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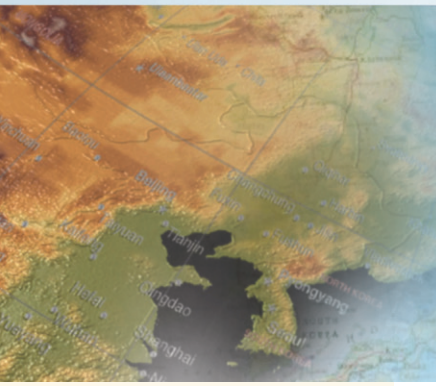

Northeast Asia Energy Focus

KOREA ENERGY ECONOMICS INSTITUTE

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CERNA
Center for Energy Research, Northeast Asia
KEEI

Editor's Message

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CERNA / KEEI

The Korea Energy Economics Institute (KEEI) is celebrating the 20th anniversary on September, 2006. The KEEI was established on September 1st, 1986 as a non-profit government think-tank for energy policy research and planning under the Ministry of Energy and Resource, the Republic of Korea. Since then, the KEEI has undertaken policy-oriented researches on energy and resources issues for sustainable economic development and endeavored to establish an efficient energy and resources system not only in Korea but also in Northeast Asia.

KEEI's researches on regional energy cooperation in Northeast Asia were commenced in 1991, when Korea began to normalize diplomatic relations with China and Russia, hoping that Korea would import energy sources from the countries in the region in near future. Since then, the research scope was expanded to cover not only domestic energy issues but also international/regional energy cooperation with serious attention.

Then it was anticipated that the development of Russia's oil and gas would be facilitated, the cross-border infrastructure for transporting energy resources being constructed in some years, thanks to the improvement of political environment after the end of the cold war era. However, the realization of this hope still seems to be a long way ahead.

Promoting energy cooperative projects in the region often appeares to be impeded by some deteriorated political situations, in particular surrounding the Korean Peninsular in respect to the nuclear related issues in the DPR Korea. Obviously, economic cooperation proved not to be free at all from the political realities in the region.

On the other hand, we can also observe that there has been some significant progress for the last ten years in the light of regional energy cooperation and trade in Northeast Asia. China became a major supplier of coal to Korea, for instance. Russia actively established bilateral energy relationship with China and Korea at the government level. Russia has emerged as a key source of energy in the Northeast Asian region. Already, Russia has been making efforts to promote discussion with neighboring countries to develop and supply oil and natural gas from oil and gas fields in East Siberia and the Far East to Korea, China, and Japan.

In commemoration of the its 20th anniversary, the KEEI is organizing an international symposium under the theme of 'Towards Regional Energy Cooperation in Northeast Asia: Key Issues in the Development of Oil and Gas in Russia,' in the middle of September with supports from the Ministry of Commerce, Industry and Energy (MOCIE), the Presidential Committee on Northeast Asia Cooperation Initiative (PCNACI), and the Seoul Broadcasting System (SBS). The objective of the symposium is to provide an opportunity for executive officers and renowned energy experts in the region to share their information and perspectives on the subject. It is expected that comprehensive discussion would be held at the symposium on the issues of energy cooperation in Northeast Asia, including opportunities for practical energy cooperation projects of private sectors. It is our sincere hope that the symposium will provide a significant momentum for enhancing energy cooperation among Northeast Asian countries.

I would like conclude this remark with a wish for a great success of regional energy cooperation in Northeast Asia in next twenty years to come. ▣

News Update

Inside the KEEI

The MOU signing ceremony and the Joint International Symposium between the KEEI and the YUST

On July 4 - 6, 2006, the second session (Management, Economics and Energy Session) of the 2006 International Symposium was held jointly by the KEEI and Yanbian University of Science and Technology (YUST) at Yanji, China. Also, two organizations performed a MOU signing ceremony for research cooperation in the energy field on July 4, 2006 in connection with this Symposium.

The theme of the Symposium was "Establishment of a Foundation of Economic Cooperation and Technology Cooperation in Northeast Asia." At the second session of the Symposium, the main focus was given to the ways to promote practical energy/resources cooperation projects in Northeast Asia, especially, power grid interconnection and new & renewable energy cooperation among Northeast Asian countries, and energy cooperation between two Koreas.

Also, the KEEI and the YUST, by concluding the MOU on research cooperation in the energy policy/planning area, agreed to conduct joint researches on commonly interested subjects through organization of co-hosted conferences, data and information exchange, and researcher exchange programs.

KEEI-Nautilus Joint Workshop

DPRK Energy Expert Study Group Meeting" co-organized by the KEEI , the Nautilus Institute and the CISAC(Center for International Security and Cooperation, Stanford University) was held during the period of June 26 to June 27, 2006 in East Palo Alto, California, USA. At the workshop many valuable papers were presented by internationally well-known experts on the DPR Korean energy issues. Presentation and discussion on the DPR Korean sectoral energy demand and supply was the main content of the seminar, which were followed by active discussion on the impact of recent trends and challenges concerning the DPR Korean economy and the international cooperation for redevelopment of the DPR Korean energy sectors.

Research Proposal Evaluation Workshop

CERNA organized "Research Proposal Evaluation Workshop" for the successful implementation of research projects for 2006 on Northeast Asian Energy Cooperation. The Workshop was held during the period of July 20 to July 21 in Sangrok Resort, Cheonan, Chungcheongnam-Do, Korea. All members of CERNA and related research personnel in KEEI participated in the workshop, where 16 research proposals on Northeast Asian Energy Cooperation were closely examined and discussed.

Presentations in Seminars outside the KEEI

▶ The 5th Northeast Asia Economic Cooperation Forum" organized by the Northeast Asia Peace Movement(Korea) was held on 22-27 July 2006, in Khassan Russia. More than 50 experts from Russia, China, and Korea participated in the forum. Participants discussed extensively several issues on energy cooperation, transportation, tourism, and regional development in the cross-border area among Russia, China, and DPRK.

▶ "East Asia Consultations on International Climate Regime Beyond 2012" organized jointly by the Institute for Global Environmental Strategies (IGES, Japan) and the Energy Research Institute (ERI, China) was held on 3-4 July 2006, at Beijing China. The objective of the consultations, which were informal in principle, was to promote constructive thinking on future actions against climate change beyond 2012 in the Asia-Pacific region, and contributing to the shaping of a future regime that reflects concerns and developmental aspirations of the regional countries.

More than thirty experts from China, Japan, Korea, and Mongolia participated in the consultation. Participants discussed extensively five thematic issues, which are national perspectives on climate regime beyond 2012, energy security and development needs in relation to climate regime, technology development and transfer, restructuring CDM, and facilitating adaptation.

▶ On June 27-29, 2006, International Conference was held in Yakutsk, Russia under the theme of "Investment Potential of the Sakha Republic: Eastern Course of Development of Russia" and "Cooperation in Energy Industry in Asia: Mechanisms, Risks, Barriers". This Conference was jointly organized by the Republic of Sakha and the Far Eastern Branch of the Russian Academy of Sciences. The main purpose of the conference is to discuss possibilities of investment attraction to energy and transportation sector in the Republic of Sakha and the Far Eastern Region after the change of East Siberia-Pacific Ocean Oil Pipeline route. Dr. Sung-Kyu Lee in KEEI and many experts in energy sector from Russia and foreign countries took part in this conference. In the oil and gas session were discussed the current issues about oil and gas pipeline network construction between the East Russian region and Northeast Asian countries.

Welcome to KEEI

▶ In July 11, 2006, Mr. Mikhail Shabalov, Deputy Trade Representative of Russia in Seoul, paid a visit to KEEI to discuss the prospects for energy cooperation in Tumen River Area. He asked KEEI about the current situation and prospects of Tumen River Area energy cooperation.

Dr. Ji-Chul Ryu and Dr. Yong-Duk Pak explained the benefits of the establishment of international oil distribution hub in Tumen Area like Rotterdam oil spot market because the area can be a very effective channel for Russian oil supply to China, Korea and Japan. There will be a huge volume of oil trade between Russia and three big consumers of China, Korea and Japan. This prospect of huge oil trade will help the Tumen Area oil distribution hub to become a very influential international oil spot market. Mr. Shabalov showed a big interest in establishing the oil hub and agreed that we needed to promote the oil hub project with high priority put on it among energy cooperation projects in Northeast Asia.

▶ Professor Peter Drysdale of the Australian National University (ANU) visited the KEEI on June 25, 2005 and had a meeting with Dr. Ki-Yual Bang, President of the KEEI, Dr. Ji-Chul Ryu,

Executive Director of the KEEI/CERNA, and Dr. Euy-Suk Yang. Professor Drysdale discussed research cooperation activities between the KEEI and the ANU under the theme of regional energy cooperation in Northeast Asia, particularly concerning the DPR Korea and China.

▶ On May 23, 2006, the next generation leaders from Commonwealth of Independent States (CIS) countries, who are energy-related government officials in their countries, visited the KEEI as part of the Korea Foundation Invitation Program and had a small conference at the Conference Room in the KEEI. The KEEI provided introductory presentations on its current status and the energy policies and planning of Korea. After the presentation, there was a free and heated discussion on the role of a government-sponsored energy research institute concerning national energy policy making and planning.

New Publication of the CERNA Policy Reports in 2005

16 policy reports on energy cooperation in Northeast Asia have been published. These reports are the final outcome of the 2005 research projects in the CERNA. They are available in the web-site of CERNA.

- Second-Phase Action Plan for Energy Coopera tion in Northeast Asia(Sang-Yul Shim)
- USA Energy Development Strategy in Eastern Russia and Energy Cooperation in Northeast Asia (Sung-Kyu Lee)
- Analysis of Northeast Asia Energy Market (Cheol-Seon Hong)
- Management of the Northeast Asia Energy Database and Information System (Tae-Won Kang)
- A Study on the Energy Expert Network for the Energy Cooperation in Northeast Asia (Ji-Chul Ryu)
- A Study on the Comparison of Energy Resources Statistic Systems in Northeast Countries (Euy-Seok Yang, Tae-Gyu Kwon)
- Establishment of Institutionalized Framework for Energy System Integration in the Korean Peninsular: The Petroleum Sector (Kyung-Sool Kim)
- A Study on the Action Plan for the Strengthening of the DPR Korean Non-Physical Capacity in Energy Sector (Kyung-Sool Kim)
- Study on Institutional Arrangement for FTA in Northeast Asia: Energy FTA among Korea, China, and Japan (Sung-Hee Choi)
- On the Model Analyzing Economic Impact of Northeast Asia FTA in Energy Sector (Yong-Duk Pak)
- The Impact of Chinese Oil Market Opening on the Oil Product Trade in Northeast Asia (Dal-Sok Lee)
- A Strategy for Exploring Energy Resources in the Sakhalin: 2nd Phase (Dal-Sok Lee)
- The Russian Oil Market Expansion in Northeast Asia and Import & Utilization Strategies of NEA Countries (Euy-Seok Yang)
- Economic Benefit Analysis for Energy Efficiency Improvement of Korea, Japan and China (Euy-Seok Yang)
- Importation Plans of Natural Gas from East Siberia and Russia's Far East under UGSS (Seung-Jick Yoo, Sung-Gue Lee)
- Economic Benefit Analysis of Northeast Asian Strategic Petroleum Reserve Cooperation (Jin-Young Soh)

Briefs in NEA

Northeast Asia Focuses On Crude Oil Reserve

As the oil price rises, competition among Korea, China and Japan for procuring oil is relentless.
The three countries are searching for new oil and gas fields all around the world, as well as increase its reserve facilities in its own land.
China recently spurred its crude oil reserve ability and has led the competition among the three countries.
Since 2003, China has increased its ability to reserve oil, which it recently completed construction of new oil reserve facilities in Junhai province, which can hold 10 million barrels. China is in the process of adding more reserve facilities at Dalian and Huangdao province, which will roughly hold 5 million barrels.
Korea, which reserved 122 million barrels of crude oil for urgent times, utilized natural caves as reserve facilities. As it stands, 70 percent of all the reserve facilities in Korea are caves.
The caves that Korea uses, saves a tremendous amount of money on constructing oil reserve facilities.
Management expense per barrel in Korea for 2005 was recorded at 416 won, it was just 1/5 of the price compared to the management expense in Japan.
Japan, which reserved 321 million barrels, is the top among the three countries oil reserve scale. By 2010, Japan plans to construct new reserve facilities, which will hold 15 million metric tons.

Korea to Expand Overseas Search for Energy

South Korea will expand its overseas search for both coal and oil this year, Korean government officials said.
Korea Resources Corp. and SK Corp. have requested permits to take part in three additional coal projects this year, one of which in Australia will be completely controlled by the two.
South Korean companies also operate in Indonesia, China, Russia, Canada and the United States.
While the country produces 22.2 percent of its own coal, total coal imports reached 69.3 million tons last year, and were worth 4.5 trillion won ($4.8 billion).
Coal from mines in which South Korean companies held an interest came to 15.4 million tons.
Twenty-five companies were either mining or exploring new sources of coal in 25 countries in 2005.
The bulk (45.6 million tons) of the imported coal is used to generate power, while 16.9 million tons is used by steel factories. The remainder is used by industries like cement production, according to the Ministry of Commerce, Industry and Energy.
Guaranteeing a steady supply of coal is becoming more important as high demand in China drives up prices, according to the ministry.
As the fourth largest oil importer in the world, South Korea will also try to expand independent oil projects abroad.
South Korea is completely dependent on imports for its oil supply, making it the fourth largest oil importer in the world.
Under a plan to expand independent oil development projects over the next 10 years, 12.15 trillion won ($12.8 billion) will be spent to help the Korean National Oil Corp. and private companies explore overseas oil fields, according to the Ministry of Science and Technology.
The ministry hopes to raise the percentage of imported oil produced by overseas independent oil developers from the current 3.8 percent to 18 percent by 2015.
The move is expected to help the country save 47.4 trillion won ($50.7 billion) in energy import costs and create 300,000 new jobs in the energy and resource sectors.

Japanese-Russian talks progress over ESPO oil line

Talks between Japan and Russia are said to be progressing over a proposal to have Japanese firms join Russian development of an East Siberian oil field in connection with the project to lay the 4,188-

km East Siberia Pacific Ocean crude oil pipeline.
Reports say the two sides have not yet agreed on which specific Siberian oil field they will develop but that Japan Oil, Gas & Metals National Corp., an independent administrative agency, in oil development in eastern Siberia is being considered as a participant, while private sector firms such as Sumitomo Corp. and Inpex Corp. also have indicated a desire to invest.
The two governments are talking to prepare for a deal that could be concluded by Japanese Prime Minister Junichiro Koizumi and Russian President Vladimir Putin when they meet in mid-July on the sidelines of the Group of Eight summit to be held in St. Petersburg.
Russia has long said it may be possible to export as much as 80 million tonnes/year of oil through the fully extended pipeline, but that meeting such a target will depend on output from fields in eastern Siberia which have yet to be developed.
The Japanese side hopes that an agreement with Russia on development of the fields, in which the oil produced will be exported to Japan, will speed the early construction of the eastern half of the projected ESPO line so that the Siberian oil can be shipped to Japan.
Due to such commercial considerations, Russia has not decided when, if ever, to start construction of the eastern half of the line, although it started building the western half on Apr. 28 under a plan to complete the portion in 2008.
The western half will start from Taishet near Lake Baikal and will extend to Skovorodino near the Russian-Chinese border, the midpoint of the entire pipeline route. From there, Russia plans to export oil to China via railroad or a branch line of the pipeline.
In May, Japanese Foreign Minister Taro Aso urged Russian Chamber of Commerce and Industry Pres. Yevgeny Primakov to hasten the start of talks on construction of the ESPO line

New Undersea Energy Concession to Begin in East Sea

The Ministry of Commerce, Industry and Energy (MOCIE) announced on May 25 that they are in the process of legislating of the revised Offshore Mineral Resources Development Act to designate an offshore lot in the East Sea where oil exploration can take place.
The newly-designated mine lot will be named as the 8th mine lot and it has a sea area of 8,481 km≤, south of the Ulleung Island.
The location is near the north of the 6-1 mine lot, which holds the East Sea-1 gas field, and is known to be a deep-sea area with 1,000 meter-depth.Within Korean territorial waters, there are a total of six mine lots, with the mine lot No.1 first designated in the West Sea, and the seventh one south of the Jeju Island, known as the Korea-Japan joint development area.A MOCIE official revealed that, "Since the Korea National Oil Cooperation (KNOC) has a plan to explore an oil field in the East Sea in cooperation with Woodside Petroleum Co. during the second half of this year, we have decided to designate a new mine lot in the area through legislation in order that oil exploration rights can be established."Woodside Petroleum Co. is an Australian company, specialized in oil exploration which holds technology and expertise in exploring deep sea areas, while it is in 14 years that foreign investment participates in national offshore oil exploration, reportedly.

Global Cooperation Shapes Korea`s Energy Policies

Reliance on imported oil pushes the government to focus more on developing renewable energy resources
With pressures intensifying to secure stable crude sources amid soaring global oil prices and tight supply, Korea`s dependence on imports has driven it to adopt policies for energy diversification through aggressive exploration and international cooperation.
As the world`s fifth-largest crude importer, Korea has developed long-term approaches, including international cooperation, for coping with its oil needs. These approaches entail a future-oriented

energy consumption system and aggressively pursuing overseas oil exploration projects, the Ministry of Commerce, Industry and Energy says.
Deprived of domestic oil reserves, Korea imports about 98 percent of its crude oil, which makes up the largest share of the country`s total energy consumption. Petroleum accounted for 54 percent of the country`s primary energy consumption in 2002. In 2004, the nation consumed about 2.14 million barrels a day (bbl/d), down from a high of nearly 2.3 million bbl/d in 1997. Last year, the country`s primary energy consumption during the first nine months rose by 4 percent compared to a year ago, according to the Korea Energy Economics Institute.
Eighty-one percent of the country`s oil imports come from the Persian Gulf region, with Saudi Arabia supplying about one-third, the Energy Ministry said.
By energy category, from January to September 2005, consumption of nuclear power and alternative energy increased significantly from 2004, according to the KEEI. Demand for coal and liquefied natural gas was comparatively low.
The Energy Ministry`s 2006 policy initiative outlines long-term policy goals that aim to balance environmental changes and the outlook for supply and demand. Since the 1997-98 financial crisis, the country has felt a greater need to rethink its reliance on imported oil for domestic energy demand.
Diverse exploration The reliance on imported oil has pushed the government to focus more on developing renewable energy resources and necessary technologies. Along with its goals in the 21st century of promoting green development, such as increasing the use of photovoltaic power and fuel cells, the country`s environmental outlook depends on its ability to shift its energy supply to cleaner-burning fuels and reduce the emissions of greenhouse gases blamed for causing global warming.
Another long-term policy objective is staking out oil and gas fields. This secures energy needs to reduce reliance on foreign oil and strengthens national competitiveness in the global economy.

