Environmentally Friendly Energy Use in Northeast Asia: Necessity and Possibility

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INTRODUCTION

Looking back on the twentieth century, we may define it as a "century aimed at human affluence." In fact, industrialized nations achieved material abundance hand in hand with remarkable technological advancement over the course of the century. On the other hand, this material civilization has generated serious environmental problems. Twentieth-century economic activities consumed a large amount of energy, most of which was supplied by fossil fuels, including coal and oil. As a result, air pollution and acid rain have spread across the globe. Moreover, the global warming issue, which was barely recognized until the 1990s, worsened even as we were unaware of its seriousness.

Even now, in the twenty-first century, the damage that the environment has suffered continues to worsen. In fact, the population of industrialized nations, which achieved affluence in the previous century, accounts for only 20% of the total population of the world. The remaining 80% of the world's population is yet to achieve affluence. For developing nations, in which the overwhelming majority of people live, the twenty-first century will be the time to catch up with the industrialized nations, and their energy consumption is rapidly increasing. People in industrialized nations are also continuing to increase their affluence, and therefore energy consumption in these countries also shows a tendency to increase. However, if industrialized nations cannot achieve a new style of growth, and if developing countries continue to grow in a manner similar to the traditional form of economic growth in industrialized nations, it is inevitable that the environment, which is in part a non-renewable resource, will be irreparably damaged.

We must not seek growth without giving attention to environmental preservation. It is obvious that we have to make the twenty-first century the "century of the environment." Given that it was the wisdom of our predecessors to discover fossil fuels, leading to our prosperity, it is up to us to make concerted efforts to develop environmentally friendly uses of energy, in order to bequeath an untainted (or adequate) environment to future generations.

Northeast Asia is at an extremely important strategic and experimental stage in terms of advancement toward this goal, because it comprises a variety of countries and regions in close proximity. These include Japan, which is the world's second largest economy and excels in environmental technologies; South Korea, which has joined the group of advanced nations and will be required to contribute more to the international community in the near future; China, which has serious energy and environmental problems; North Korea and Mongolia, which are expected to move ahead with economic growth in the future; and Eastern Russia, which is rich in clean energy resources, including hydropower and natural gas. There is a mutual complementarity in Northeast Asia that can promote the environmentally friendly use of energy. If energy use of this kind is promoted in this region—with its population of about 1.5 billion—it will prove to be not only a model case for other areas, but will also directly contribute to the improvement of the global environment. In the following sections, this paper discusses the forms of environmentally friendly use of energy considered possible in Northeast Asia.

CURRENT STATUS OF ENVIRONMENTAL ISSUES IN NORTHEAST ASIA

Energy-related environmental issues can be roughly divided into two categories. One is the issue of air pollution caused mainly by SOx and NOx emissions, which has an adverse effect on human health and agricultural products in the short term. The other is the issue of global warming, which is climate change due to the accumulation of greenhouse gases (including CO_2) in the atmosphere, and which, for example, will increase the sea level and reduce forestation over the long term.

Because the issue of air pollution is far more visible than that of global warming, it is easier to proceed with counter measures, and even developing nations, which have difficulty in providing funds for dealing with environmental issues, have a strong sense of crisis. On the other hand, measures to respond to the issue of global warming seem to have been delayed, because its major effects are expected to appear only in the next generation, and because the link between climate change and greenhouse gases emissions is not necessarily clear.

For the past thirty years, SO_2 density has consistently decreased in Japan, while CO_2 emissions have continued to increase, parallel to energy supply (see Figure 1). It will be far from easy for Japan to achieve the obligation to reduce emissions of greenhouse gases to which it committed itself at the Third Conference of the Parties to the UN Framework Convention on Climate Change (COP3). Therefore, it will be necessary for Japan to obtain greenhouse gases emission credits from abroad by, for example, conducting clean development

mechanism (CDM) projects in developing nations in the future. On the other hand, given the cross-border nature of the air pollution issue, Japan will also have to provide advice to surrounding countries, based on its own experience, to overcome the SO_2 problem. Thus, Japan certainly has positive reasons for promoting the improvement of the global and regional environment in cooperation with other Northeast Asian countries.

