use Conflicts in Seoul Metropolitan Region", *Regional Development Dialogue*, United Nations Center for Regional Development, Vol.12, No.4, Winter 1991,pp.21-37.

Valuating the Economic Impacts of Urban Environmental Problems : Asian Cities, Euisoon

Shin et al., Working paper No. 13, Urban Management Programme, UNDP/ UNCHS/ World Bank; June 1997.

"Acid Rain Problems in Northeast Asia and Environmental Cooperation (in Korean)" *Korea Journal of Resource Economics,* Vol.7, No.1, September 1997.

"Economic Analysis of Transboundary Air Pollution in Northeast Asia," Kap-Young Jeong et al eds., *Towards New Dimensions of Cooperation in Northeast Asia,* The Institute of East and West Studies, Yonsei University, 1998, pp.163-196.

Korean Economy and Energy Policy (in Korean), Ddanim Publishing Co., April 2001.

CURRICULUM VITAE

WOO JIN CHUNG

Korea Energy Economics Institute

Woo Jin Chung is a Research Fellow at Korea Energy Economics Institute. He has been working on various fields of energy studies. His recent researches include Northeast Asia energy issues related to natural gas and electricity trades through grid interconnections in the region. He has been involved in government's policy-making for deregulation of oil industry and privatization of gas industry. He is currently studying the North and South Korea Energy Relations at Korea Energy Economics Institute.

CURRICULUM VITAE

ERIK ULFSTEDT

Energy Charter Secretariat

Mr. Ulfstedt joined the Energy Charter Secretariat on 1 September 2000 as Director with responsibilities for Energy Efficiency, Investment, Ratification and Expansion/Accession issues.

He graduated from the Helsinki Commercial Institute for Businessmen in 1970. Since then he has worked for the Finnish Ministry for Foreign Affairs. He has had a wide range of Diplomatic postings including Copenhagen, Moscow and the United States.

From 1988-1991 he served as Director of the Division for Soviet Union at the Department of External Economics Relations in the Ministry for Foreign Affairs.

In 1991 he obtained the rank of Ambassador and was posted as Minister to the Embassy of Finland in London from 1991-1993.

From 1993-1996 he was appointed Ambassador to the Ukraine, and also served as Ambassador to Moldova from 1994-1996.

In 1996 he returned to the Ministry for Foreign Affairs in Helsinki and was appointed Ambassador to the Northern Dimension Unit with responsibility for developing and promoting the Finnish initiative for a Northern Dimension in European Union policies. (Action Plan on Northern Dimension adopted by European Council in June 2000).

He also participated in the work of the CBSS(Council of Baltic Sea States) and BEAC(Barents Euro-Arctic Council)/Finnish Chairmanship 1999/2000.

Mr. Ulfstedt speaks fluent Swedish and other Nordic languages, as well as English. He has good knowledge of both German and Russian.

He is married with three sons.

CURRICULUM VITAE

M. Farhandi

The World Bank

Farhandi is Lead Energy Specialist for the World Bank, and presently Acting Sector Director for the Energy and Mining sector of the Bank's East Asia and Pacific Region.

Mr. Farhandi has been with the World Bank for almost 20 years, working in the energy sectors of many countries, notably, Argentina, Brazil, Bolivia, Peru, Chile, Nigeria, Kenya, Ghana, and Senegal. For the past 10 years he has been responsible for energy activities in Thailand, Korea, Indonesia, the Philippines, Vietnam, and Laos.

During this period he managed the processing and supervised implementation of many World Bank-financed energy project loans. These have included gas transmission, oil product pipelines, refineries, LNG liquefaction plants, power generation and electricity transmission and distribution projects. He is currently managing a study to assess the viability of regional gas trade in Northeast Asia.

Mr. Farhandi has also worked extensively with governments and energy sector officials to design and implement appropriate energy product pricing policy frameworks, legislative and regulatory aspects, institutional arrangements, capacity building, corporate and financial restructuring, and corporatization and privatization of energy sector entities.

CURRICULUM VITAE

Name : Ahmad M. A. Al GHAMDI

Job : Adviser; Minster's office
Ministry of Petroleum and
Mineral Resources, Saudi Arabia

Degrees :

B.S. (1972)	Riyadh University, Saudi Arabia.
M.A. (1978)	Denver University, U.S.A.
Ph.D. (1982)	Colorado State University U.S.A.