Japan to Start Receiving Sakhalin Crude Oil This Year

Japan will start receiving its first shipments from the $13 billion Sakhalin-1 oil and natural gas project in Russia this year, helping the world's second-largest economy cut dependence on imports from the Middle East.
The Exxon Mobil Corp.-led venture will begin sending oil to Japan “in the next few months,” Shiro Matsumoto, deputy general manager of the project department at Sakhalin Oil & Gas Development Co., a Japanese investment company with a 30 percent equity stake in the venture, said in an interview. First flows to mainland Russia began in October.
The project, 10 times closer to Japan than Saudi Arabia, will allow the Asian nation to reduce the amount of oil it buys from the Middle East, where a dispute over Iran's nuclear program threatens to disrupt supplies. Oil from Sakhalin-1 will meet about 6 percent of Japan's daily needs.
The Sakhalin projects led by Exxon Mobil and Royal Dutch Shell Plc have combined oil reserves of more than 3.3 billion barrels. A new flow of oil into Asian markets could make Russian oil a benchmark in the region along with Dubai and Oman. Russia, the world's second-largest oil producer, now directs most of its oil exports to Europe.

Japan Sales

Sakhalin Oil & Gas will sell most of its oil entitlement, equal to its stake in the Sakhalin-1 project, to refiners in Japan, Matsumoto said by phone on June 21. The light, low-sulfur Sokol grade of oil will be shipped from Russia's Far East port of DeKastri. It's piped to the port from offshore processing plants on the west coast of Sakhalin island.
This year, the project will raise production fivefold to 250,000 barrels a day. The project's three offshore fields -- Chayvo, Odoptu, and Arkutun Dagi -- have recoverable reserves totaling 2.3 billion barrels. They took a decade to develop.
Expectations that Sakhalin oil will become Asia's home-grown benchmark are increasing, because it is a North Asian grade that could compete against oil dominantly shipped from the Middle East into Asia, Nippon Oil Corp. Chairman Fumiaki Watari said. Dubai and Oman crude oil are used to set prices in Asia.

Lower Costs

Sakhalin oil may help refiners such as Nippon Oil cut costs from shipping similar low-sulfur varieties from Saudi Arabia, Abu Dhabi and West Africa. The shipping distance to Japan from Saudi Arabia is about 6,600 miles, compared with about 650 miles for the run from DeKastri port to northern Japan.
The Middle East accounts for about 90 percent of Japan's oil imports, up from 68 percent in 1987.
All five of Japan's top oil suppliers are from the Middle East, led by Saudi Arabia. Japan is reducing the amount it brings in from Iran, the third-largest supplier, on concern the standoff over the Islamic Republic's nuclear program increases the risk of supply disruption.
Japan purchased 4.29 million barrels of oil a day in the year ended March 31, according to data from the Ministry of Economy, Trade and Industry. The country bought 1.25 million barrels a day from Saudi Arabia, or 29 percent of Japan's total oil imports that year.
Japan, which is vulnerable to supply cuts because it relies on imports for almost all of its oil, is seeking ways to secure natural resources over the next 25 years as China and India step up acquisition of oil and gas assets abroad.

Government Help

The government plans to help Japanese companies increase overseas oil assets to 40 percent of the country's total oil imports by 2030, from 15 percent now, the Trade Ministry said in an energy policy proposal on May 29.
Japan has lobbied Russia for more than three years to build a pipeline to carry Siberian oil to the Pacific coast for shipping on to Japan. When Japanese Prime Minister Junichiro Koizumi met President Vladimir Putin in St. Petersburg in May 2003, he asked Putin to agree to extend a pipeline linking eastern Siberia and China to the Pacific.
Japan's government, refiners, trading houses and exploration companies are keen to participate in Russian oil projects.
A unit of Mitsui & Co. owns 25 percent of the Sakhalin-2 oil and gas project, operated by Sakhalin Energy Investment Co. Mitsubishi Corp. holds a 20 percent stake through its subsidiary. Royal Dutch Shell has a controlling 55 percent holding in Sakhalin-2, which pumped 70,000 barrels a day of Vityaz oil in 2005.

Stable Output

Sakhalin Energy expects to keep production unchanged this year, Belentina Kiseleva, a company spokeswoman said last week.
Sakhalin-1's partners comprise Exxon Neftegas Ltd., Japan's Sakhalin Oil & Gas Development, two affiliates of OAO Rosneft and India's state-owned oil company ONGC Videsh Ltd.
Sakhalin Oil & Gas Development is a Japanese joint venture, with the government holding a 50 percent stake. Itochu Corp. and its unit own 18.12 percent. Japan Petroleum Exploration Co. has 14.46 percent and Marubeni Corp. holds 11.68 percent. Inpex Holdings Inc., Japan's largest oil and gas exploration company, now holds a 5.75 percent stake, and plans to buy additional shares from the Japanese government and increase its shareholding to 33 percent.
Oil imports from Russia are set to continue in the years ahead, the Institute of Energy Economics' Nagata said. The Sakhalin-1 venture pumps oil to the international market in tandem with the Royal Dutch Shell-led Sakahlin-2 project.
``In addition to the Sakhalin projects, Russian oil will be shipped out to the north Asian market, once an east Siberian pipeline is built," Nagata said.
In the year ended March 31, Japan increased imports of Russian oil by 9.7 percent to 30,000 barrels a day, compared with a year earlier. All of the oil came from the Sakhalin-2 project, according to the Trade Ministry's statistics.

China Maps Out Natural Gas Pipelines

Experts have mapped out China's natural gas pipeline network already in existence and to be constructed over the next 20 years. Natural gas, the most rapidly growing energy resource of the century in terms of consumption, was a key topic of discussion at the China Oil & Gas Pipelines Development Summit that was held in Beijing from June 15 to 16.
The main highlights of the network plan were published in a Beijing Morning Post report on June 19.

Domestic arteries

Since the late 1990s, several natural gas arteries have been constructed including the Shaanxi-Beijing Pipeline, West-East Gas Pipeline that starts in Lunnan Oilfield in the Tarim Basin in northwest China's Xinjiang Uygur Autonomous Region, spans eight provinces and autonomous regions and ends in Shanghai, the Zhongwu Line that pipes gas out of Sichuan Province, and a second Shaanxi-Beijing Pipeline.

"Adding the Coastal Natural Gas Pipeline and several cross-border pipel ines through Russia and Kazakhstan, which are under construction now, a basic frame of gas transportation pipelines in China is forming rapidly," said Professor Liu Yijun from China University of Petroleum.

Currently, China's natural gas pipelines measure a total of 24,000 kilometers. According to estimates provided by Liang Chengyu, head of Guangdong Oil & Gas Association, this should increase to 36,000 kilometers by the end of 2010.

Pan Jiahua, honorary chairman of the executive council of the Petroleum Reserve and Transportation Committee of the China Petroleum Society, this period of time -- from now until 2020 -- will see rapid development of China's natural gas pipelines industry. Pan sets 2021 to 2030 as the maturation period.

Despite this rapid development, China will continue to be faced with the challenges of inadequate natural gas supplies. It is estimated that by 2020, China's natural gas shortage could be as much as 90 billion cubic meters.

"China will solve the shortage mainly through imports of liquefied natural gas (LNG) and land pipeline natural gas," said Tang Yali, vice general manager of China National Petroleum Corporation (CNPC)'s Natural Gas and Pipeline Branch Company.

In order to satisfy growing domestic demands, China has already started several LNG import projects, Australia being one of the main exporters. At present, 11 coastal provinces, municipalities and autonomous regions have plans to build large-scale LNG import projects, with Guangdong planning on two. An estimated 12 LNG projects are being drafted and will be submitted for state approval.

Cooperation with Russia and Central Asia

In March, China and Russia signed a Memorandum of Understanding for the transport of natural gas from Russia to China. From 2011, Russia, the world's No.1 natural gas exporter, will supply 60 to 80 billion cubic meters annually to China.

Exports will be transported in two ways: the west pipeline will enter China's Xinjiang through Siberia and Altai, and finally connect with the West-East Gas Pipeline, supplying natural gas to China's coastal areas. The east pipeline, yet to be confirmed, might transport natural gas from Kovykta or Sakhalin and Chayandinskoye gas fields located in Yakut.

Russia and two of China's major oil companies, CNPC and China Petroleum and Chemical Corporation (Sinopec), will construct the 3,000-km long west pipeline first. It is expected to transport gas within five years, which can supply 30 to 40 billion cubic meters of natural gas to China annually.

As significant is the planned natural gas pipeline between China and three Central Asian countries. "After 2009, the 30 billion cubic meters of natural gas that Turkmenistan will supply annually will also be an important source of China's natural gas reserves," Pan said.

Pan was referring to the contract signed between China and Turkmenistan during Turkmen President Saparmurat Niyazov's visit to China in April. Under the 30-year contract, Turkmenistan will export 30 billion cubic meters of natural gas annually to China starting from 2009, two years earlier than China's agreement with Russia. The contract also provides that the China-Turkmenistan natural gas pipeline should be completed by then.

However, because China and Turkmenistan do not share any borders, certain monetary and logistical arrangements have to be made to transport the natural gas through Uzbekistan and several Kazakhstani territories before finally connecting with the West-East Gas Pipeline.

Uzbekistan and Kazakhstan also have abundant sources of natural gas, and both have expressed their willingness to export to China. Once the China-Turkmenistan pipeline is constructed, all three Central Asian countries will be able to supply natural gas to China simultaneously. ▣

Issue & Focus

Comparative Case Study: Lessons and Observations for NEA from Regional Energy Cooperation in Central Asia Region and ASEAN

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Background

As North East Asia (NEA) energy cooperation advances, it is important to learn from other regions' cooperation experiences. We can see that countries in some regions, for example, Central Asia, have been able to accomp lish significant results in terms of advancing regional energy cooperation in spite of their different political and economical structures. There are many ongoing large scale projects (gas and oil pipelines, power links), which will significantly affect supply and demand patterns in China and the whole Central Asia.

Countries of the Association of South East Asian Nations (ASEAN) also are working actively to create an ASEAN power and gas networks, which require significant commitments in terms of political will, resources, etc.

The article will briefly examine current status of energy cooperation in Central Asia and ASEAN and draw lessons and observations for NEA countries to facilitate future cooperation in the region.

Current Status of Central Asia regional energy cooperation

The countries of Central Asia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, have enjoyed an average GDP growth of 8.7% (2000~2003), and the average growth rate of 10% were recorded in Kazakhstan. Turkmenistan grew even faster. With well-educated population of 60 million and combined annual GDP of $43 billion, the Central Asian states, such as Afghanistan, Azerbaijan, and the Xingjian Uighur region of People's Republic of China (PRC) have enjoyed its development and prosperity[1].

The Central Asian countries are endowed with significant energy related natural resources, although distribution of these resources is uneven. The Kyrgyz Republic and Tajikistan have abundant hydropower potentials but negligible reserves of commercially exploitable fossil fuels. In contrast, Kazakhstan has significant reserves of oil, gas and coal; Uzbekistan has substantial gas reserves as well as some oil and coal; Turkmenistan also has substantial gas reserves together with some oil.

Central Asian countries possess 47, 7 billion barrels of oil reserves (4% of the world's reserves), and as of 2004 oil production reached about 2000 million barrels per year[2].

Proven natural gas reserves of Central Asia are 9.2 trillion cubic meters (about 5% of world gas reserves, and current gas production stands at 133.5 billion cubic meters (2.9% of world's total).

Among the latest regional energy projects which were recently realized, the largest one is the Baku-Tbilisi-Ceyhan (BTC) Oil Pipeline, and this project will benefit Central Asian countries to get better access for their oil exports. The Baku-Tbilisi-Ceyhan (BTC) Oil Pipeline will transport up to 50 million tons of oil per day a distance of 1,767 km from an expanded terminal at Sangachal on the Caspian Sea in Azerbaijan (443 km), through Georgia (248

1) Source Central Asia in the Global Economy, by S.Frederick Star

2) Source: Central Asia: Mapping Future Prospects to 2015, Malcolm Dowling and Ganeshan Wignaraja, Economics and Research (ERD) paper series, #80, Asian Development Bank (ADB), April 200

km) to the Mediterranean port city of Ceyhan, Turkey (1,076 km). The total project costs are estimated at USD 3.7 billion. There are pre-feasibility stage studies for potential extensions of the oil pipeline to Kazakhstan, and Kazakhstan signed an agreement with Azerbaijan to transport 25 million tones of Kazakh oil per annum[3].

The Other large project recently realized is the Kazakhstan- China oil pipeline, which is 962 km long. The first phase will transmit 10 million tons of oil a year, and will reach 20 million tons of oil[4] a year by 2011[5]. The pipeline was developed jointly by the China National Petroleum Corporation (CNPC) and the Kazakh state energy company, Kazmunaigaz.

Kazakhstan and China are working to build gas pipeline in parallel to the existing Atasu-Alashankou oil pipeline.

Kazakhstan will use Chinese loan to build power plants and grids to transmit power to China.

The installed generating capacity of all power stations of the CAPS amounts approximately 25,000 MW (2002). Annual electricity demand reached 136,128 GWh in 2003 and is expected to reach 180,225 GWh in 2020, and 206,075 GWh in 2025.

Afghanistan, Pakistan, Iran, China and Russia are all potential markets for electricity produced in Central Asia. Power links with Central Asia would help to decrease power shortages in Afghanistan, Pakistan and Iran, to balance power demand for Russia to meet its goal to increase power supply to Europe, to meet power demand in Urumqi, Xinjiang Uighur regions of China. This power in western China can also be transmitted to eastern costal areas of China, where the power supply is most needed, and support the power transmission plan from west to east. In terms of potential generation projects, most financially feasible projects to meet electricity export to the above-mentioned countries are Sangtuda I hydropower project (670 MW), Rogun Hydropower Project (Phase I (1200 MW), Phase I and II (in total 3600 MW) in Tajikistan, Talimardjan thermal power project (800 MW) in Uzbekistan, Kambarata hydropower project II (360 MW) in Kyrgyzstan, thermal power plants at Ekibastuz in Kazakhstan etc.

Investment needs of all identified projects including rehabilitation of transmission and distribution and new projects is estimated at about US$ 13 billion in real terms of the next 20 years[6].

The Central Asia region has significant energy related water resources within the Aral Sea basin, which is comprised of the Syr Darya and the Amu Darya river basins. The Aral Sea Basin includes Northern Afghanistan, southern Kazakhstan, and most of Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan.

The Central Asia Power System (CAPS) of Central Asia as an integrated electric power pool with the united dispatch center in Tashkent, developed in the 1960' s by the Soviet Union and, currently, the main 110 kV, 220 kV and 500 kV transmission lines link the power systems of southern Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. Afghanistan is also linked to the CAPS on a limited basis[7]. It is necessary to introduce market-based principles in the CAPS, coupled with water use demand and management coordination.

The ADB supported energy as a priority area in promoting regional cooperation in Central Asia since 1996. ADB supported many important projects, such as Central Asia Regional Power Modernization Project, rehabilitation of irrigation and drainage etc., and commissioned a number of studies and organizational meetings.

It is notable that there are active intergovernmental organizations, such as Shanghai cooperation organization (SCO), which aimed to strengthen mutual trust and good-neighborly relations, to promote cooperation in political affairs, economy

3) www.gazeta.k

4) 15 per cent of China' s total crude oil imports for 200

5) Source People' s Daily Online, http://english.people.com.cn/200607/12/eng20060712_282194.html

6) Source Central Asia Regional Electricity Exports Potential Study (REEPS), December 2004, the World Bank

7) Source ADB, The Study on Water and Energy Nexus in Central Asia, J.Michael Biddison, 200

and trade, energy, transportation and other fields, and to strive towards creation of democratic, just, reasonable new international political and economic order among member states[8].

There are many other donors contributing to the development of regional cooperation in Central Asia, and among them the Asian Development Bank (ADB) has been very active in promoting regional development and poverty reduction.

The Central Asia Regional Economic Cooperation (CAREC) Program was established in 1997. Member countries include Azerbaijan, People's Republic of China (Xinjiang Uygur Autonomous Region), Kazakhstan, Kyrgyz Republic, Mongolia, Tajikistan, Uzbekistan. The priority areas are energy, water, trade, and transport. The Secretariat is the Asian Development Bank, and institutional framework components consist of Ministerial Conference, Senior Officials' Committee (SOC), Project Working Groups, National Focal Points, and Secretariat. Main donor participants since 2003 have been the ADB, EBRD, IMF, IsDB, UNDP, and the World Bank. Total lending to CAREC countries reached US$ 2.6 billion, including US$ 187 million in regional projects, and technical assistance grants amounted US$ 175.8 million, including US$ 14.8 in regional projects[9].

Significant amount of lending from donor countries was committed to promote regional cooperation through projects which will address priority areas to economic growth and poverty reduction. The Asian Development Bank (ADB) and other donors' rationale for supporting the Central Asia's regional cooperation is that the regional cooperation is not an option, but a necessity. Tadao Chino, the ADB President says, "··· The countries of Central Asia are uniquely independent. Because of the region's remoteness, integrated infrastructure, shared natural resources, and small individual country markets, regional cooperation provides a strategic framework for development···"

The ADB CAREC initiative has addressed priority sectors vital to the economical and regional development of Central Asian region, such as trade, transport and energy. Development of ICT Master plans for customs and tax, reforms, trade logistics development projects will bring tangible results. Extractive industries transparency initiative (EITI) is an important partnership of the Governments, nongovernmental organizations, extracting companies that will improve access to information in the oil, gas and mining industries. It is supported by countries of the region as well. Central Asian countries joined the CAREC Member Electricity Regulators Forum (CMERF) (i) to share regulatory and sector reform experiences; (ii) build regulatory skills and conduct training programs; (iii) cooperate to develop common electricity regulations[10]. Since Central Asian countries differ significantly in terms of political structure, institutional capacity, the ADB's initiative to improve regulatory and institutional capacity to regulate electricity sector was very important to promote regional cooperation.

Current Status of ASEAN energy cooperation

The challenges of globalization demand greater regional integration to increase competiveness, and one of regional alliances in Asia is the Association of South East Asian Nations (ASEAN)[11]. Today, the ASEAN region is a vast market of more than 520 million people with a total area of 4.5 million square kilometers. Its combined gross domestic product is about US$ 610 billion, and the total trade is more than US$ 700 billion.

Member countries of The Association of South East Asian Nations (ASEAN) have vast reserves of 22 billion barrels of oil, 227 trillion cubic feet of natural

8) http://www.sectsco.or

9) Source CAREC newsletter, Lending and TA amounts as of April 2004 and excluding People's Republic of China (PRC

10) Source: A Diagnostic Review of Regulatory Approaches and Challenges (DRRAC)", Asian Development Bank (ADB)

11) Source http://www.aseansec.org

gas, 46 billion tons of coal, 234 GW of hydropower, 20 GW of geothermal capacity, and countries have worked actively to promote regional energy cooperation towards economic integration.

Guided by the Treaty of Amity and Cooperation (TAC) of 1976 as its fundamental principle, the ASEAN continues its cooperation since then in areas, such as trade, finance, investment, industry, services, finance, agriculture, forestry, energy, transportation, information communications technology, intellectual property, small and medium enterprises, and tourism. For the energy, the Senior Officials Committee (SOME) has the overall responsibility in the supervision, coordination and implementation of ASEAN cooperation programs, projects and activities. The ASEAN Ministers on Energy Meeting (AMEM) provides the issues and concerns of common interest and set policy and program directions in ASEAN energy cooperation[12].