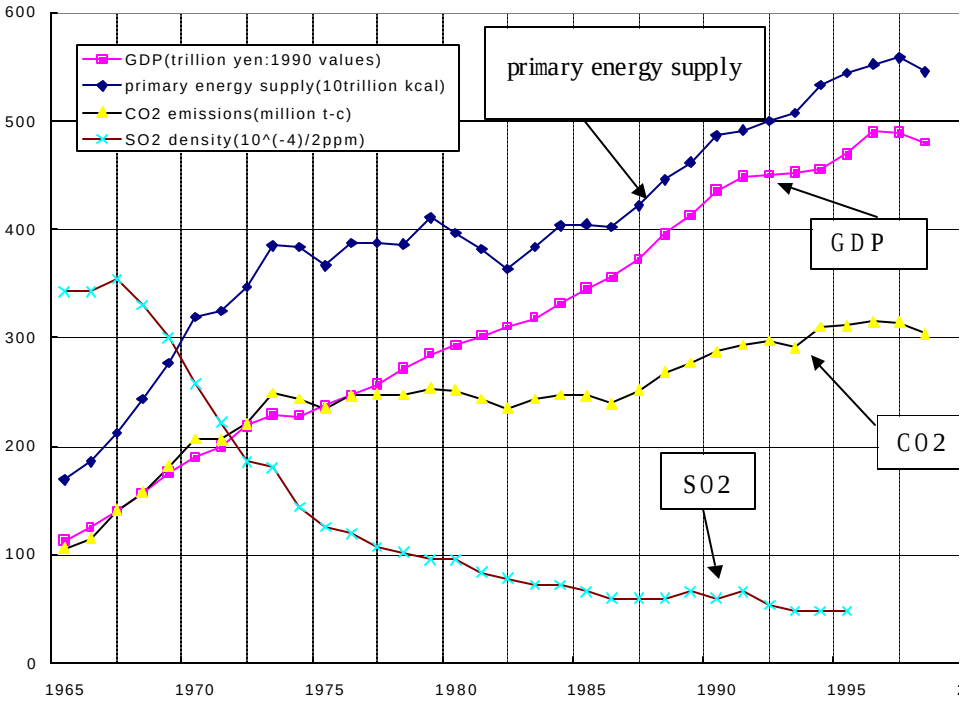

Figure 1. CO_2 emissions and SO_2 density in Japan, 1965–2000.

As Figure 2 shows, China and South Korea achieved remarkable or steady economic growth in the 1990s, while Japan experienced low growth. Economic growth is generally accompanied by increased energy consumption, and energy consumption in both China and South Korea increased rapidly in the 1990s. Although energy consumption in both countries decreased temporarily at the end of the 1990s, it is expected to increase in the first decade of this century, along with economic growth and improvement in standards of living. On the other hand, in Japan, energy consumption will not change on a large scale, owing to its economic situation and its own COP3 commitment.

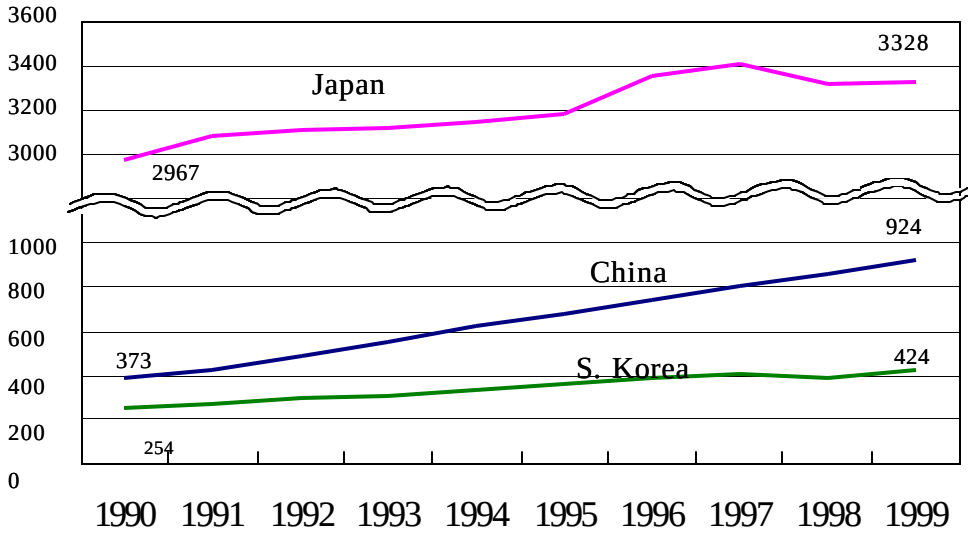

Figure 2. Economic growth in Northeast Asia, 1990–99 (1990 billion US$)

Source: US Energy Information Administration.

Note: Japan 112%, China 248%, and South Korea 167% for 1999/1990.

As a result of energy consumption (Figure 3), carbon dioxide (CO_2) emissions in the three countries have increased, as shown in Figure 4. From 1990 to 1997, CO_2 emissions in China, Japan, and South Korea increased by 30%, 10%, and 77% respectively. Considering that energy consumption in China and South Korea will continue to increase in the near future, CO_2 emissions in the whole region will also increase, even if Japan can achieve its own commitment.