Curriculum Vitae

Mr. Gholamhossein Hassantash

Institute of International Energy Studies

Gholamhossein Hassantash holds a Masters degree in Energy Economics from Tehran University and a Masters degree in Public Administration. For the past 15 years, he has served as Secretary of the Commission of Foreign Policy in the Islamic Consultative Assembly, and as Deputy Director of Pecuniary and Office Affairs of the Ministry of Oil. He has also served as Director of Office Affairs in the National Iranian Oil Company (NIOC) and as a member of the General Assembly for Engineering and Construction of Oil Industries.

Furthermore, he has been Economic Advisor to the Ministry of Oil, Deputy to the President of IIES, and member of the board of Organization for Helicopter Services. His previous position before heading IIES was undersecretary of support services at Iranian National Airlines. He has lectured at universities in different topics including Economy of Oil, Political and on Economic issues on Energy and Economics Development. Mr. Hassantash has written a book in Economy of Oil and he has translated another book titled "Energy Efficiency Policy" written by Victor Anderson. In addition, Mr. Hassantash has published numerous articles at Oil and Gas Conferences such as the Second International Conference on Oil and Gas Resources held on Tehran on November 7-8 1998, which he was one of the organizers.

Mr. Hassantash has been directing the IIES since January 1998.

Session Chair

Biographical Sketch

1. Name : Chang, Hyun-Joon

2. Date of birth : Dec. 23. 1952

3. Education : B.A., Economics, Seoul National University, 1975
Ph.D., Economics, Cornell University, 1985

4. Employment Record

From September 1998
To Present : Korea Energy Economics Institute
Position : (September 1998-Present)
President

5. Job Experience

1974-75	Research Assistant, Korean Institute of International Economics (KIEI)
1976-79	Reporter, Joong Ang Daily News
1985-88	Fellow, Korea Development Institute(KDI)
1985-89	Specialist, Minimum Wage Commission
1988-98	Editor, Joong Ang Daily News
1988-91	Member, Korea Labor Law Reform Committee
1989-94	Fellow, Presidential Commission on the 21st Century
1994-	Member, Korea Statistical Advisory Committee
1997-98	Member, Economic Deregulation Commission
1998-99	Member, Administration Reform Committee
2000-	Fellow, Presidential Commission on Sustainable Development
2000-	Outside Director, Board of Directors, Hanvit Bank

6. Research Activities

Doctoral Dissertation

"Unemployment and Age: Structural Hazard Approach", 1985, Cornell University

Major Works

- Auction vs. Grandfathering in Emission Trading, IAEE International Conference, 2000.6
- Prospect of Northeast Asia Energy Coalition, Workshop on East Asian Energy Markets and Energy Cooperation in Northeast Asia, Rice University, 1999.12
- Restructuring and Privatization of Korean Power Industry, APERC Pacific Rim Workshop, 1999.11
- Korean Energy Market in Transition, USAEE/IAEE Annual Conference, 1999.9
- Current Status and Prospects of Natural Gas Market and Infrastructure Development in Northeast Asia, 2nd Seminar on Energy Security Linkage between Asia and the Middle East. the Ministry of Foreign Affairs of Japan, 1999.2
- Japan's Economic Development and Chaebol, (trans.), Oreum Press, 1997.
- Economic Behavior and Institutions, (trans.), KDI Press, 1997.
- My Capitalism, (trans.), Hanwha Economic Research Institute, 1997.
- Cooperative Labor Relations for Higher Productivity, KCA, 1996. 6.
- Managemential Outcome and Compensation Structure,(trans.), KMA, 1995
- New Labor Relations Towards the Future, (trans.), Korea Labour Institute, 1995
- New Paradigm for the Korean Economy: Productivity Enhancing Institution Building , Korean Tax Research Institute, 1994
- Heartbeat and Pulse of the New Economic Order in Global Scale, Joon-Ang Daily News Press, 1993
- Wage Determination in Korea, 1991, KDI Press
- Public Assistance Program in Korea, 1989, KDI Press
- Gain Sharing and Labor Relations, 1991, KREI Press
- Politics of Subversion, Tony Negri, (trans.) Korean Version, 1990
- The Age of Diminished Expectations, Paul Krugman, (trans.) Korean Version, 1991