During the 2nd ASEAN Informal Summit in December 1997 Malaysia was assigned to establishing the interconnecting arrangements for electricity, natural gas, and water utilization within ASEAN member countries through the ASEAN Electricity Grid and Trans-ASEAN Gas Pipeline. Also the ASEAN Ministers approved the ASEAN Vision 2020, which among other things, resolved to: "... establish interconnecting arrangements in the field of energy and utilities for electricity, natural gas and water within ASEAN through the ASEAN Electricity Grid and a Trans-ASEAN Gas Pipeline and Water Pipeline, and promote cooperation in energy efficiency and conservation, as well as the development of new and renewable energy resources.

And as a follow-up implementation action has been adopted the Hanoi Plan of Action by the ASEAN Heads of State / Government at the 6th ASEAN Summit, Hanoi, Vietnam, December 15-16, 1998, which called to: "...institute the policy framework and implementation modalities by 2004 for the early realization of the trans-ASEAN energy networks covering the ASEAN Power Grid and the Trans-ASEAN Gas Pipeline Projects as a more focused continuation of the Medium-Term Programme of Action (1995~1999)." [13]

At the 20th ASEAN Ministers on Energy Meeting (AMEM) in Bali in July 2002, the ministers signed the Memorandum of Understanding (MOU) on the Trans-ASEAN Gas Pipeline (TAGP) Project. The MOU will serve as a framework for the ASEAN public and private sectors for the realization of the TAGP project. The 20th AMEM also approved the roadmaps for the concerted implementation of the ASEAN Power Grid and Trans-ASEAN Gas Pipeline Projects.

To date with the technical assistance of major donors, such as the ADB and many others, the Trans-ASEAN Gas Pipeline Master Plan, the ASEAN Interconnection Master Plan Study and many other studies were completed.

The ASEAN Interconnection Master Plan Study (2003) identified 14 interconnection projects. Two interconnection projects are operational, and these are: i) the Peninsular Malaysia-Singapore interconnection; and ii) Thailand-Peninsular Malaysia Stage #1 and Stage #2 interconnections. For further implementation of the ASEAN Power Grid Project priority has been given to following five optimal interconnection projects:

- Thailand-Laos Interconnection Project to be completed by 2009;
- Thailand-Cambodia Interconnection Project to be completed by 2009;
- Vietnam-Cambodia Interconnection Project to be completed by 2007;
- Malaysia (Peninsula)-Indonesia (Sumatra) Interconnection Project to be completed by 2009;
- Malaysia (Sarawak)-Indonesia (West Kalimantan) Interconnection Project to be completed by 2009[14].

The "Trans-ASEAN Gas Pipeline (TAGP) Infrastr ucture Project" Master Plan (2000) identified that

12) Source ASEAN Plan of Action for Energy Cooperation (APAEC) 2004-2009, Adopted by The Twenty-Second ASEAN Ministers on Energy Meeting (2n AMEM), 9 June 2004 in Makati City, Metro Manila, Philippine

13) Source Dr.Hardiv H Situmeang-KNI-WEC, South Asia Regional Energy Transmission Partnership 1t Executive Exchange, Kathmandu, Nepal, December 14-16, 200

14) http://www.egat.co.th/english

there 175 trillion cubic feet of proven and 94 trillion cubic feet of probable natural gas reserves in the seven ASEAN Council in Petroleum (ASCOPE) member countries, and Indonesia has the highest gas reserves. Seven (7) gas interconnection projects have been identified within the TAGP roadmap, and firm commitments have been secured for the gas interconnection projects between Sumatra, Indonesia and Singapore and W. Natuna (Indonesia)-Duyong (Malaysia). The TAGP task force identified that for 7 gas interconnection projects covering the length of 4200 km the total investment requirements would be at US $ 7 billion[15](2001).

Other ASEAN initiatives on energy include promotion of sustainable development and utilization of coal, promotion of energy efficiency and conservation, renewable energy, facilitation of regional energy policy and planning etc.

In terms of financing, member countries emphasize an important role of private sector in provision of needed capital investments.

Lessons and Observations from Central Asia and ASEAN regional energy cooperation

- It is clear that the Central Asia is an important source for power, oil and gas, which will significantly enhance the supply of energy resources to China and other countries outside of the region and will diversify supply to neighboring countries and regions.
- At this moment energy security issue prevail over concerns for economical, geopolitical and other risks, which might influence projects in Central Asia region.
- In case of China with regard to energy cooperation with Central Asian countries, namely Kazakhstan, Turkmenistan and others, most energy resources, such as oil, gas and power, are secured on bilateral arrangements.
- It is clear that the ASEAN countries advanced significantly in terms of regional energy cooperation. Important studies and master plans for developing regional power links and gas pipelines already have been conducted, and main priority areas for regional energy cooperation have been identified.
- The ASEAN has a strong institutional arrangement for regional energy cooperation, such as ASEAN Ministers on Energy Meeting (AMEM), and Senior Officials Committee as a main body for implementation and coordination of projects and activities. In regard to NEA the creation of SOC is an accomplished step, which will facilitate future activities.
- For ASEAN the identification of major priority projects and activities in regard to energy policy and planning was vital at the beginning, which led to undertaking major regional studies and master plans. Since the first Senior Officials Committee (SOC) on Energy Cooperation in North-East Asia created the Energy Policy and Planning Working Group (EPP-WG), it shows that the countries of NEA go on the right path.
- The role of multilateral cooperation with ASEAN, such as cooperation with EU, Japan, ASEAN + 3, ASEAN + Australia, with the Energy Charter Secretariat, was extremely important in promoting the ASEAN regional energy cooperation.
- At the initial stage the leadership of certain countries to facilitate and coordinate other countries is important at the initial stage (at the beginning Malaysia was assigned to establishing interconnecting arrangements for electricity, natural gas, and water utilization within ASEAN member countries). In case of Northeast Asia (NEA), the role of Republic of Korea (ROK) has been and remains very prominent from the beginning of regional energy cooperation in NEA. ▣

15)Sourcehttp://www.neda.gov.ph/PCAAC/ENERGY/energyTrends.ht

Russia's Oil Supply Potential to the Asia-Pacific Region

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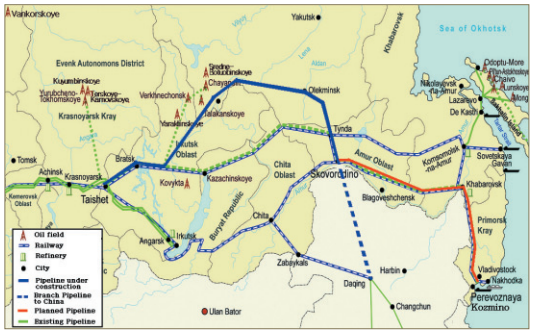
Change of the First Stage of the ESPO Oil Pipeline

In August 2006, it was reported that the Transneft, the state-owned oil transport corporation in Russia, announced the revised route of the East Siberia-Pacific Ocean (ESPO) oil pipeline by moving the pipeline route a couple of hundred kilometers northward off the drainage basin of Lake Baikal, which was registered as a World Heritage Site by UNESCO.
In the previous original plan drafted by Transneft, the route was designed to pass Lake Baikal at no more 800 meters, which used to be a target of incessant debate from environmental ecologists in Russia, although the plan had been approved by Rostechnadzor, the Federal Environmental, Technological and Nuclear Oversight Agency in Russia, in March 2006.
However, following President Putin's order to change the route in April, Transneft has been devising a new route to detour the sensitive ecological zone of Lake Baikal. As a result, Transneft announced a preliminary route of re-projected segments on August 14, 2006, which includes; Ust-Kut in Irkutsk Region→Talakanskoye and other oil and gas fields around the boundary between Irkutsk Region and Republic of Sakha (Yakutia)→Olekminsk→Aldan→Neryungry→Tynda in Amur Region→Skovorodino. This route is designed to bypass Lake Baikal northeasternward at a couple

[Figure 1] New Route of the First Stage of the East Siberia-Pacific Ocean Oil Pipeline



Source: based on the data from the Russian press and Transneft

<Table 1> The East Siberia - Pacific Ocean Oil pipeline Project

	Construction Stage	
	First Stage	Second Stage
Route of the Oil Pipeline	Taishet → Ust-Kut → Talakanskoye → Lensk → Olekminsk → Aldan → Neryungry → Tynda → Skovorodino Construction of oil export terminal on the Pacific Coast	Skovorodino → oil export terminal on the Pacific Coast
Length	about 2,800km	about 1,919km
Transport Supply	0.6 million b/d in 2008 (30 million tons per year)	1.6 million b/d (80 million tons per year)
Cost	$12~16 billion	
Financing	Transneft's own capital+bank loan (Sberbank, foreign banks)	Project Financing
Period	April 2006~December 2008	It is up to the status of oil fields development in East Siberia

Source : based on the data from the Russian press and Transneft

of hundred kilometers. Its total length between Taishet and Skovorodino will be about 2,800 km and re-projected segment - 2,000 km. Transneft, in spite of total length extended by more than 500 km, still plans to complete the construction of the pipeline system by the end of 2008 as planned before.

The first stage includes not only the trunk pipeline between Taishet and Skovorodino but also an oil export terminal in Primorsky Territory on the coast of Pacific Ocean in parallel. However, the selection of oil export terminal in Primorsky Territory faced a strong resistance from ecologists until January this year, when the Rostechnadzor disapproved Transneft's plan to construct the terminal at Perevoznaya Bay. Ecologists' opposition against the Transneft's decision on the terminal site in Perevoznaya Bay was due mainly to shallow depth of sea water and strong winds which can cause a high risk of ecological catastrophe in case of oil spills. In compliance with Rostechnadzor's disapproval, Transneft has decided to select the Kozmino Bay area for the terminal site as alternative site.

Ecological Feasibility of the Change of Route

Until March in 2006, it was not expected that President Putin would order to change a route of the first stage project, because the Rostechnadzor approved the Transneft's original plan after having an environmental assessment on the pipeline off Lake Baikal at 800 meters in March.

However, ecologists' criticisms on the Transneft's plan are mainly related to a risk of irreparable damage to ecosystem around Lake Baikal, high possibility of accidents taking place and consequently a financial risk from pipeline accidents in the long term. A huge scale of artificial infrastructure system, like the trunk pipeline, itself has a high possibility of having negative effects on ecosystem highly sensitive to the environment. In case of pipeline accidents the damage would be pernicious to the ecosystem. What is worse, according to observation by the Siberian Branch of Russian Academy of Sciences, around 1,000 times of earthquakes take place in the basin of Lake Baikal a year. They estimate that with 4,000 tons of oil spilled from pipeline even in some minutes, one third of Lake Baikal would be spoiled by oil film, irretrievably damaging unique ecosystem around Lake Baikal. It is often reported that 15% of oil pipeline accidents in Russia is attributed to geological activities.

Furthermore, concerning the ecological safety of environment around oil pipeline, there appeared recently an unexpected factor to be taken into account, that is, pipeline corrosion. BP recently took measures to shutdown the Prudhoe Bay oil field in Alaska to repair severe pipeline corrosion and a small spill from a Prudhoe Bay oil transit line, which was discovered unexpectedly. Actually, the situation in Russian oil pipeline is known to be worse. For example, the Druzhba pipeline system, which was constructed around 40 years ago, reportedly often experiences many spills caused by the pipeline corrosion, so that a half of its pipes need to be replaced. These deteriorated oil pipelines increases a concerns significantly on the ecological safety around East Siberia-Pacific Ocean pipeline route.

Finally, oilspilling accidents, if it happened, within the drainage basin of Lake Baikal would directly lead to enormous economic loss of the related companies. In such broad context, Russian and foreign ecologists' campaign against construction of pipeline near Lake Baikal might make sense, leading to Putin's unexpected decision to change pipeline route off the basin of Lake Baikal north up by 40 km.

This pipeline issue appears to enhance the public awareness on environment protection not only in Russia but also globally in implementing a huge energy system infrastructure and is expected to serve as good model of energy development projects in future.

The New Route's Negative and Positive Effects

Negative factor of the newly designed route can be related with some climate and economics of the projects. First of all, harsh climatic conditions in the area for the pipeline can make the pipeline construction and operation more difficult. As mentioned by Transneft, the construction of the pipeline system will be required to satisfy strictly all specific standards and requirements to lay out oil pipeline to fit characteristics of localized permafrost soil (LPS).

In addition to the technological challenge, the second negative factor will be significant increase in construction cost at least in the short- and mid-terms.

The main increase factors will be the extension of the route length by more than 500 km, the additional construction of diverse infrastructure including 1,700 km of electricity grid and 300-400 km of road, and the increase in transit fee, etc. Transneft has not announced the estimate the total construction cost yet.
The third one will be a considerable increase in transport fee by the extension of oil transit length: the estimate for transport fee in the previous plan was $38.8 per 1 ton of oil between Taishet and Skovorodino, but after revision of route the additional construction of electricity grid alone would add $1.5 per 1 ton of oil to the earlier estimate.
On the other hand, there are also positive effects from the shift of route, which are expected to offset the negative factors with. The first positive effect, above all, is the reduction of potential risk cost by avoiding the basin of Lake Baikal characterized of high seismicity.
Furthermore, the second positive effect is that the trunk pipeline will pass through oil and gas fields in northern part of Irkutsk region and southern part of Republic of Sakha including Talakanskoye and Verchne-Chonskoye. Shortened distance between trunk pipeline and oil and gas fields would lead to significant reduction of construction cost of branch linking them to trunk pipeline. It may relieve oil developers of economic burden laid on them from branch construction after completion of trunk pipeline.
The third positive one, in relation to the second one, lies in the expectation that shortened distance would stimulate development of oil and gas fields near the trunk pipeline. In particular, the development of oil fields in the middle and northern parts of Republic of Sakha will be facilitated and added on the list of oil supply sources of the pipeline.

Oil Supply Potential for the Oil Pipeline Construction Projects

The federal government in Russia has established a plan to provide 80 million tons of oil per annum to the Asia and Pacific region through the pipeline. According to the first stage of the plan, 30 million tons of oil per annum is planned to provide China with crude oil by branch pipeline after completion of pipeline to Skovorodino as well as Asia Pacific region through oil export terminal at Kozmino Bay by railway. China already started to construct the branch pipeline within its territory to reach Sino-Russian border.
Completion of the first stage of the ESPO pipeline system is supposed to be followed by the second stage, that is, construction of trunk pipeline linking Skovorodino to oil export terminal at Kozmino Bay. After completion of second stage, oil supply by pipeline is supposed to be expanded to 80 million tons per annum. Among them 24 million tons will be supplied from oil fields in West Siberia, and 56 million tons of oil from those in East Siberia and Russia's Far East.
However, several major obstacles lie ahead for realization of Transneft's oil supply plan. The first obstacle lies in uncertainty of oil reserves to fill up the trunk pipeline. According the Ministry of Natural Resources of the Russian Federation, it is estimated that 9 major oil fields near the ESPO pipeline may have 0.5 billion tons of explored reserves by categories A, B, and C1 and 12.8 billion tons of explored and preliminary estimated reserves by categories A, B, C1 and C2. However, this estimation was not confirmed as authentical yet.
The second concern is that oil production in underdeveloped oil and gas fields in East Siberia and Republic of Sakha is not promising yet. At present, oil and gas fields in East Siberia and Russia's Far East are in the preliminary stage of development yet. In 2004, the oil production in East Siberia and Far East such as Krasnoyarsk Territory, Irkutsk Region, and the Republic of Sakha, had reached no more than 587 thousand tons, at an increase rate of 14.6%. Given this situation, in order to meet the oil supply of 6 million tons after the construction of the first stage the increase in oil production should be more that 78% per annum from 2005. This figure accounts the volume of crude oil less 24 million tons of crude in West Siberia from total crude oil supply of 30 million tons per annum.
In this respect, the prospects for crude oil supply are not so bright, in considering of sluggish oil production in West Siberia in recent years. This is due mainly to deterioration of production facilities, lack of domestic and foreign investment in modernization and construction of energy-related facilities, a so on. The increase rate of oil production in Russia, having reached around 10% in early 2000, has continued to fall down to around 2%. It is expected that current low increase rate of 2 or 3% will remain at the same level even in near future.
This implies that without implementing comprehensive measures to facilitate development

of oil and gas fields in the regions would there be little possibility to fill up the trunk pipeline with capacity

[Table 2] Reserves by Oil Fields in East Siberia and Far East
(Unit: million tons)

Fields	Crude Oil Reserves	
	A+B+C1	A+B+C1+C2
Yurubcheno-Tokhomskoye	66.0	387.8
Kuyumbinskoye	54.4	189.3
Tersko-Kamovsky		1.5
Vankorskoye		260.0
Verkhne-Chonskoye	160.0	202.1
Yaraktinskoye	11.3	
Sredne-Botuobinskoye	54.2	66.1
Talakanskoye	105.0	123.1
Chayandinskoye	42.5	50.0
Total	493.4	1,278.4

Source: Ministry of Natural Resources of the Russian Federation (2005)

of 30 to 80 million tons with oil from those regions.
The third obstacle is related to exceptionally high price of oil through this pipeline. It is roughly estimated that the overall construction cost of the ESPO pipeline project would reach US$ 12 to 16 billion. Apart from high construction cost, the transport fee is also estimated higher than that of any other pipelines in western region of Russia. Especially the transport fee of oil produced from West Siberia to the oil export terminal near Nakhodka would increase even higher than that of oil from East Siberia and the Far East.
Considering the above-mentioned obstacles against oil supply to the pipeline, it may be necessary to devise deliberate and comprehensive policies to tackle the obstacles on the governmental and business dimensions.

Developing Large-scaled Fuel and Petroleum Industry Complex near Nakhodka

At the moment, Russia's oil refining industry is known to be less competitive both global and domestic markets due to its low facility investment. Thus, in Russia, there exists a supply shortage problem of refined oil product, and for example, Russia is importing transport fuels from overseas for its domestic demand. Recently, Russian consumption of refined oil products has rapidly increased in parallel with high economic growth and income increase.
Given that situation, the federal government in Russia set a new strategy to convert oil export structure from crude oil to the oil products by intensively developing higher added value oil refining industry.
At present, there are Khabarovsk Oil Refinery, Komsomolsk Oil refinery, Transbunker Oil Refinery (near port Vanino), PetroSakhalin Oil Refinery in the Far East, which are known to be small-scaled, inefficient and out of dated. The reason is that they had been built in the period of the Former Soviet Union and that there has been little modernization investment ever since Russia's transition to the market economy in 1990s.
As the moment, seaports equipped with shipping facilities accessible by tankers are the Magadan harbor in Magadan Region, De-Kastri harbor, Vanino harbor in Khabarovsk Territory, Nakhodka harbor in Primorsky Territory and Moskalvo harbor, Piltun-Astokhskoe harbor, Okruzhnoe harbor, Korsakov harbor, Nevelsk harbor in Sakhalin Region.
The federal government and the local government of the Far East in Russia have established the mid- and long-term measures to foster new industry complex for oil refineries, aiming at entering into the Asia-Pacific refined oil products market with huge growth potential in it. The federal government in Russia has a plan to build a large-scaled petroleum industry complex around the oil export terminal at the final destination of the ESPO pipeline, tentatively Kozmino Bay.
It also plans the construction of Sino-Russian Joint Oil Refinery at the Sino-Russian border, taking into consideration a high demand in refined oil products in China's northeast region.
The federal government is planning to create the Northeast Asia oil market, similar to those at the Amsterdam-Rotterdam and Singapore petroleum markets in oil export terminal on the Pacific Coast in Primorsky Territory. Northeast Asian countries are expected to have a high level of potentials for expanding oil trade and cooperation in future.
However, there remain some problems to be tackled in pursing creation of oil market in Primorsky Territory. The solution can be found by developing infrastructures for software and hardware for the regional oil market in Northeast Asia, ensuring stability of oil supply, and securing attractive environment for foreign investments. ▣

Wind Energy Potential of China and Its Development

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Located in the east of the Asian continent and on the western shore of the Pacific Ocean, the People's Republic of China has a land area of about 9.6 million sq km, and is the third-largest country in the world, next only to Russia and Canada. From north to south, the territory of China stretches from the center of the Heilong River north of the town of Mohe to the Zengmu Reef at the southernmost tip of the Nansha Islands, covering a distance of 5,500 km. From east to west, the nation extends from the confluence of the Heilong and Wusuli rivers to the Pamirs, covering a distance of 5,200 km, as seen in Figure 1.