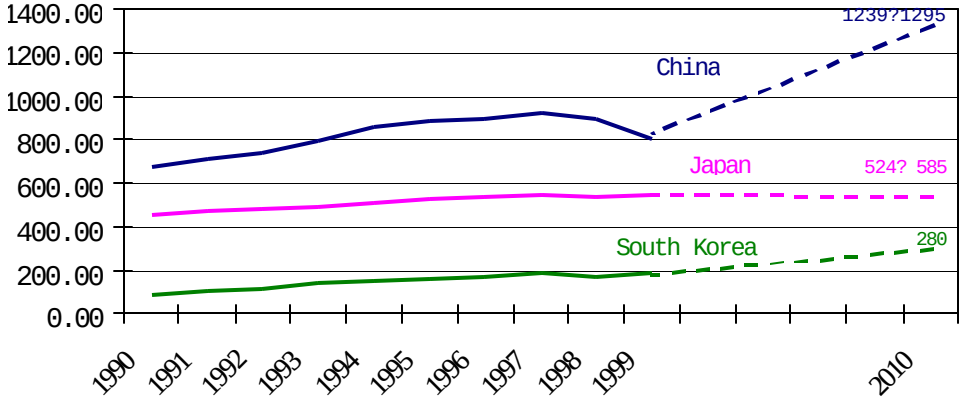

Figure 3. Primary energy consumption in China, Japan, and South Korea, 1990–2010 (million tons of oil equivalent)

Sources: US Energy Information Administration. Energy Research Institute, China. NIRA, Japan. Korea Energy Economics Institute.

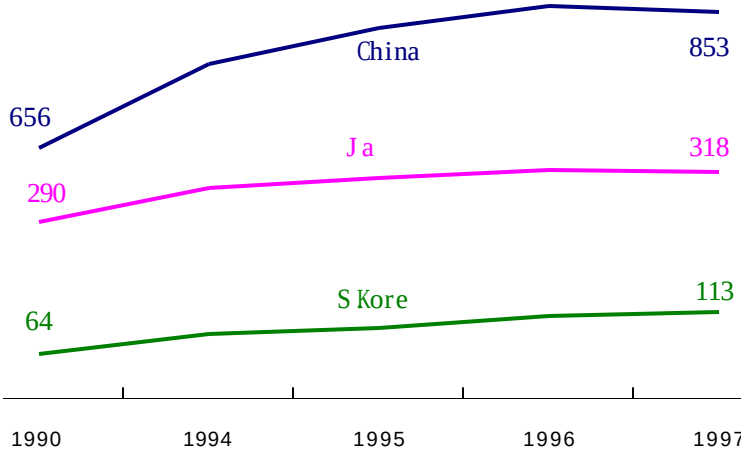

Figure 4. Carbon dioxide emissions in China, Japan, and South Korea, 1990–97 (million tons of carbon)

Source: Institute of Energy Economics, Japan.

Among Northeast Asian countries, environmental problems in China are most serious, but the government is making efforts to improve them. Although emissions per capita are still very small, China is the second largest CO_2 emitter

in the world and is likely to exceed the United States in the future. In addition to that, China has a serious air pollution problem due to smoke dust, Nox, and SOx. In fact, the area affected by acid rain has increased year by year, at a great cost to the economy and human health. Two points explain the seriousness of air pollution problems in China. First, China depends mainly on coal for its energy supply as shown in Table 1.

Table 1. Energy structures of Japan, China, and South Korea, 1998 (%)

Economy	Coal	Oil	Natural Gas	Nuclear	Hydro
Japan	16.6	51.1	11.7	17.0	3.6
China	71.4	23.7	2.4	0.4	2.1
South Korea	20.6	56.2	7.6	14.3	1.2

Source: OECD Energy Balances, 2000.

Coal still accounts for about 70% of China's energy structure. On the other hand, dependence on coal in Japan and South Korea is far lower than in China, though both countries still depend heavily on fossil energy. Second, energy efficiency in China is lower than in Japan and South Korea. For example, CO_2 emissions per unit of GDP (million US dollars) in China were 1,022 tons in 1997, while those in Japan and South Korea were 59 tons and 219 tons, respectively. This implies that improvements in energy structure and energy efficiency—environmentally friendly energy use—are necessary in China.

Currently, there are high expectations for the expansion of natural gas use in particular, because there are rich natural gas reserves in the areas surrounding Northeast Asia. However, it will not be easy to improve the energy structure, as the case of Japan demonstrates. Although Japan has worked toward the diversification of energy for many years, given its necessity in terms of security, the nation still depends heavily on oil (more than 50%). Considering the current status of China, it will also be necessary to promote the rationalization of energy use, for example electrification.