Fig. 1 China administrative divisions

With a land boundary of approximately 22,800 km, China borders the Democratic People's Republic of Korea to the east; Mongolia to the north; Russia to the northeast; Kazakhstan, Kyrgyzstan and Tajikistan to the northwest; Afghanistan, Pakistan, India, Nepal and Bhutan to the west and southwest; and Myanmar, Laos and Vietnam to the south. Across the seas to the east and southeast are the Republic of Korea, Japan, the Philippines, Brunei, Malaysia and Indonesia.

China's mainland coastline measures approximately 18,000 km, with a flat topography and many excellent docks and harbors, most of which are ice-free all the year round. The Chinese mainland is flanked to the east and south by the Bohai Sea, the Yellow Sea, the East China Sea and the South China Sea, with a total maritime area of 4.73 million sq km. The Bohai Sea is China's continental sea, while the rest are marginal seas of the Pacific Ocean.

A total of 5,400 islands dot China's territorial waters. The largest of these, with an area of about 36,000 sq km, is Taiwan, followed by Hainan with an area of 34,000 sq km. The Diaoyu Island and the Chiwei Island, located to the northeast of Taiwan Island, are China's easternmost islands. Many islands, islets, reefs and shoals in the South China Sea, known collectively as the South China Sea Islands, are China's southernmost island group. They are called the Dongsha (East Sandbar), Xisha (West Sandbar), Zhongsha (Middle Sandbar) and Nansha (South Sandbar) island groups according to their geographical locations.

China's topography was formed around the emergence of the Qinghai-Tibet Plateau, the most important geological event over the past several million years. Taking a bird's-eye view of China, the terrain gradually descends from west to east like a staircase. Due to the collision of the Indian and Eurasian plates, the Qinghai-Tibet Plateau rose continuously to become the top of the four-step "staircase," averaging more than 4,000 m above sea level, and called "the roof of the world." Soaring 8,848 m above the sea level on the plateau is Mount Qomolangma (Mount Everest), the world's highest peak and the main peak of the Himalayas. The second step includes the gently sloping Inner Mongolia Plateau, the Loess Plateau, the Yunnan-Guizhou Plateau, the Tarim Basin, the Junggar Basin and the Sichuan Basin, with an average elevation between 1,000 m and 2,000 m. The third step, dropping to 500-1,000 m in elevation, begins at a line drawn around the Greater Hinggan,

Taihang, Wushan and Xuefeng mountain ranges and extends eastward to the coast of the Pacific Ocean. Here, from north to south, are the Northeast Plain, the North China Plain and the Middle-Lower Yangtze Plain. Interspersed amongst the plains are hills and foothills. To the east, the land extends out into the ocean, in a continental shelf, the fourth step of the staircase. The water here is mostly less than 200 m deep.

Wind Energy Resources and Its Distribution

China is endowed with rich and widely distributed wind energy resources. According to estimates of the China Meteorology Research Institute, total wind energy reserve with the 10m height level in China is 3226GW, in which the exploitable wind energy on the nationwide land totals around 253 GW, and the offshore wind energy is about 750 GW. Both of them add up to about 1000 GW. And the wind energy is widely distributed throughout the country, as seen in Figure 2.

East-south coastal areas and their close-by islands are zones abundant in wind energy resources. Equality line of effective wind power density over 200w/m^2 parallels coastline. Effective wind power density on coastal islands is more than 300 w/m^2, and the time of wind speed over 3m/s in the whole year is about 7000～8000 hours, over 6m/s is 4000 hours.

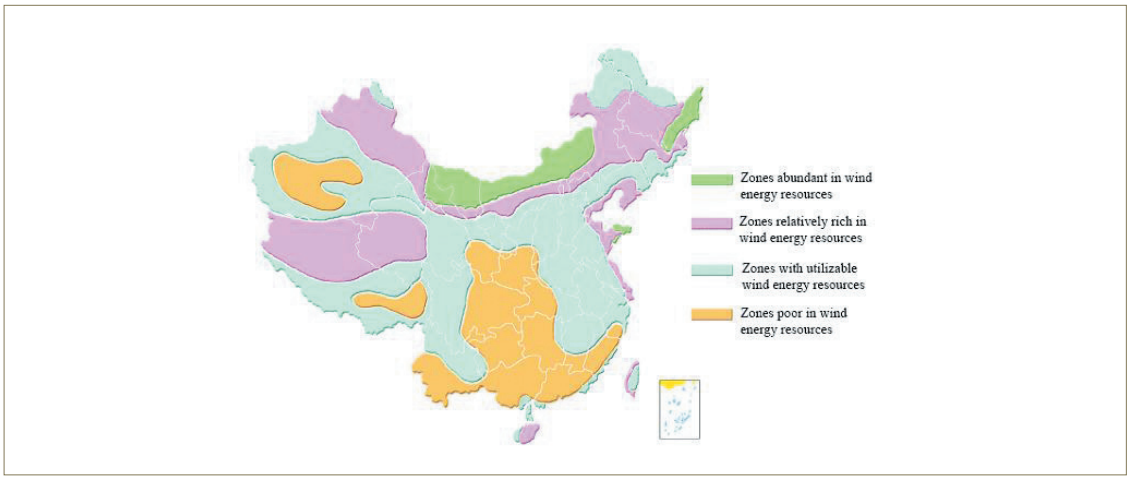
Inner-Mongolia and the north parts of Xinjiang and Gansu are also zones abundant or rich in wind energy resources. Effective wind power density is between 200 and 300 w/m^2, and it is even more than 300w/m^2 in some part. The time of wind speed above 3 m/s is more than 5000 hours in the whole year. The time of wind speed above 6 m/s is more than 3000 hours in the whole year.

Heilongjiang, the east part of Jilin, the north part of Hebei and Liaodong are zones relatively rich in wind energy resources. Effective wind power density is more than 200w/m^2. The time of wind speed above 3 m/s is 5000 hours in the whole year, and over 6 m/s is 3000 hours.

Effective wind power density of Qinghai-Tibet plateau is between 150 and 200 w/m^2. The time of wind speed above 3 m/s is 4000 to 5000 hours in the whole year, and over 6 m/s is 3000 hours. Because the altitude of Qinghai-Tibet plateau is high and air density is low, effective wind power density is low also.

The mountainous areas of Yunnan, Guizhou, Sichuan, the southern parts of Gansu and Shan'xi, Henan, the west part of Hunan, Fujian, Guangdong, Guangxi and Xinjiang and Talimu

Fig.2 Distribution of wind energy in China



Basin of Xinjiang and Yaluzangbujiang River of Tibet are zones poor in wind energy resources. The effective wind power density is lower than 50w/m2. The time of wind speed above 3m/s is below 2000 hours in whole year, and over 6 m/s is below 150 hours. These areas are endowed with very low wind power potential.

As discussed above, China is endowed with widely distributed rich wind power resources, which suffice for conditions to develop wind power industry.

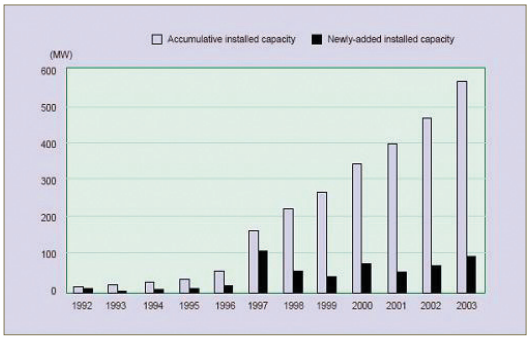
The Current Status of China's Wind Power

Although it started development of wind power late, China has put great efforts to utilize wind power resources in the past few years. It stepped into the stage of commercialized development and scale-construction only in 1990s. As of the end of 2003, there were 40 wind power fields that were equipped with 1042 generating units. Their generating capacity amounted to 567 MW, accounting for 0.14 per cent of the nationwide total. Accumulated and newly added installed generating capacity over the years is seen in Figure 3. These units are distributed in 14 provinces (regions and cities), of which 126.5 MW in Liaoning, 103.5 MW in Xinjiang, 88.3 MW in Inner Mongolia, and 86.4 MW in Guangdong. Single-unit capacity increased from 100 kW, 200 kW, and 300 kW to 600 kW, 750 kW, and 1300 kW step by step.

Development of China's wind power was faster in 2005 than before because of benefic news saying that promotion of wind power development would be set forward. The newly increased wind power capacity is 500MW in 2005, and its growth rate from year 2004 is 251%. The accumulative installed capacity is 1,266MW and distributed in 61 fields as of the end of 2005, whose growth rate is 65% in comparison with that in 2004. The rank of the China in accumulative installed wind power capacity was upgraded from 10 in 2004 to 8 in 2005 all over the world.

China has made great strides forward in the manufacturing technology of wind power equipment and has a basic manufacturing capability of 700 kW and below wind power units. At the same time, the operating departments have mastered management techniques in wind power farms to a certain extent, and a batch of qualified personnel in the field of design and construction has been trained.

Fig. 3 Accumulative and newly-added installed capacity of wind power



The Law and Policies Promoting Wind Power

China has been striving to improve institutional infrastructure, such as laws and policies, to promote wind power development. To promote wind power construction, the Chinese government has issued a Circular on Questions Concerning Advancement of Renewable Energy Resources in 1999, in which the preferential policy of renewable energy, in particular, wind power projects, were set forward. According to the Circular, bank-loaned projects would be given a fiscal subsidiary of 2% and wind power projects using Chinese-made equipment would be given a preferential treatment of 5 per cent on rate of return on investment, etc. Furthermore, the fourteenth meeting of the Tenth National People's Congress Standing Committee approved PRC Renewable Energy Law on February 28, 2005. It went into effect from January 1, 2006. Renewable energy refers to wind, solar, hydropower, biomass, geothermal, ocean, and

other non-fossil energy. The Law stipulates that State Fiscal Department will establish special funds for the development of renewable energy to support the following activities,

▶Research on technology, development of industrial standard and demonstration projects,

Table 1 Summary of examined wind power projects (Jan. 2005 to May 2006)

No.	Project name	Location	Installed capacity (MW)	Examined time
1	Chifengkeqi Saihanba Phase 1 Wind power	Inner-Mongolia	30.6	January 14,2005
2	Fujian Zhangpu Liuao Phase 1 Wind power	Fujian	30.6	March 6,2005
3	Huadian Inner-Mongolia Huitengxile Wind Power	Inner-Mongolia	100	March 9,2005
4	Guangdong Huaneng Nanao Phase 2 Wind Power	Guangdong	45.05	March 10,2005
5	Datang Gansu Yumen Diwopu Wind Power	Gansu	49	March 15,2005
6	Fujian Zhangpu Liuao Phase 1 Wind Power	Fujian	30.6	August 15,2005
7	Huaneng Zhongdian Weihai Wind Power	Shangdong	19.5	September 14,2005
8	Datang Ximeng Huitengliang Phase 1 Wind Power	Inner-Mongolia	49.5	October 18,2005
9	Jiangsu Rudong Dongling Wind Power	Jiangsu	90	November 8,2005
10	Zhongdiantou Inner-Mongolia Gubayinaobao Phase 1 Wind Power	Inner-Mongolia	49.5	November 9,2005
11	Zhongdia tou Jiangsu Dafeng Wind Power	Jiangsu	200	December 16,2005
12	Zhongdianyou Dongbei Fenggongsi Chifeng Wengniuteqi Yigegong Phase 1 Wind Power	Inner-Mongolia	49.5	December 29,2005
13	Jiangsu Rudong Dongling Wind Power	Jiangsu	90	January 11,2006
14	Henan Sanmenxia Wind Power	Henan	24.65	February 15,2006
15	Datang Chifengkeqi Sanhanba Phase 2 Wind Power	Inner-Mongolia	45	February 24,2006
16	Inner-Mongolia Ximeng Huitengliang Wind Power	Inner-Mongolia	300	February 28,2006
17	Inner-Mongolia Damaoqi Wind Power	Inner-Mongolia	200	March 1,2006
18	Hebei Danjinghe Wind Power	Hebei	200.6	March 24,2006
19	Zhongdiantou Inner-Mongolia Bayinhanggai Wind Power	Inner-Mongolia	49.5	April 7,2006
20	Huaneng Qidong Wind Power	Jiangsu	91.5	April 19,2006
21	Hauneng Weihai Wind Power	Shangdong	49.5	April 21,2006
22	Inner-Mongolia Datang Internation Zhuozi Phase 1 Wind Power	Inner-Mongolia	40.5	April 25,2006
23	Henan Fangcheng Wind Power	Henan	21	April 27,2006
24	Chifeng Dongshan Phase 1 Wind Power	Inner-Mongolia	49.3	April 29,2006
25	Jiangsu Rudong Phase 2 Wind Power	Jiangsu	90	May 30,2006
26	Huaneng Taobei Wind Power	Jilin	49.3	May 31,2006
27	Total		2044.7	

and utilization of renewable energy.

- Renewable energy projects for living use in rural and pastoral areas.
- Construction of independent power systems using renewable energy in remote areas and islands.
- Resource prospecting, evaluation and related information system construction of renewable energy resources.
- Promotion of localized production of renewable energy equipment.

The Law also stipulates that financial institutions can provide financial subsidies and preferential loans for renewable energy development and utilization projects, which are listed in State Renewable Energy Industry Development Guide Catalogue and meet loan conditions. The States give tax concessions to projects, which are listed in State Renewable Energy Industry Development Guide Catalogue.

A power network enterprise should sign an agreement with a renewable energy generation enterprise, which is approved by administrative department or submitted for records. The networks purchase sum power generation from renewable energy projects within net coverage.

After the PRC Renewable Energy Law, State Development and Reform Commission issued a scheme "The Renewable Energy Generation Prices and The Cost-sharing Management Pilot Scheme" on January 4, 2006. It will promote wind power greatly.

National Wind power Engineering Technology Research Center (NWTC) was founded in Xingjiang in order to conduct the research on wind power technologies. It was approved by PRC Ministry of Science & Technology in October, 2004. Beijing Inspecting Station of NWTC was founded in Beijing in January 17, 2006. Wind Power Vocational Technology Training Centre was founded in Suzhou in Jiangsu Province in June 2, 2006 in order to educate professional technological staffs.

All of the efforts mentioned above have contributed to accelerate wind power development in China.

The Prospects of Wind Power

In the past two years, wind power development was accelerated fast due to three forces in China: energy shortage, awareness of environmental pollution problem of fossil fuel, and government's efforts to promote wind power development. There have been 26 wind power projects with total capacity of 2044.7MW examined since 2005. The detail is provided in Table 1.

Wind power enjoys the most mature technology among new sources of energy, with the best development conditions and prospects of commercialization. Attaching great importance to development of wind energy is a common trend in the world, especially in developed countries, because it is considered as one of the most important measures for structural adjustment, environmental protection and sustainable development. Following the trend, China will also greatly increase portion of wind power in the future.

To this end, China has set a long term plan for development of wind power. As of the end of 2005, the total installed wind power capacity was 1,266MW in China. It will increase to 5,000MW in 2010, 30,000MW in 2020 and 100,000MW in 2030. By the end of 2005, the total generating capacity in China was 508.41 GW (giga watts), of which thermal power (384.13GW) accounted for 75.56%. The total electricity generated in 2005 was 2,474,700 GWh (gigawatt-hours), of which thermal power amounted to 2,018,000 GWh, accounting for 81.5% of total generation. Of thermal generation, 95% was from coal-fired power plants. At present, there is over 1 billion ton coal per year to be fired for power generation in China, and it causes various environmental problems. Fast wind power development will be useful to alleviate these problems. ▣

China's External Energy Strategy

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China is a giant country in energy consumption, as well as in energy production. Generally speaking, China resorts to domestic resources for resolving the energy issue. Coal accounts for around 70% of the total energy production and consumption in China, 60% of oil consumption depends on domestic production, and hydropower and gas have a steadily rising proportion in the total production and consumption. China's primary energy self-sufficiency rate was about 94% in 2004, with an external dependency rate of 6 percent. As oil is the major energy resource relying on overseas markets, China's external energy strategy has been developed focusing on oil. In light of the growing demand for natural gas, China will rely more on the overseas markets to secure gas source. As for hydro-electricity, the Northeast China has started to import electricity from Russia at a very limited scale, which has an insignificant impact on the overall external energy strategy of China. A countrywide integrated external energy strategy has not been established yet due to the fragmented energy administration by different sectors.

China's energy production, consumption and external energy demand

Status quo

As the 2nd largest energy consumer in the world, China's energy consumption accounts for 11% of the world energy consumption. It is also the 2nd largest energy producer, with primary energy output totaling 1.85 billion tons of coal equivalent(TCE) in 2004, compared with the total energy consumption of 1.97 billion TCE for one year. Coal, playing dominant role in China's energy production and consumption, is the most stable component in the national energy structure. Coal, gas, hydropower have generally balanced proportion of production and consumption. However, crude oil production and consumption are unbalanced: oil production has declined to 15.2% in 2003 from 23.8% of the total energy output in 1980, and oil consumption has increased from 20.7% to 22.7% during the same period, showing an ever-widening gap between supply and demand. Thus, it is oil that is China's major energy resource heavily depending on import. In 2004, crude oil reported a 40% ratio of import dependency as China produced 175 million tons of crude oil and imported 120 million tons, with that figure on the increase. The proportion of natural gas import will also grow in future.

China's energy demand is expected to reach 3.1 billion TCE, or 13.2% of the world energy demand in 2010. Given that China is expected to continue the trend of annual GDP growth rate above 7% over the next two decades, it will be under the pressure for securing energy supply growing at a rate of 4% per year. It is predicted that China's oil production and demand gap will be 155 to 187 million tons in 2010 and 240 to 520 million tons in 2020, with export dependency rates of 46.3% to 52.3% and 55.8% to 66.1% respectively. The increasing reliance on foreign source may result in the more influence of foreign energy resources to Chinese energy demand and has adverse effect on its energy security. Any uncertainty in the world's oil market, dramatic fluctuation in oil price and barriers to transportation routes may bog China down in crises of energy security and threat its economic development.

Overseas energy (oil & gas) distribution, consumption and supply

Overview of overseas oil resource distribution

Oil resource abounds in the world, with 456.3 billion tons of ultimate recoverable conventional oil and some 600 to 979.5 billion tons of unconventional oil resource. The residual proved oil reserve has risen to 140.28 billion tons at the end of 2000, which is an 89.8% from 73.94 billion tons at the end of 1971. Meanwhile, the oil output has climbed from 2.41 billion tons to 3.34 billion tons. The growth rate of the residual proved oil reserve is 2.3 times that of oil production, and 38% of recoverable oil reserve is distributed in the Middle East; 17.3% and 16.5% are distributed in the former Soviet Union and the North America, and less than 4% in Europe. Besides, 30.5% of commercially recoverable oil in the world is distributed in the Middle East. The International Energy Agency (IEA) points out that the Middle East' s oil output is vital to meet the increasing oil demand in all over the world for the next two decades. In the twenty years to come, the world' s oil reserve growth will largely come from the following four regions such as the Middle East, Russia-Central Asia, South America, and North Africa, which might be the strategic targets for China to tap the world' s oil source in.

Three changes in global trend of oil demand and supply

First, the world' s oil demand structure has changed. Energy demand in the developing countries such as China and India has climbed sharply, whereas the U.S., Europe and Japan have stabilized their oil demand and gained a strong control over the oil sector. Subsequent to the two oil crises, the developed countries have reduced their over-reliance on oil, e.g. Germany has cut the proportion of oil of the energy consumption structure from 53% in 1970 down to 38% in 2000. By contrast, major developing countries including China and India are undergoing oil demand increase. Second, oil supply has been significantly diversified. The emerging oil producers have accelerated development, while the existing major suppliers press on the production to hold more market shares. More players have appeared on the international arena. OPEC' s control over oil export has dropped from 53% in 1973 to 37% at present, and will continue to fall. The non-OPEC oil producers including Russia and the African countries will march into the international oil market. With oil output rebounding, Iraq has become a key leverage for the U.S. to manipulate the international oil market; Africa boasts bountiful reserve of high-quality, low production cost oil with convenience of transportation. The trend of diversification in oil supply has triggered a new round of geopolitical power play on oil. Third, the new roles and factors have a growing influence on the international oil market. Through a decade of global operation, the "Big Four", i.e. Exxon-Mobile, BP, Shell and Chevron Texaco lead the energy resource competition by gripping more than 80% of quality oil and gas resources in the world.

China' s strategy for external energy: diversification and going abroad

Since the Chinese government has not formally announced its strategy on capitalizing external energy, this paper sums up China' s energy strategy goals based on its activities in the international oil market, i.e. its being active to explore overseas energy supply channels, implementing global energy strategies, and building world-wide supply network by way of diversification and going-abroad .

Diversification strategy: to promote diversification of energy development cooperation and energy import

Currently 75% of China' s oil import relies on the Middle East. A strategy for diversifying external energy market is under way in China, shifting from the old-time single energy diplomacy. China' s energy diversification

strategy has been brought to the spotlight with its contest with Japan for Russian oil pipelines unveiled. In the past, China focused its exploration and development more on oil and gas resources in the Gulf region, South America and Africa or offshore than on those in Russia and Central Asia. China missed the best opportunity to enter the Russian market as it opined that the Russia-proposed oil pipeline laying costs high.

According to the prediction of the American Rand Corp., the ideal future oil security strategy for China should be: the Middle East-1/3; Russia-1/3; Central Asia-1/3 leaving out of account Africa and South America. At present a quarter of China's oil imports are from Africa. Its energy supply structure will take on a new look of diversification in future, incorporating the Middle East, Russia, Central Asia, Africa and South America. China is developing a global strategic energy plan. Within the above scope, priority will be given to Russia, Kazakhstan, Turkmenistan, Iran, Iraq, Sudan, Venezuela, Indonesia, etc. in expanding and strengthening oil and gas exploration and development by increasing output and reserve share and by building solid oil production bases.

Oil and gas cooperation becomes a significant part of Sino-Russia economic and trade cooperation. Russia will take into consideration the possibility of extending its oil pipelines into China; it will embark on more railway oil trades to increase its oil import to China to 10 million tons in 2005 and even to 15 million tons in 2006; both parties have also decided to expedite the development of a gas exploitation cooperation plan. In the Central Asian region, China has been in successful cooperation with Kazakhstan, in oil pipeline construction. In Africa, it has teamed up effectively with Sudan. China has begun to buy oil from Gabon, Egypt and Nigeria, etc. since 2004 and meantime signed the oil agreements with Cameroon, and Equatorial Guinea, etc. Four countries in South America have been in close negotiations with China over energy investment. China has promised to invest US$5 billion in the oil and gas projects in Argentina over the next five years, and invest US$8.5 billion in infrastructure and mining in Brazil. Venezuela plans to build an oil pipeline through Columbia to the Atlantic Ocean for easier oil transportation to China. China has also reached overall agreement with Canada on investment in Canadian oil resources.

"Going abroad" strategy for energy enterprises

As guided by energy diversification strategy, the Chinese government has been encouraging the domestic energy corporations to pursue energy cooperation in implementing the "going abroad" strategy. The major consideration is that the impact of crude oil's high price on economic development will be offset and mitigated to a large degree as long as China has sufficient overseas oil output. To have sufficient oil supply, producing oil is more preferable than buying oil. Various cooperation projects between China and other countries adopt the form of "shareholding oil", i.e. China is involved in the local oil construction projects by means of equity participation or investment, receiving a certain share of oil output each year. In current outbound oil and gas exploration and development, China has obtained the right of shareholding, equity participation or independent exploration and development in Sudan, Malacca, South America, the Gulf of Mexico and Central Asia, etc. The residual recoverable reserve of the overseas shareholding oil in China's grip exceeds 0.4 billion tons, and the realized capacity of crude oil production amounts to 130 million tons per year. In 2004, China extracted more than 20 million tons of crude oil overseas.

For energy enterprises, there are three major ways to go abroad: first, futures and spot trading; second, overseas development to gain refined oil and third, setting up overseas production bases. Some domestic energy

enterprises have taken aggressive steps to expand overseas market via the above three ways. The major oil companies including Sinopec, CNPC, and CNOOC have expedited their overseas strategic implementation. Based on the data from the Ministry of Commerce, the above domestic oil operators have been involved in 65 oil and gas exploration and development projects in more than 30 countries, having invested US$7 billion in total and, in return, having gained 60 million tons of shareholding oil. Other Chinese corporations are also pushing forward overseas acquisition activities. Sinopec has successfully gained a foothold in Saudi Arabia, the largest oil and gas reservoir in the world and participated in the local oil and gas projects in Canada, Iran, Saudi Arabia, Gabon, Kazakhstan, Yemen, and Ecuador, etc. CNPC is implementing 44 overseas oil investment projects covering 18 countries and areas in 4 continents. Four major overseas oil and gas production bases (i.e. North Africa, Central Asia, South America and Asia-Australia) have been set up.

Priorities of external energy strategy for China

Strategic ties with major energy suppliers overseas

Russia

Russia is a leading oil and gas producer, with oil and gas resource serving as the "trump card" in its global strategy. Russia yielded 458 million tons of oil in 2004, and it has adjusted oil development plan for 2010 targeting at 530 million tons. Russia's energy strategy is featured by the stress on exploring the world market, in particular the non-European market including China, Japan, the U.S. and Turkey. China is in rapport with Russia in terms of politics. The prime ministers of both countries have made the decision to increase trade value to US$60 billion by 2010. Yet, Sino-Russian energy cooperation lags and remains in infancy despite negotiating efforts for years. Energy collaboration will be the priority of both parties' economic cooperation for the next step, as China holds an important position in the energy strategy of Russia. The Russian government has promised to carry out land trade in oil at first and then build oil and gas pipelines. China has committed itself to investing US$12 billion in Russia, a substantial part of which will be used in oil and gas cooperation. China will leverage on the role of Shanghai Cooperation Organization to mobile the strong political relations with Russia and focus on developing medium and long-term strategic collaboration with Russia, along with promoting mutual benefit and "win-win strategy" with other countries.

Gulf region

As a major energy supplier in the world, the six countries of Gulf Cooperation Council ("GCC") have 45% of oil reserve and 20% of total oil output in the world. GCC has indicated its interest in building strategic energy partnership with China to ensure oil and gas supply to China. China also proposes to strengthen cooperation with GCC in oil and gas exploration, development and petrochemicals, so that Chinese corporations will be able to participate in upper-stream development and energy-connected labor services and equipment export. China is expanding the opening-up to attract more foreign investments. For the wealthy Gulf countries, China should be the ideal destination of oil dollar investment. On the other hand, Chinese corporations with rich experience accumulated in them through implementing the "going abroad" strategy can be valuable supporters to the Gulf countries in developing projects of harbors, railways and highways construction.

Central Asia & Caspian countries

In oil and gas development, China acquired all of the stakes in North Buzachi oil field of Kazakhstan in 2003 (supplying 20 million tons of oil to China), apart from cooperation in oil field development in Aktjubinsk and Uzin. In

pipelaying, China's "West-East Gas Pipeline" project will have reliable gas source if the gas pipelines from Turkmenistan to China are built, which will have a transmission capacity of 20 to 30 billion cubic meters a year. China should support and join Iran, Kazakhstan and Turkmenistan in building pipelines from the Caspian Sea through North Iraq into the Persian Gulf. Once this southwardly route being established and pipelines between China, Kazakhstan and Turkmenistan built, the oil and gas pipelines of Central Asia and Caspian Area will be linked together with those of the Middle East. Thus, China will have the access to the energy source of Central Asian and Caspian area without taking the risk of sea transportation of the Middle East energy.

Africa

Africa possesses 8.9% proved oil reserve and 7.7% proved gas reserve of the world. China's oil import from Africa accounts for 25% of its total imports. Africa has become its 2nd crude oil source area, with Angora, Sudan, the Republic of Congo, Equatorial Guinea, Gabon, Cameroon, Algeria, Libya, Nigeria and Egypt as major suppliers. Among them, Angola, Sudan, and the Republic of Congo provided China with 10.1 million tons, 6.26 million tons, and 3.38 millions tons of oil respectively in 2003. By the end of 2003, African proved oil reserve had exceeded 101.8 billion barrels, which can support continuous exploitation of 33.2 years based on current production. Sinopec secured its first long-term oil trade agreement with Gabon in 2004, and a memorandum has been reached between China and Gabon for cooperation in exploring the offshore oil of West Africa; China has also clinched long-term oil collaboration agreements with Egypt and Algeria.

Latin America

Latin America is one of the main oil suppliers in the globe. Venezuela, Mexico, Brazil, Columbia, Ecuador, and Bolivia are all oil producers. Venezuela is the sole Latin American member of OPEC and the 5th oil exporter of the world, producing 2.10 million barrels a day, 60% of which flows to the U.S. Mexico, the most productive one in Latin America, yields 3.80 million barrels of oil every day. Brazil comes out third with a daily production of 1.90 million barrels, followed by Argentina with a daily production of 0.88 million barrels, most of which is consumed domestically. The 5th oil producer in Latin America is Ecuador, generating 0.55 million barrels a day, with most of them exported. During a recent visit to the four Latin American countries, Mr. Hu Jintao, President of China, made a commitment to investing US$70 billion in this area. China highly values its economic and trade relations with the Latin American area, regarding it as one of the future energy suppliers.

Competition & collaboration between China and major energy consumers

China and Japan

China and Japan appear to be downright rivals when it comes to Russian oil and gas pipelines and East China Sea oil fields. However, the ultimate, proper choice for both parties should be to replace strife and conflict with cooperation. Cooperation is the win-win solution for China and Japan to obtain energy security. Through positive and efficient energy cooperation, the two neighbors will be able to avoid the vicious circle of the mutually hostile "zero-sum game." No. 1 bulk commodity in export, oil and gas are vital to Russia's fiscal revenue and stability of economy and society. It cannot underestimate the potential in China's stable market and Japan's vast demands backed by substantial foreign exchange reserves. China and Japan should initiate aggressive efforts in energy development, technology transferring and diplomatic cooperation, thereby enhancing mutual benefit and trust. Moreover, equal participation by Japan is welcome to China for its energy industry growth, technology renovation, and energy conservation. Today's China has become an integral part of the global oil and gas market as driven by the surge of

globalization. Against such a backdrop, it will not have the initiative in the energy race between oil producers and oil consumers unless it pursues multi-faceted, multi-level cooperation in energy diplomacy. That represents a key issue concerning sound interactions between oil consumers not only in Northeast Asia but indeed the whole Asia.

China and the U.S.

Being the one and only superpower in the world and the largest oil consumer, the U.S. has reached its sensitive "oil antenna" into the territory of all oil exporters or prospective exporters. The oil game between China and the U.S. is all about containment and counter-containment, mainly embodied in their conflicts on oil export of suppliers including the Middle East, Central Asia/Caspian Sea and oil transportation channels in the Gulf and South Asia. First, the U.S. provides security assurance for oil transportation by sea with its navy strength. It exhausts all possible excuses to put curb on Iran and Iraq, preventing other countries from having access to the energy area of the two countries. Iran is the traditional crude oil exporter for China, supplying about 18% of the total imports of the latter. Strife over the Middle East's oil resource is looming ahead. Second, enormous oil reserves stored in the Caspian Sea and the surroundings will relieve the world of its dependence on the Middle East. The U.S. allies with the major oil companies in Europe and Americas to make its way into the Caspian region, waging a fight against Russia and keeping a vigilant eye on China. Kazakhstan is now seeking diversified export channel alternatives as it exports 70% of oil via Russia. The key for China to achieve diversified import and to guarantee oil security rests with the Central Asian/Caspian oil resources, and China's market potential brings opportunities for the Middle East Asian oil exporters. The Sino-Kazakhstan pipelines will provide China with the access to oil resources in the Caspian area, West Siberia of Russia, and even the Gulf (e.g. Iran). The third aspect relates to Sino-Pakistan oil transport system. Agreements have been reached about the southwardly oil and gas pipelines from Turkmenistan through Afghanistan into Pakistan (i.e. the Indian Ocean area) as proposed by the U.S. Under this arrangement, the Caspian area will get out of the control of Russia and Iran, able to export oil and gas to Afghanistan and Pakistan. The U.S. is trying to entice Pakistan into this scheme so as to block the process of Sino-Pakistan oil transportation system in construction, which is supposed to transmit oil imported from the Middle East and North Africa to China through Pakistan (rather than through the Malacca Straits). The U.S. sticks to the guideline of "effective containment" in the energy game, aiming to slow down China's growth pace and provide buffer to its strategy against China.

China and India

China and India have faced soaring demands for crude oil in recent years. Both countries are engaged in the intense competition for resources in Iran and Russia. In January 2005, Indian Oil and Natural Gas Corp. Ltd. (ONGC) signed a US$40 billion agreement with the National Iranian Oil Co. Under this agreement, ONGC will acquire 20% shares in the Yadavaran oil field-the largest onshore oil field in Iran, of which Sinopec holds 50% interests. India signed a bilateral energy development agreement with Russia in December 2004 about a massive US$3 billion investment-US$1.5 billion in Sakhalin-III and another US$1.5 billion investment in the joint Russian-Kazakh Kurmangazy oil field (with one billion tones of reserve) in the Caspian. ONGC already has an investment of US$1.7 billion in the Sakhalin-I oil field. China, Japan and India set foot in oil and gas development of Sakhalin at the same time. On the other side, China and India also had encounters in Africa and Indonesia. Since 2000, Indian state-owned corporations have spent more than US$3.5 billion in acquiring interests in oil fields to seek energy all around the world. India has been a strong rival to China in the contest for overseas oil, but they have begun to

work together. Their recent equity participation in Nigerian National Petroleum Corporation indicates that the cake-sharing approach will be a good start. The joint efforts between China and India will help create a win-win situation in their pursuit of overseas oil resources. First, the state-owned oil corporations of both countries are confronted with the fierce competition from international oil companies in finding their way into overseas market. Those entities on both sides can enhance their competitive edge by joining hands in aspects of capital, technology and management because there are big gaps between them and the international players. Second, cooperation between China and India will give them combined weight in their price negotiations with energy suppliers, especially OPEC and Russia. Their energy cooperation is still in the initial stage at the moment. Both sides should take the opportunities to set up a bilateral energy collaboration mechanism as well as multilateral energy collaboration mechanisms with China and India as leaders.

Conclusions

China does not have an integrated external energy strategy as yet. Oil and gas are the major areas for the implementation of external energy strategy in future, subject to its specific structure of energy production and consumption. Its external energy strategy mainly incorporates diversification of external energy sources and "going abroad" strategy for Chinese energy corporations. Its external oil strategy is still in the early stage, and its share in the global oil trade value is merely 6%. Russia and Central Asia will become the most significant strategic partners of China in oil and gas cooperation. As neighbors with complementary economies, they will enter into a new era of energy cooperation. Meanwhile, China should be prudential in addressing the issue of competition and collaboration with the major oil consumers including the U.S., Japan and India.

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Current Status of Power Supply & Demand and Long-term Forecast in China

Review on Power Supply Demand Situation in 10th Five-year Plan

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During the 10th Five-year Plan period (from 2001 to 2005), under the guidance of correct policies of "widening up internal demand, taking the favorable opportunity of joining WTO, striving to enhance export" in line with economic structure adjustment, continuously implementing active financial policy, enlarging internal demand and vigorous development of western regions, Chinese economy has persistently grown in high speed, with GDP growth rate of 7.5 ~ 9.9% and an average growth rate of 8.8%. (see Table 1.1)

Driven by persisted high speed growth of economy, in particular the incessant expansion of high electricity consuming industries, the electricity consumption has rapidly grown, far beyond the target of 10th Five-year Plan forecasted. The growth rates were 9.04%, 11.6%, 15.29%, 15.18% and 13.45% in 2001, 2002, 2003 2004 and 2005 respectively. The coefficients of electricity intensity were all greater than 1 in these years. Peak demands in all regional power grids have been continuously escalated, and the total electricity consumption reached 2469 TWh in 2005, with an annual growth rate of 12.9%.

To meet ever increasing power demand, Chinese power industry has been rapidly developed, the electricity generation has increased from 1368 TWh in 2000 to 2475 TWh in 2005, with an increase of on average more than 200 TWh per year, which was unprecedented. Installed capacity increased correspondingly from 319 GW in 2000 to 508GW in 2005, which broke through the critical level of 500 GW, accounting for in an annual growth rate of 12.6%, the specific figures of growth rates are shown in Table 1.2.

In the period of 10th Five-year Plan, the rapid development of power production had supported high economic growth, the coefficients of electricity intensity reached as high as 1.47, but the nationwide power supply-demand situation was still severe. Power supply has tended to be strained since 2002, with nationwide power shortages in 2003, resulting in power curtailments in 23 provinces and the extension of power curtailments to 24 provinces in 2004. The most severe power shortages in recent years happened in 2004. The thermal power utilization hour reached 5,991 hours, exceeded the historical highest record in 1987. In 2005 along with additional installed capacity, the utilization hour of thermal power has drooped a little bit to 5,876. The immediate reason of power shortage might be attributable to insufficient power installed capacity and the newly commissioned capacity can't catch up with the rapid increase of power demand.

Table 1.1 : China's Electricity Consumption Growth in the 10th Five-year Plan

	Whole social electricity consumption TWh	Whole social electricity consumption growth (%)		Electricity consumption elasticity coefficient①	Thermal power utilization hours
2000	1347				
2001	1468	9.04	7.5	1.21	4900
2002	1639	11.60	8	1.45	5272
2003	1889	15.29	9.1	1.68	5767
2004	2176	15.18	9.5	1.58	5991
2005	2469	13.45	9.9	1.36	

Source : China Statistical Abstract(2000-2005), China Electric Power Yearbook(2000-2005)
Note① : Electricity consumption elasticity coefficient= Whole social electricity consumption growth rate(%)/GDP growth rate(%)

Table 1.2：Growth of China's Installed Capacity and Electricity Generation in the 10th Five-year Plan

	Electricity generation TWh	Electricity generation growth (%)	Installed capacity (GW)	Installed capacity growth (%)
2000	1368		319	
2001	1484	8.43	339	6.04
2002	1654	11.48	357	5.30
2003	1908	15.34	391	9.52
2004	2194	15.18	442	13.02
2005	2475	12.8	508	14.9

Source：China Statistical Abstract(2000-2005), China Electric Power Yearbook(2000-2005)

Outlook on Power Supply-Demand Situation in 2006

To deal with power shortage, the Chinese government set forth various measures to expand power supply and decrease power consumption. The 11th Five-year Plan starts in 2006. The year of 2006 is the key period of practicing scientific development ideology, energy saving, consumption reduction and continuous promotion of "appropriate and steady" macrosco pic regulation policy. With enhanced macroscopic regulation and industrial structure adjustment, investment in primary industries and tertiary industries will be continuously intensified, while investment in secondary industries will be slackened. The national economy will still keep developing steadily but faster. It is predicted that, given that the GDP growth rate is around 9%, the power demand will still be forceful, but the growth rate will be slackened. Industrialization and urbanization are still the main supporters for power demand increase. Though the growth of energy intensive industries has been somewhat slowed down due to implementing nation's macroscopic regulation, the power demand will still grow at a faster rate. The growth rate of electricity consumption of iron & steel industry is predicted to be around 11.4%, that of non-ferrous metal industry around 14.8%, manufacture of non-metallic mineral products around 13.8% and the chemical industry around 9.4%.

The newly installed capacity will be around 75 GW in 2006, which will be a record-breaking in terms of the largest newly power capacity addition in one year in China. Hence the nation's power supply capability will be greatly increased.

Based on the above analysis, as the scope and duration of power shortage will be greatly shrunken, the national power supply-demand situation will be alleviated in 2006. The power supply in 2007 will meet the demand, with a little surplus on a nationwide, but with possible occasions of power shortage arising in individual localities.

The actual figure of GDP growth rate in the first quarter was 9.5%, reached 3,135.5 billion yuan or 0.3 percentage point lower than the same period of last year, while CPI increased by 2.8%. The electricity consumption was still kept growing in a high speed, but with a lower growth rate. Due to joint effects of more newly added power capability and better water inflow in major water reservoirs, power supply and demand situation has been relieved compared to last year. Therefore, the number of power shortages is significantly reduced. The number of provincial power grids suffering from power curtailments has decreased from 9 in January to 2 in March.

The national electricity generation in the first quarter of 2006 has increased by 11.1% over the same period of last year, and the total electricity consumption increased by 11.81% (Note: Due to different sources of statistics, the electricity generation and consumption taken from Monthly Bulletin are incomparable). The utilization hour of power generation was 62 hours lowered, of which thermal power was 90 hours lower, while hydropower was 11 hours higher than that during the same period of last year. It can be accounted for by higher increase of thermal installed capacity and better hydropower operational conditions (see Table 2.1 and Table 2.2 for details).

Even though power consumption in individual localities has still suffered from power shortage during the second quarter of 2006, the scale and scope of power shortage have been significantly reduced. By a comprehensive judgment, the

growth rate of electricity consumption for the overall country will be around 11.8 ~ 12.4% in 2006, and the total electricity consumption will amount to 2760 ~ 2775 TWh.

Table 2.1：China's Electricity Production in the First Quarter of 2006

	Unit	First quarter 2006	Growth over first quarter 2005	Mix (%)
1 Newly commissioned capacity	GW	11.9889		100
Hydropower	GW			5.93
Thermal power	GW	11.252		93.85
2 Electricity generation	GW	606.826	11.1%	100
Hydropower	TWh	64.226	15.70%	10.58
Thermal power	TWh	526.963	10.8%	86.84
Nuclear power	TWh	12.566	-3.10%	2.07
3 Net coal consumption	gce/KWh	364	0	
4 Utilization hours	h/unit year	1251	-62	
Hydropower	h/unit year	602	11	
Thermal power	h/unit year	1405	-90	

Table 2.2：China's Electricity Consumption in the First Quarter of 2006

	First quarter 2006 (TWh)	Growth over first quarter 2005(%)	
Whole social electricity consumption	624.987	11.81	100
A Category by industry			
primary industry	14.778	11	2.36
secondary industry	465.404	11.31	74.47
tertiary industry	67.255	12.3	10.76
	77.55	14.63	12.41

Forecast on Future Power Demand

The background and foundation for this forecast is based upon the overall construction of well-off society and realization of GDP quadrupling in the first 20 years of 21st century, set forth on the 16th Party Congress. It is predicted that the growth rate of Chinese economy will be kept around 7.2% in coming 20 years. To the year 2020, the nation's GDP will be quadrupled than that in 2000, with a total amount of 35000 billion yuan, the nation's industrialization will then be basically realized, power development will match with the overall target.

Since the beginning of the new century, under the guidance of the overall target of constructing well-off society, the socialist modernization construction has entered a new high speed developing stage. In this stage there appear enough distinct heavy industries and sustainable development to face a new round of energy growth. It is characteristic of a profound change of consumption structure, acceleration of urbanization process, and the inherited international manufacturing industries transfer. The degree of reliance on energy has been strengthened. Power demand will keep increasing for the next 15 to 20 years, power market will be flourishing. Before 2020, Chinese power industry will show a high growth rate and a huge power construction. This period will also be an important turning point for large-scale power structure adjustment. The basic guideline for future power development shall be the overall, coordinated, sustained and scientific development, equally stressing on development and conservation, insisting on multi-functional complementary for energy development, taking coal as a foundation, centering on electric power and developing appropriately in advance, striving to promote rural electrification ratio among energy end uses.

Power development shall also insist in the meantime on the following policies: strengthening power grid constructions, vigorously developing hydropower, optimizing coal-fired power development, actively promoting nuclear power, appropriately developing gas-fired power and giving priority to new energy development. Through power industry restructuring, energy efficiency, water and power savings as well as environmental protection shall be promoted.

Based on the above instructive ideas and power development policy, multiple scenarios of future power demand and structure have been carried

out and will be subject to several adjustments to the year 2020. These can be summarized into energy saving and two BAU scenarios, i.e. to the year 2020, the nation' s total installed capacity will reach 1200 ~ 1260 GW, the corresponding electricity generation will amount to 5595 ~ 5862 TWh. And then, the per capita electricity consumption will be around 3780 ~ 3961 kWh. The average power growth rate in these 20 years will be between 7.38 ~ 7.63%. To realize the BAU scenario, the coefficient of electricity intensity in these 20 years shall be 1.063, which can guarantee GDP to be quadrupled; while the energy saving scenario is concerned with power supply still under tense situation, calling for strengthening economic structure adjustment and energy (electricity) saving by improving technology, the coefficient of electricity intensity shall be 1.028 in these 20 years.

The installed capacity will be 755 ~ 780 GW, and electricity generation will amount to 3,603 ~ 3,721 TWh in 2010, with an average growth rate of 10.34 ~ 10.70% for electricity generation in this period from 2000 to 2010. The per capita electricity consumption will then be 2,618 ~ 2,704 kWh/person, it exceeds the world average per capita electricity consumption of 2,548 kWh in 2001.

Table 3.1 : Forecast of China's Electricity Demand Growth Rate in the Future

	1980 ~2000	2000 ~2010	2010 ~2020	2000 ~2020
GDP growth rate (%)	9.63	8.74	5.64	7.18
Electric consumption elasticity coefficient	0.817	1.183 ~1.224	0.798 ~0.824	1.028 ~1.063
Electricity demand growth rate (%)	7.87	10.34 ~10.70	4.50 ~4.65	7.38 ~7.63

Table 3.2 : Forecast of China's Electricity Demand in the Future

	2000	2005	2010 LOW	2010 BAU	2020 LOW	2020 BAU
Population (billion)	1.267	1.308	1.376	1.376	1.48	1.48
GDP(billion yuan)①	8947	14070	20674	20674	35787	35787
GDP AAGR %		9.48	8.00②	8.00②	5.64③	
Electricity demand (TWh)	1347	2469	3603	3721	5595	5862
Electricity demand AAGR %		12.94	7.85②	8.55②	4.50③	4.65③
GDP/per capita(yuan)	7061	10757	15024	15024	24181	24181
electricity consumption/ Per capita (kWh)	1063	1888	2618	2704	3780	
Electric consumption elasticity coefficient		1.359	0.981	1.069	0.798	0.824

Note : ① The every year GDP are used constant prices of 2000.
②AAGR of 2005-2010
③AAGR of 2010-2020

Outlook of Power Mix and the Position of Nuclear Power in Chinese Future Power Supply

Capability of Hydropower Exploitation

According to the survey of China water resources publicized in 2005, the theoretical water potential in annual electricity generation amounts to 6,082.9 TWh, the average power will be 694.40 GW, the technical exploitable capacity will be 541.64 GW, and annual electricity generation of 2,474.0 TWh. The economical exploitable installed capacity is 401.80 GW, and annual electricity generation of 1,753.4 TWh, ranking first in the world. Based on calculations on above survey, if all exploitable water resources of China are fully tapped, for 100 years the ratio of coal resources will account for 51.4% of total conventional energy resources, while water resources account for 44.6%. Water resources will be the second largest conventional energy resources of China.

All developed countries with ample water resources in the world have unexceptionally given priority to hydropower development. Generally, the degree of hydropower exploitation has already reached higher than 70%. While due to capital and technical restrictions, the degree of hydropower

exploitation in China and some other developing countries have been commonly low. By the end of 2005, hydropower installed capacity amounted to 116.52 GW with annual electricity generation of 401.0 TWh. It accounted for 21.5% and 29.0% of technical exploitable and economical exploitable hydropower installed capacity, respectively.

To accelerate hydropower exploitation, the 10th Five-year Plan has put forward that hydropower is a kind of clean energy, it integrates primary energy and secondary energies into one, its benefits on flood control, irrigation and water transportation are remarkable. Thus the exploitation shall be intensified. The <Outline of 11th Five-year Program> has also pointed out that to orderly exploit hydropower, well and unified managing reservoir immigrants, flood control and navigation, it shall be on the basis of ecological protection. Hydropower stations bases on Jinsha River, Yalong River, Lancang River and Yellow River as well as Xiliudu, Xiangjiaba will be constructed. Some pumped storage stations will also be appropriately constructed. The State has basically decided to increase in hydropower capacity from original target of 250 GW to 300 GW to the year 2020. It will then account for 55.39% and 74.66% of technical exploitable and economical exploitable capacity respectively. To realize this target, 12.23 GW hydropower capacity shall be commissioned during the period between 2006 and 2020, thus the construction tasks are arduous.

Nuclear Power Development

The State Council meeting chaired by Premier Wen Jiabao deliberated and passed the "medium- and long-term nuclear power development plan (2005-2020)" on March 22.

On the meeting, an important energy strategy for actively pushing forward nuclear power construction has been set forth, which played an important role in meeting ever increasing power demand for economic and social development, realizing coordinated development among energy, economy and ecological environment and promoting synthetic economic strength and industrial technical level. To actively push forward nuclear power construction, the plan stresses that China should rely on self-design and innovation, make use of international advanced technology and experience, insist on "safety first and quality first" to form an integrated capability for building advanced nuclear power plants in batches, entirely set up the construction, operation and management mode conforming to international advanced level, and establish a relatively complete system on nuclear power industry, regulation and standard.

As of the end of 2005, there were 9 nuclear power units in operation in China, with a total installed capacity of 6.85 GW. The nuclear capacity and electricity generation in the same year accounted for 1.35% and 2.11% of nation's total generation, respectively. After all nuclear power units under construction commissioned in 2006, there will be 11 nuclear power units with a total capacity of 8.7 GW, accounting for 1.5% of nation's total capacity of China.

Because there will be only one nuclear power unit of 1 GW class of Lingao Nuclear Station phase II project to be put into operation in 2010, the total nuclear power capacity will then be 9.7 GW in 2010.

It is anticipated to the year 2020 that nuclear power capacity in operation will reach 40 GW, with an annual generation of 270 TWh, accounting for 3.2 ~ 3.3 % and 4.61 ~ 4.83% of nation's total generation, respectively. On the basis of present nuclear capacity of 8.7 GW in operation and under construction, there will be 31.3 GW nuclear capacity newly commissioned and 18GW capacity under construction. In coming 15 years, China needs to newly construct about 49 nuclear power units of 1 GW class, which means to newly construct 3 units of 1 GW class every year. It is by all means an arduous task.

According to "The China's Middle and Long-Term Science Outline," which has set forth a strategic target of nuclear power installed capacity of 150 GW and nuclear electricity generation account for 16% of nation's total generation to the year 2035. To meet this target, China shall further

expand nuclear power construction after 2020.

Gas-Fired Power

Gas-fired power becomes an important component in China's power diversification development. Natural gas accounts for only 2.7% of primary energy consumption in China, far below the world average level of 24%. In medium- and long-term energy strategy of China, natural gas industry development has been put on important position. Due to restriction of natural resources and other conditions, it is predicted that the natural gas consumption will amount to 100 billion m3, account for 6% of primary energy consumption in 2020. The corresponding data for 2020 will be 200 billion m3 and 9%. The growth rate of gas consumption will be faster than those of coal and oil consumption.

With limited natural gas resources, being a kind of high quality, efficient, clean energy and chemical raw material, it should be primarily used for civil and chemical industry. The present natural gas market of China is in a premature stage, its development projects include mainly the "gas transmitting from west to east" and LNG projects in coastal regions, such as Guangdong, Fujian, Shanghai, Zhejiang, Jiangsu and Shandong LNG projects. A common problem encountered in all these LNG projects is lack of necessary natural gas pipeline networks in regions where in use. The substitution and expansion of urban gas networks also need time. Thus, it is difficult to popularize to widely dispersed residential, commercial and industrial users. To accommodate large sized natural gas projects (in particular, LNG projects) on "take or pay" basis and reduce peak valley difference of gas supply, certain ratio of gas-fired power projects were arranged in all large-scale natural gas exploitation projects in China.

Moreover, in developed southeast coastal regions, power demand has been rocket high escalated, so the peaking capability is urgently needed. In these regions of highly populated and extremely expensive land cost, the energy mix dominated by coal has brought about serious environmental pollution. If, with large-scale construction of coal-fired power plants further launched, coal transportation becomes a bottle neck, power plant site will be hard to acquire and the threshold of environmental protection hampers to step over. To meet environmental requirements, some localities have prohibited for further construction of coal-fired power plant. Because gas-fired power plant features relatively loose external requirements on plant site conditions: less land occupation, less water consumption and environment friendly, etc. Hence, gas-fired power plants are possible to be built in load center areas, supplying power to vicinities. This may in turn relieve pressure from power transmission and power grid construction and promote operational stability of power system.

It is predicted that the natural gas power installed capacity will reach 25 GW, accounting for 3.21~ 3.31 % of total capacity in 2010, and reach 60 GW, accounting for 4.76 ~ 5.0% of total capacity in 2020.

Generally, incorporated with natural gas exploitation and power grid peaking duty, gas-fired power plants will be appropriately constructed in the developed southeast coastal regions.

Table 4.1 : China's Installed Capacity Mix in the Future

Unit : GW

	2000	2005	2010 LOW	2010 BAU		2020 BAU
Total installed capacity	319.32	508.41	755	780	1200	1260
on which :						
Hydropower	79.35	116.52	170	185	280	300
Coal-Fired Power①	235.25	380.70	543.3	553.3	800	836
Gas power plant	2.29	3.43	25	25	60	60
Nuclear power plant	2.1	6.85	9.7		40	40
Renewable energy power	0.33	0.91	7	7	20	24

①contains a small amount of oil power plants.

Table 4.2 : China's Electricity Generation Mix in the Future
Unit : GW

	2000	2005	2010 LOW	2010 BAU	2020 LOW	2020 BAU
Total electricity generation		2474.7	3603	3721	5595	5862
on which :						
Hydropower	243.1	401	544.00	592.00	896.00	960.00
Coal-Fired Power①	1099.9	2006	2888	2958	4169	4362
Gas power plant	8.0	12	88	88	210	210
Nuclear power plant	16.7	52.3	65.48	65.48	270.00	270.00
	0.7	3.4	17.50	17.50	50.00	60.00

① contains a small amount of electricity generation by oil power plants.

Figure1. Trends of Future Economic Growth and Electricity Demand in China

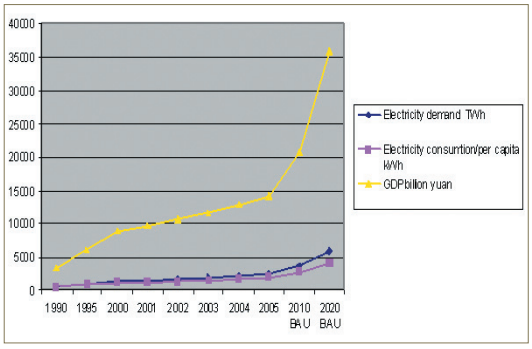


Figure2. Forecast of China's Installed Capacity in the Future

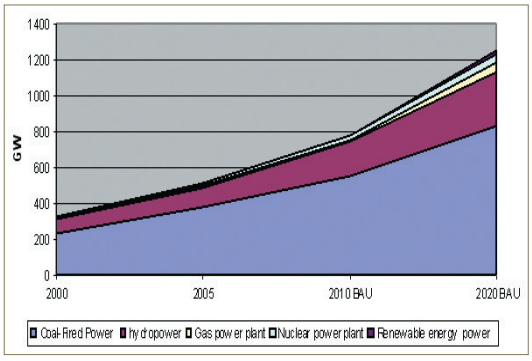


Figure3. China's Installed Capacity Mix in the Future(%)

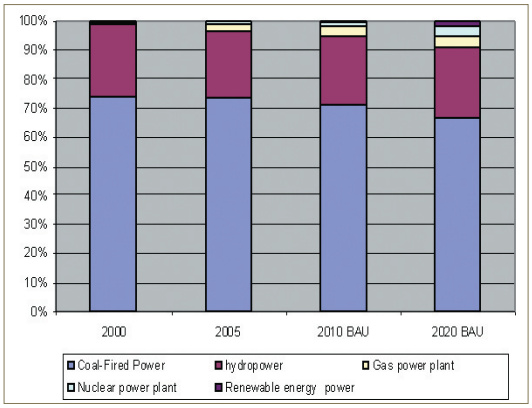


Figure4. Forecast of Future Electricity Generation Demand

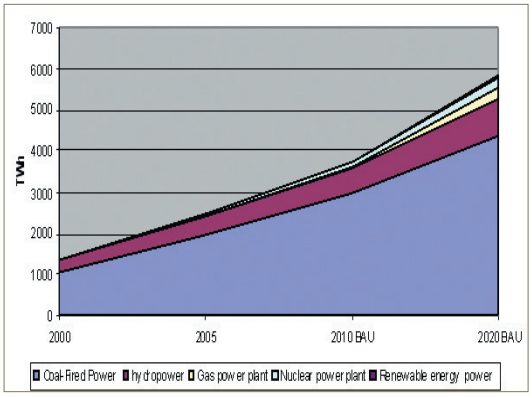
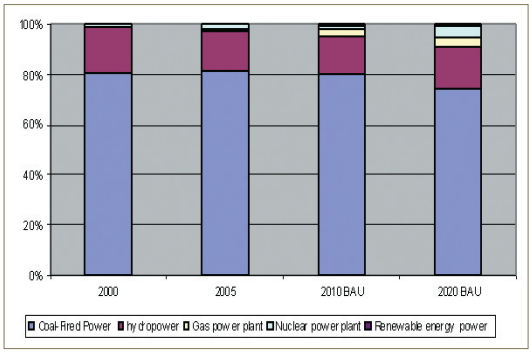


Figure5. China's Electricity Generation Mix in the Future(%)



Envisage on Renewable Energy Development

China has emphasized renewable energy development and utilizations to increase energy supply, improve energy mix, safeguard energy security, protect environment and realize economic and social sustainable development. The "Renewable Energy Law" issued and put into force on January 1st, 2006 clearly stipulates that the state gives priority to renewable energy development and utilizations by compiling renewable energy exploitation indexes and targets and taking corresponding measures to push forward renewable energy market setup and development. The specific target is to increase in the renewable energy power (mainly wind power and solar power) to 7 GW in 2010, and to 20~24 GW in 2020.

Position of Nuclear Power in China Future Power Supply

From the above analysis, it can be seen that due to rapid increase of power demand, in spite of every effort to develop hydropower, nuclear power, gas fired power and renewable energy, coal will still dominate in energy mix. From power capacity mix, the ratio of coal fired thermal power accounted for 73.50% in 2005. It will droop to 70.94% (BAU scheme) in 2010, and further down to 66.35% (BAU scenario) in 2020(see Table 4.1); as for electricity generation mix, the ratio of coal-fired electricity generation accounted for 81.06% in 2005. It will droop to 79.51% (BAU scenario) in 2010 and further down to 74.41% (BAU scenario) in 2020. By then coal consumed for power generation will amount to 2 billion tons, and the nation's total coal consumption will amount to 3 billion tons. Though China is abundant with coal resources, due to diverse restrictions for ecological environment, coal transportation and environment protection, it is impossible to completely satisfy the policy of "coal production determined by demand" in the future. After 2020, the newly added power capacity can't rely too much on coal. Because hydropower exploitation is restricted by resource ceiling, large-scale renewable energy exploitation and utilization need some time, and natural gas power limited by resources, for future energy development should be carried out the strategy of speeding up nuclear power development to meet power demand, optimizing energy mix and safeguarding energy supply.

China nuclear power construction has entered a new stage of rapid development; its necessity can be summarized into following 5 aspects:

- Nuclear power development is an important strategic move to satisfy primary energy and power demand, optimize energy mix, safeguard energy security and promote economic sustainable development.
- Nuclear power development is an effective way to reduce environmental pollution, realize coordinated development of economy and ecologic environment.
- Nuclear power development is a means to transplant military technologies into civil industries, promote nuclear science and technological development as well as to maintain and promote state nuclear deterrent power.
- Nuclear power development is an important measure to upgrade manufacturing industries.
- Nuclear power development conforms with the world energy utilization tendency.

Future investment in China Power Industry

To realize GDP quadrupling to the year 2020, 1200 ~ 1260 GW installed power capacities will be needed. For this it is necessary to commission 46 ~ 50 GW capacity in average each year in coming successive 15 years, which means that a total investment of US$ 560 ~ 600 billion in power construction is needed. Nuclear power and renewable energy provide large investment opportunities. Successful joint venture and technical transfer strategy is a key for international investors to win market. To commission 40 GW nuclear capacity in 2020 needs an investment of US$ 49 billion. If the target of 18 GW under construction added, the total investment will

exceed US$ 75 billion. Until then, China will become a real nuclear power developing center in the world; the nuclear power market in China will become a main "battle field" for big international nuclear power suppliers. At the same time, China will become the world important equipment and components manufacturing and exporting base. The magnificent blue print of renewable energy compiled to the year 2020 brings about opportunities to foreign manufacturers, who have already held quite large market shares. Many commercial banks have now started to focus on renewable energy. Some of them have started to take renewable energy as their new investment orientation. The foreign investment is directed to the hot spots of wind power and solar energy.

Main Conclusions

- In 10th Five-year Plan period, national economy has rapidly grown thanks to newly commissioned power capacity in conformity with power demand increase. It resulted in nationwide power shortage. Along with large-scale power installed capacity newly added in recent years, the power shortage situation has been gradually alleviated.
- Looking at both power supply and demand, the nationwide tense in power supply tended to be relieved. The scope and duration of power shortage has been greatly reduced in 2006. Power supply is expected to satisfy power demand, generally with a little surplus, but power shortage may still remain on a local dimension in 2007.
- To the year 2020, China GDP will be quadrupled than that in 2000 and national industrialization will be basically realized. To meet this overall target, power industry shall remain in high speed growth. By the year 2020, the nation's total power installed capacity will reach 1200 ~ 1260 GW; the corresponding electricity generation will amount to 5595 ~5862 TWh; the per capita power consumption then will be around 3780 ~ 3961 kWh. The power average growth rate will be around 7.38 ~ 7.63%, and the power intensity will be around 1.028 ~ 1.063, all greater than 1 in these 20 years.
- Even if hydropower, nuclear power, gas-fired power and renewable energy develops as far as possible in each stage, still coal will dominate in China's electricity generation mix. The growth of power supply to the year 2020 will still rely on coal-fired power, and nearly 2 billion tons of coal will be needed for power generation.
- To change the situation of coal-fired power dominating power mix of China, power construction shall implement the strategy of equally stressing various high quality power sources, including hydropower, nuclear power, gas fired power and renewable energy. In consideration of actual reserves of energy resources in China, in order to safeguard energy security in China, it is important to accelerate nuclear power development.
- To the year 2020, 1200 ~ 1260 GW installed capacities will be needed in China. It also needs a total investment of US$ 560 ~ 600 billion in power construction. The development of nuclear power and renewable energy provides large investment opportunities. ■

Energy Regulatory Activities in Mongolia : First Experiences

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Abstract

This paper describes some issues concerning energy regulations in transition of Mongolia's economy to a market-based system. In the paper special attention is paid to financial and technical aspects of energy companies of Mongolia during the implementation of the newly adopted Law of Mongolia on Energy, and power tariffs in comparison with prices in selected Asian countries, as well as in former socialist and developed countries.

Law of Mongolia on Energy as the Basis for Energy Regulatory Activities in the Country during Transition of Mongolia's Economy to a Market System

In 2001 the Parliament of Mongolia has enacted comprehensive Law on Energy, which became effective from April 2001.
Enactment of the Law provided a basis for the restructuring of the energy sector of Mongolia. At that time the Mongolian power and heat sector was formerly operated by a vertically integrated, exclusively centralized state-owned monopoly under the Energy Authority. In July 2001, the Energy Authority was largely corporatized into 18 state-owned joint stock companies, which started to function in conformity with market principles and became able to operate independently in financial terms. Entitlement share of the above state-owned joint stock companies is distributed as follows: Ministry of Fuel and Energy - 41 percent, State Property Committee - 39 percent and Ministry of Finance - 20 percent.
The Law of Mongolia on Energy gave full powers and obligations not only to the Parliament, the Government and the Ministry of Fuel and Energy (MFE), but to the new independent body - Energy Regulatory Authority (ERA).
The ERA is obligated to regulate relations concerning production, transmission, distribution, dispatching of energy, importation and exportation of electricity, construction of energy facilities and energy consumption.

Objectives, Management and Structure of the ERA and Entities under Energy Regulation

The Law of Mongolia on Energy and subsequent resolutions of the Government of Mongolia (GOM) defined the objectives, organization and responsibilities of the ERA.
The following main objectives have been determined for the ERA, which was established in April 2001:

- Issue licenses for energy activities;
- Review and approve tariffs;
- Protect equally the rights of Licensees and the consumers with addressing poverty issues;
- Create conditions for fair competition among producers and suppliers

The ERA is governed by the Board of Regulators consisting of three Regulators, with one of them as the Chairman. The Chairman and two Regulators are appointed and can be released by the Prime Minister based on a recommendation from the Minister of Fuel and Energy. They are appointed initially for 2, 4 and 6 years respectively and thereafter for 6 years,

so that expiration of their terms of service has two year intervals. The terms of service may be extended once. The Chairman manages the day-to-day work of the Authority. When the Chairman is absent, one of other two Regulators shall be deputized provided that he is older or has worked as regulator for more years.

The regulatory boards of aimags (provinces) and the capital city are within the structure of the ERA. The ERA has a duty to provide them with professional and methodological assistance.

The ERA has the following departments: (i) Licensing Department, (ii) Price and Tariff Department, (iii) Legal, Information and Administration Department. The Board of Regulators appoints the department heads and approves the Rules.

The following energy entities are under the energy regulation:

- Central Energy System (CES) consisting of five Power plants with total installed of 796 Mw, imported electricity from Russia and six electricity and heating transmission and distribution networks;
- Western Energy System (WES). which supplies three western aimags (provinces) - Bayan-Ulgii, Hovd, Uvs with imported electricity from Russia;
- Eastern Energy System (EES), which supplies the consumers of two eastern provinces (Dornod, Sukhbaatar) from Dornod Power Plant with capacity of 36 Mw;
- Dalanzadgad Power Plant (Southern prov ince)

In addition to above four parts the ERA approves and regulates the energy tariffs of Diesel stations of two aimags - Zavkhan, Gobi-Altai (western provinces and around 300 soums (Lower administration unit)).

Figure1. Production and distribution of CHPs of CES(Min kWh)

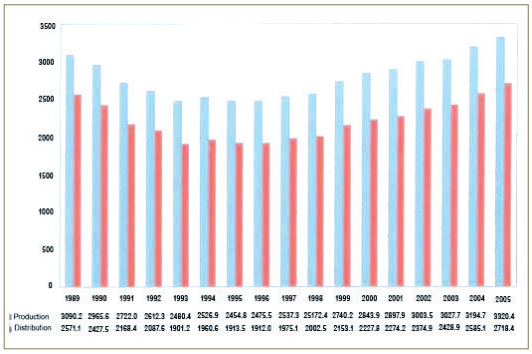
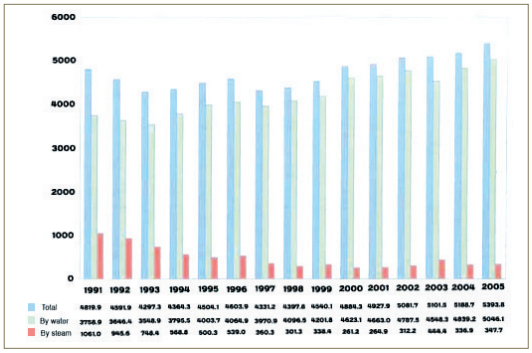


Figure2. Heat distribytion of CHPs of CES(Thousand Gcal)



Energy Regulatory Functioning Experiences

Five years have passed since the establishment of the ERA.

During this period 135 licenses for 57 entities have been issued on the energy activities, such as construction of energy facilities, power generation, transmission, distribution and importation, heat production and distribution and dispatching regulation.

Electricity and heat production has become stable and increased in conformance with the demand. The main indicators, including sales revenue, profit, and unit cost, have been improved. In addition, own consumption of electricity in power plants and technical losses in transmission and distribution have been

Figure3. Profit and loss of energy companies(Bin MNT)

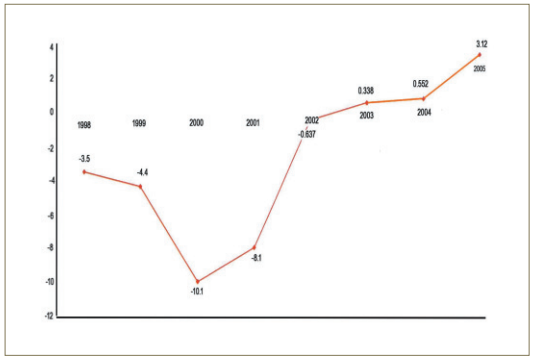


Figure5. Transmission and distribution losses in Central energy system(%)

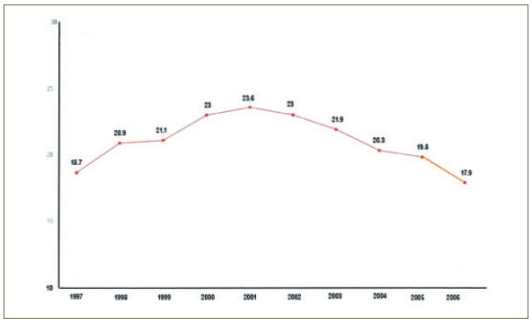


Figure4. Payables and receivables of energy companies

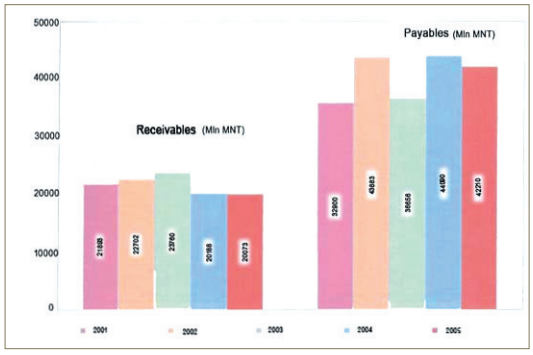
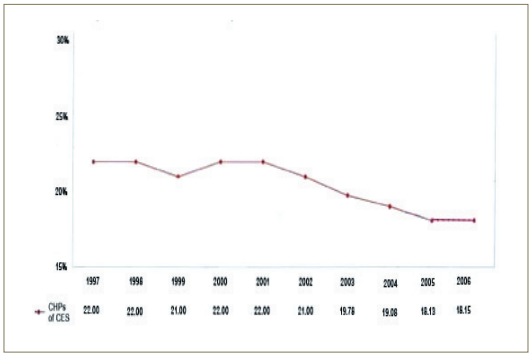


Figure6. Own consumption of electrictiy of CHPs of CES(%)



reduced.

In Figure 1 is shown the production and distribution of electricity by the CHP of Central Energy System (CES) and Figure 2 - the volume of distribution of heat by above CHP.

Profit (Loss), Payables and Receiv ables of Energy Companies

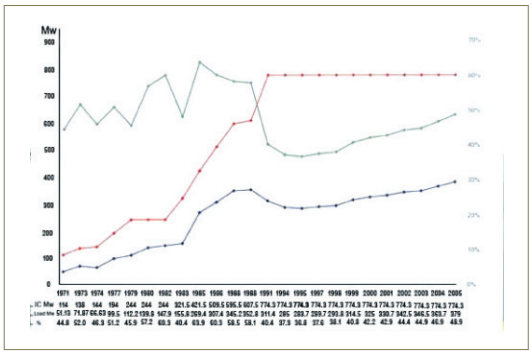
During the previous highly centralized state control the energy companies were facing hard financial problems, experiencing cash flow shortages, weak revenue recovery. And amounts of receivables and payables together with the considerable international debt had become significant deterrents in power industry. After 2000 the financial situation of the energy companies has been improved significantly.

Most of the companies are operating without losses. Inter-company arrears or amounts of payables and receivables between costumers-distributors-generation companies-coal mines, which were gradually increasing in previous years, have been reduced during 2004-2005.

Transmission and Distribution Losses of Electricity

One of the main problems of the power industry during the transitional period was a high level of electricity transmission and distribution losses. In recent years significant reduction of this rate had been achieved. Technical losses, which reached 23.6 percent in 2001, as of June 30, 2006 is reduced to 18.3 percent.

Figure7. Loading of installed capacity(IC) in CES(%)



Own Consumption Rate of Electricity Production of the CHP

CHPs of Mongolia are experiencing comparatively a high level of electricity usage for their own consumption. During 1996-2000 the percentage of own consumption was varying between 20.5-22.4%. As of July 1, 2006 this rate is reduced to 18.0%.

Load Factor of the Installed Capacity in Central Energy System (CES) and Utilization Rate of Fuel on a Unit of Electricity and Heat

As we have mentioned above, the total installed capacity of CHPs of CES is 796 Mw. During the socialist period, loading of installed capacity reached up to 2/3. But after 1991 loading factor is varying between 40-50% in accordance with demand, which is around 400 Mw. Figure 7 shows tendency of changing Loading factor rate during the period of 1971-2005.

One of the main indicators for CHPs controlled by the ERA is the rate of utilization of fuel on a unit of electricity and heat produced. During the period of the restructuring of power generation companies, this indicator has been improved. In 2005 the utilization rate of jishmel fuel has been reduced in CHPs of CES at 11.1 gram/kWh on power and 0.21 Kg/Kcal on heat.

Analyses of Energy Shortages

In early 90s Mongolians were facing the hard energy shortage problems, risen mostly because of the interruption of former Soviet Union's economic and technical assistance to Mongolia. With the donor community assistance (World Bank, ADB, USA, Japan, Germany, Republic of Korea) the Government of Mongolia has accomplished several important projects in the energy sector, including rehabilitation and upgrading of Ulaanbaatar's #3 and #4, Dornod and Darkhan power plants, Baganuur, Shivee Ovoo and Sharyn Gol coal mines, installation of a new power plant at Dalanzadgad and diesel stations in 5 aimags and more than 100 soum centres, renovation of Ulaanbaatar's heating system.

Figure8. Number and volumes of electricity shortages in distribution network of CES

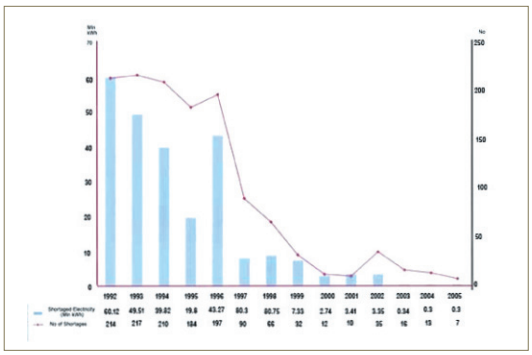


Figure9. Tariff increasing of electricity in CES

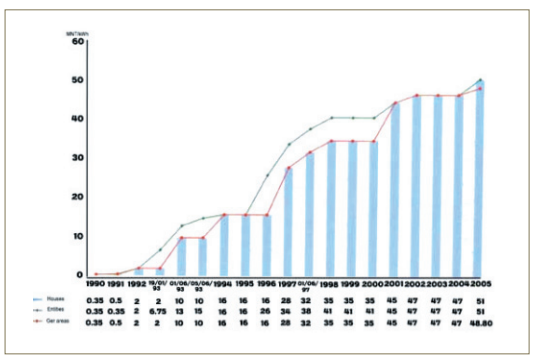
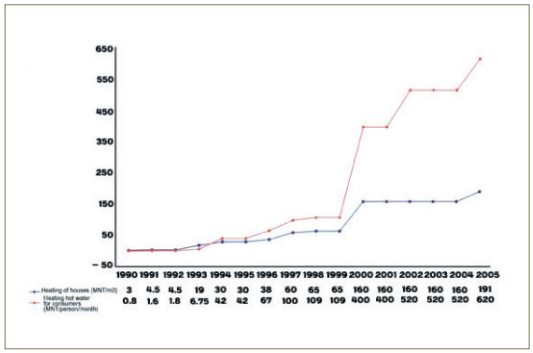


Figure10. Tariff increasing of heating in CES



Implementing the above-mentioned projects in relatively short period resulted in significantly eliminating energy shortages during the recent years. Figure 8 illustrates tendency of numbers and volumes of electricity shortage being reduced in transmission networks of the CES during the period of 1992-2005.

Tariff Setting and Price Increasing

The ERA approves the tariff structures, proposed by operating entities among other responsibilities. This is a particularly important obligation for the ERA to ensure not only that the tariffs may be perceived to be fair and just, but that the tariffs may be sufficient to financially sustain the entities without support

Figure11. Comparison of Mongolia's electricity tariffs wiht selected Asian countries

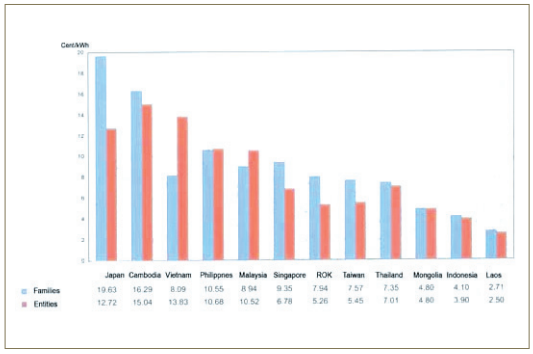


Figure12. Comparison of Mongolia's electricity tariffs wiht former socialist countries

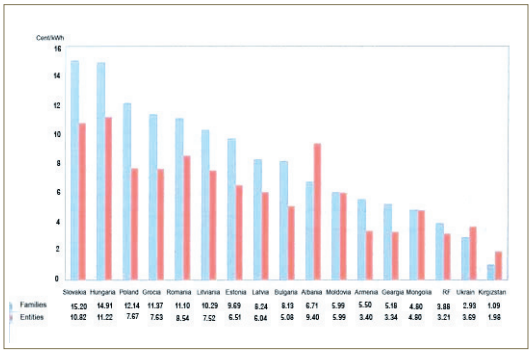
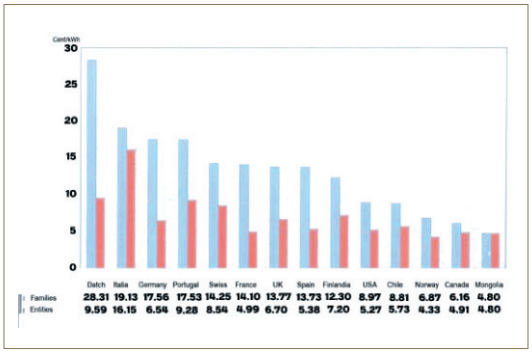


Figure13. Comparison of Mongolia's electricity tariffs wiht selected developed countries



from the central budget. ERA made great efforts to establish improved pricing tariff mechanism by introducing life line tariffs for the low income population in a relatively short period of time. Figure 9 shows dynamics of increasing electricity tariffs in period after 1990 within the CES and Figure 10 - increasing heating tariffs.

Comparison of Electricity Tariffs of Mongolia with Selected Countries

Figures 11, 12 and 13 show comparison of Mongolia' s electricity tariffs with the tariffs of the selected Asian and former socialist countries as well as with a few selected developed economies. ▣

Coal: Future of Mongolia

TUGSBAYAR Sundui
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In the 21 century, until the discovery of other reliable energy resource, coal will remain as a major fuel for producing energy in the world. Coal provides over 24% of global primary energy needs and generates 40% of the world's electr icity.

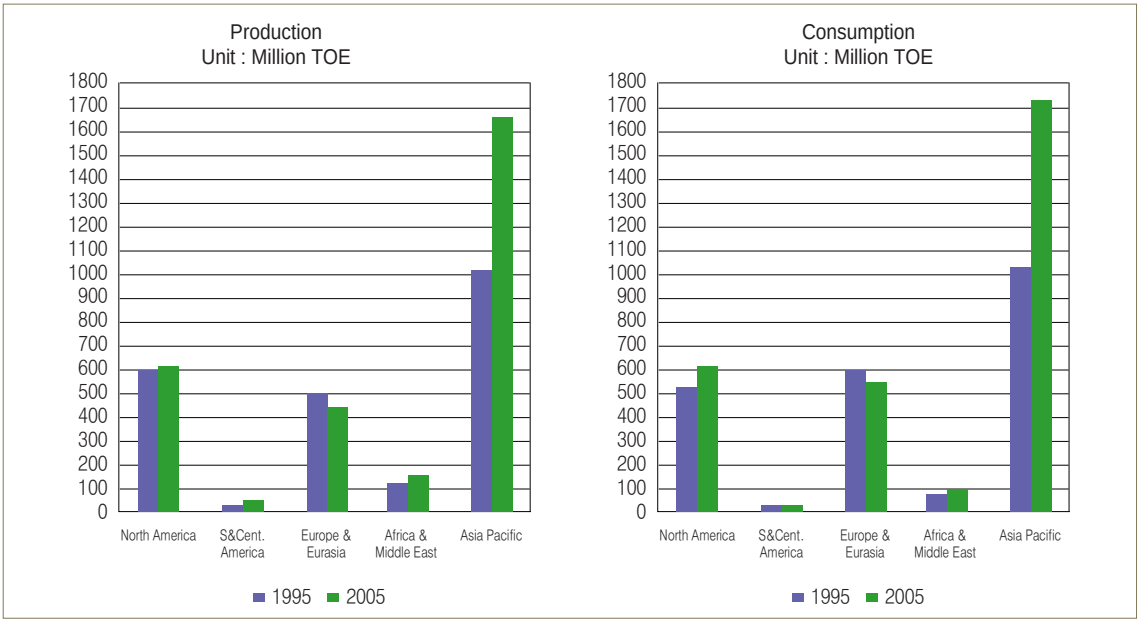
Coal has been again the world's fastest growing fuel, with its global consumption growth twice the 10 year average. Especially, coal consumption growth in China accounted for 80% of global growth. (source: BP) China plans to spend about 40 billion yuan (US$5 billion) by 2020 exploring for coal reserves across the nation.

The Ministry of Economy, Trade and Industry (METI), Japan, plans to provide coal liquefaction technologies to China as a part of a broader effort to promote the energy resource in Asia outside Japan in order to alleviate the global shortage of crude oil. Two Chinese firms plan to start operating a liquefaction plant by 2010. Japan is also considering the cooperation with India, Mongolia and the Philippines in this field. Japan has studied coal liquefaction technologies since the 1980s. But with costs of 25-30 USD per barrel, the process was considered too expensive. However, crude oil prices recently having hit 75 USD a barrel, the path to commercialize coal liquefaction in Asia has opened up. (source: Forbes)

But in proportion to the progress of industr ialization and urbanization, developing countries come to face more serious problems of air, soil and water pollution. Particularly in Asia, where the percentage of coal in the energy mix is large, sustainable economic development further emphasizes the importance of the development and widespread dissemination of coal utilization technology with full-scale environmental conservation measures.

Mongolia has abundant coal resources and amount of coal deposits as much as 150 billion tons. Over the last decade, the Mongolian government has set the development of its abundant coal resources

Table1. World Coal Production and Consumption in 1995 and 2005



as a top-priority task. It also urgently conducted a comprehensive program for coal development and utilization, including the renovation of its main coal mines, and the master plan study for coal development and utilization until 2010 and the technical renovation of domestic coal mines. As a result, the reliability of equipment and production capacity of most domestic and main coalmines within central energy system was significantly upgraded. Currently, Mongolian coal industry provides domestic coal market with resources, placing Mongolia into the list of coal-exporting countries in the world. Though the coal industry has made some progress, however, it is still encountered with new challenging tasks.

Nowadays, Mongolia has not yet found proven oil and gas deposits, so coal will remain as a major fuel for producing energy. With coal being cheap and available, almost 90 % of electricity used in Mongolia is produced at coal-fired power stations. In 2005, Mongolia extracted over 7 million tons of coal and exported almost 2 million tons that was the highest figure on record over the last decade. Ministry of Fuel and Energy of Mongolia has established a strategic document, "Coal" program, to improve security of coal in Mongolia by making coal extraction and coal-processing industry stable, and take a new step by defining the outlook for 20-30 years long term development of coal industry.

"Coal" program was developed in accordance with Mongolian government policy for increasing household income, alleviating poverty by creating new jobs, expediting development of economic zones, reducing air pollution by introducing more efficient clean coal technology and environmental friendly technology which would be acceptable by international requirements. Therefore, it is required to introduce clean coal technologies that are already commercially viable in developed countries.

The situation of electricity supply in Mongolia is different specifically in remote areas not covered by the central energy system. There is a severe shortage of electricity due to transportation cost of the imported diesel fuel for long distance. From year to year, the migration of local people to urban areas is increasing because of bad situation of electricity supply in remote areas, which causes the poverty and unemployment. In order to stop this social negative consequence, it is requested to improve the electricity supply of school, hospital, and other social infrastructure services in the remote areas.

To provide stable energy service in the remote areas, the government is introducing and testing small sized IGCC plant. This small sized power generator is relatively cheap, compared with diesel power generator so that coal can be available and affordable in all provinces of Mongolia.

This long-term coal development program aims not only to develop coal utilization industry, but also increase export of coal, coking coal and other related products in the southeast and northeast Asian region, which will contribute to its economic growth and position heightening in the international market.

The Mongolian government approved and adopted the law in compliance with "Stockholm convention" in 2003, which is pursued in many countries with a view to protecting environment and human health by introducing clean coal technology and refusing the old technology infamous for inefficient coal combustion, which is to blame for volatile organic compound, and using electrostatic precipitators and bag filters in power stations to prevent emit black smoke and dust from being emitted into atmosphere. Also, Mongolia adopted the Kyoto Protocol, which requires developed countries a reduction for the emission of six green house gases in certain level.

The Government Policy to Uphold Coal Industry

The economic policy basis of the Mongolian government is to stabilize economy, restructure organizational structure based on private sector and technology renovation, and provide economic growth by promoting foreign investment.

In Mongolia's government action plan of 2004-

2008, it noted the government policy for coal mining and processing industry. It makes efforts to uphold industry producing an intellectual and exportable goods, coordinate mining exploitation of mineral deposits with local community where mineral deposit is located, with a view to enhancing living standard of the rural people, and promote the study of synthetic oil products from coal and oil shale, utilize Liquid Petroleum Gas widely in households, industry and transport, improve coal supply in rural areas by renovating equipment and technology of the domestic coal mines, and establish infrastructure for exploring Tavantolgoi coking coal deposit.

Government has been implementing the strategic policy to promote export with every possible way including increasing export of mineral resources, coal and electricity produced from coal. The main objectives of this policy are to upgrade efficiency of domestic coalmines by renovating equipment and technology, to improve energy efficiency and energy conservation, commercialization of existing state-owned enterprises in the coal sector, to foster development of coal processing industry by increasing share and role of private industry.

The coal and energy industry need to be supported with law and regulation act, exempted from custom' s duty and taxation, as it will become basis of the future development of Mongolia.

The government tasks within the most important and necessary policy and regulation need to be implemented in the long- and mid-term for the development of coal sector:

- Main strategic guideline is to use lignite and sub-bituminous coal as a major energy source and supply with reliable and affordable coal especially to Gobi economic zone and Arkhangai, Gobi-Altai,Zavkhan, Sukhbaatar aimags by introducing modern equipment and advanced technology into domestic coal mines.
- Build infrastructure and connect economic development zones with road, electricity transmission and railroad lines by utilizing and exploring biggest coal and other mineral deposits such as Tavantolgoi coking coal, Tsagaansuvarga zinc, Ouy tolgoi gold-copper, Kharaat uranium deposits in the foreseeable future.
- Increase coal export significantly.
- Establish coal-chemical industry based on completely processing coal with following technology such as coal liquefaction and gasification, producing chemical products, coking coal.
- In compliance with Kyoto protocol for decreasing environmental pollution from utilizing coal, we need to use more efficient clean coal technology like a small sized IGCC power generators with international technical and economical assistance.
- The Mongolian government proposed economic development zones. And for secure fuel and energy supply to the zones it is necessary to construct coal gas power generator stations on the basis of Baganuur, Shivee-Ovoo, Bayanteeg, Zeegt, Khar- tarvagtai coal deposits which are currently supplying most aimags in the central and western economic development zones.
- The air pollution became the biggest concern due to increasing number of households, vehicles and population in the Ulaanbaatar city. To decrease this air pollution and eliminate problems arising from emission in the capital city and other big cities we should use a smokeless and toxic free coal briquette for the households and emission-free liquefied petroleum gas for the vehicles.

Possibilities for Increasing Coal Export

Industrial and economic expansion of China and North East Asian countries, forecasted to continue during period of the next 10-30 years, will escalate energy demand, which gives us a pleasant condition for exporting coal for this region.

The thermal coal is traded in China around 40-50 $US in 2004, because of its high domestic demand. The demand of coal in China will increase due to its escalating energy demand.

It is reported by experts that the crude oil price will

increase and estimated to reach 80-100 $US/bbl. This situation seriously influenced economy of many developed countries with high energy consumption. They consider introducing alternative energy technologies, but those technologies will not be competitive compared with existing conventional technologies such as coal fired power technology due mainly to the relatively low price of coal.

Developing Asian countries consumed 40% of total coal output in 2001 and by end of 2025 it will reach 51% because of increasing energy consumption in this region, mainly in China and India. The China imported over 14 million tons coal in 2001, and it is estimated that coal demand of those countries will rise almost 67% by the end of 2025 in comparison with the coal consumption in 2001.

The Japan imported over 172 million tons coal in 2002 and by end of 2025 will acquire 22 % of total coal imports in the world coal trade. In 2004, Japan imported over 1.5 million tons coking coal for its steel industry from USA. During that time USA exported to this region over 23.4 million tons coking coal.

Also, South Korea and Taiwan are the coal importing countries in Asia. Therefore, we have plenty of opportunities for developing coal export cooperation based on investigation of coal demand and supply in this region. We need a good policy and management to implement these opportunities and increase export of coal and electricity from lignite.

Coal Processing Study Conducted in Mongolia

The exploratory study of coal-conversion chemistry has begun in Mongolia since 1960's. In the post communist countries were implemented study on coal liquefaction and gasification through hydrogenation study. "Fossil Fuel Complete Exploitation Study" was being implemented from 1976-1980, within this study coal sample from the biggest coal deposits of Mongolia such as Baganuur, Bayanteeg, Talbulag, Uvdugkhudag, Sharingol, Chandgan tal,Tavantolgoi, Tsaidamnuur was collected and put through laboratory test in former Soviet Union, Poland and East Germany.

Conclusion

The first and foremost direction in sustainable development of Mongolia, developing country with limited economic potential, is to introduce clean coal technology such as coal liquefaction and gasification, coal conversion chemical plant since Mongolia has abundant and affordable coal reserves.

Long term-development strategy for the coal mining and processing industry intends to utilize our abundant coal reserves more efficiently and process completely, which would give an opportunity not only to provide domestic market with coal but also to provide possibilities for exporting coal, also coking coal and other related products in the Asia and Pacific region.

It is considered that the coal would remain as the most important source for primary energy in the XXI century and also it will be the alternative source (raw material) for producing oil, gas, and other chemical products. Also, within the world development trend, much more progress has been achieved in improving the social and environment performance of coal production and efficiency existing technology.

The industrialization of coal processing industry in Mongolia can be implemented rapidly since it has many positive advantages such as a well trained specialists and surveys carried out in the most biggest coal deposit. There is plenty of opportunity to introduce technologies into the coal industry and to develop international cooperation in this field.

The energy outlook 2004 shows that with a current production level, known coal reserves are forecast to last over 200 years, known oil reserves of oil for 40 years and gas for 60 years. Verified coal reserves in Mongolia are estimated to last over 400-500 years and it is possible to increase by future survey. ▣

NEA Statistics

● Oil Demand Outlook of Russia, EU, 3 Northeast Asian Countries

(Unit: Mln. b/d)

	2002	2010	2020	2025
3 Northeast Asian Countries	12.7	17.1	20.6	22.4
Korea	2.2	2.6	2.9	2.9
Japan	5.3	5.3	5.4	5.3
China	5.2	9.2	12.3	14.2
Russia	2.6	3.0	3.1	3.4
West Europe	13.8	14.1	14.4	14.9
Whole World	78.2	94.6	111.0	119.2

Sources : EIA, International Energy Outlook 2005

● Oil Import Outlook of 3 Northeast Asian Countries and Russia Oil Supply in 2020

(Unit: Mln. tons)

	Import in 2004	2020				
		Oil Import(A)			Russian Oil Supply by Plpeline	
		EIA	IEA	APERC	(B)	B/A(%)
3 Northeast Asian Countries	443.97	836.6	772.3	879.7	80	9.1 ~ 10.4
Korea	113.12	144.4	144.4	205.6	30	14.6 ~ 20.8
China	121.65	268.9	268.9	298.9	20	6.7 ~ 7.4
Japan	209.20	423.3	359.0	375.2	30	7.1 ~ 8.4

CALL FOR PAPERS

"Northeast Asia Energy Focus"

"Northeast Asia Energy Focus" (NAEF) is published quarterly by the Center for Energy Research, Northeast Asia, (CERNA) of the Korean Energy Economics Institute(KEEI). The aim of the journal is to stimulate the researches on the Northeast Asia issues and to illuminate the role of Korea in the regional cooperation and development.

Northeast Asia Energy Focus is now soliciting papers for a wide scope of the Northeast Asia Energy issues including regional energy cooperation for the next publication. The submission guidelines are as the followings:

1. Manuscript must deal with energy issues relevant to the Northeast Asia.
2. Manuscript must be in English and typed in A4 with 12 point typefaces.
3. Preferred length of manuscript is approximately 8 pages or 12,000 ~ 20,000 characters including spaces.
4. The deadlines
   - Deadline for intent submission is September 25, 2006
   - Deadline for manuscript submission is October 31, 2006

An accepted manuscript will receive an honorarium of $500. For more information, please contact Mr. Cheol-Seon Hong at cshong@keei.re.kr

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