PROSPECTS FOR EXPANDING THE USE OF NATURAL GAS

Natural gas produces the least environmental burden among fossil fuels. It contains no sulfur and emits less NOx and CO_2 than coal and oil when burned. In addition, natural gas has advantages over oil in terms of the size and location of deposits. The use of natural gas has therefore been promoted in Western

countries, and in most Western countries it accounts for 20–30% of the energy structure (Table 2).

Table 2. Energy structures of selected Western economies, 1998 (%)

Economy	Coal	Oil	Natural Gas	Nuclear	Hydro
United States	23.6	39.8	22.7	8.5	5.4
Canada	12.4	35.0	29.2	8.0	15.5
United Kingdom	17.5	35.8	34.1	11.2	1.5
France	6.6	36.2	13.1	39.5	4.7
German	24.3	40.6	21.1	12.2	1.7
OECD	20.5	41.9	20.6	10.9	6.1

Source: OECD Energy Balances, 2000.

In Northeast Asia, however, and even in Japan, which introduced LNG in the 1970s, the percentage of the energy structure represented by natural gas is small: only 12% in Japan, 8% in South Korea, and 2% in China in 1998 (Table 1). Meanwhile, there is an abundance of natural gas in China and eastern Russia, as there is in Southeast Asia and Central Asia. As shown by the fact that various plans exist for natural gas pipelines in Northeast Asia, this region is well supplied with natural gas resources, which will act as a base for the expansion of its use.

If the use of natural gas expands in Northeast Asia, especially in China, environmental problems in the region will be noticeably improved. If electric power plants and heating plants use natural gas as fuel, and if networks for the supply of natural gas to households are established, the emission of air pollutants including SOx will be drastically reduced. Emissions of CO_2 will also be reduced. In Beijing—which has constructed a domestic natural gas pipeline originating from a nearby gas field and introduced a regulation to reduce the burning of coal—air pollution has been noticeably improved over the past few years. As this fact demonstrates, there is no doubt that expansion in the use of natural gas has tremendous environmental benefits.

Needless to say, the Chinese government itself has recognized this fact, and has commenced construction of a 4,200-km pipeline from a gas field in the Xinjiang Region in the western part of China to Shanghai, and is promoting an LNG project in the southern coastal area, taking in Guangdong Province. If these two projects are completed, it will be possible for many major cities in China to increase their use of natural gas. However, since these projects do not cover China's northeastern region, which is a center of heavy industry and has a very serious air pollution problem, it will be necessary to make efforts to fill in this gap.

Although the Northeastern region of China is not blessed with natural gas resources, it is close to Eastern Siberia in Russia, where there is an abundance of natural gas. There is a plan for a pipeline originating in either Irkutsk or Yakutsk in Russia, and passing through the northeastern region of China. If this plan is realized, it will be possible to expand the use of natural gas in the region. Since a natural gas pipeline is infrastructure that will make it possible to respond quickly to new clean use technologies for natural gas, including fuel cells and gas to liquid (GTL), when they are put into practical use, it will also be important in improving environmental problems in the long run.

However, for realizing this plan a large amount of low-interest funding and massive demand seem vital. For these reasons Japan is expected to play a positive role, though Japan is paying attention mainly to the development of natural gas in Sakhalin and is unlikely to participate readily in other plans at present.

Considering that the pipeline could be extended to South Korea and in that case it would contribute to improved energy security and political stability in the Korean peninsula, South Korea too is expected to be a major player. However, it is difficult to solve the financing issue without broader cooperation. In addition, there have been few experiences of multilateral cooperation in Northeast Asia. Therefore, international organizations, which can contribute to solving these issues, are also expected to be involved. Even if Japan does not play a direct role in this pipeline plan, it will be able to contribute indirect assistance through international organizations.

THE NECESSITY FOR COOPERATION IN THE ELECTRIC POWER FIELD

The Relationship between Electrification and the Environment

Whether one electric power system is advanced or not, is generally decided by the following three factors: (1) the percentage of electricity use in final energy consumption is high; (2) use of a clean electric power source; and (3) high efficiency in power generation and transmission. In short, the degree of development of electric power systems will have a great influence on the country's environmental level.

The progress of electrification makes it possible to restrict the inefficient burning of fossil fuels in households and small plants, while facilitating the introduction of environmental regulations and environmental equipment, including the flue gas desulfurization system. Therefore, the effects of energy consumption on the environment can be reduced. In fact, in advanced countries where air pollution problems are comparatively minor, electrification is advanced. (The OECD average was 18.6% in 1997.) By contrast, in countries where air pollution

is serious, the level of electrification is low (China 12.1%, Vietnam 8.99%, Mexico 12.5%). However, the seriousness of air pollution such as China's cannot be explained only in terms of the rate of electrification. It is also very important to make the power source as clean as possible and to increase the efficiency of power generation and transmission. For example, in advanced nations, the percentage of nuclear energy and natural-gas-fired power generation (kWh) in the structure of power sources is high. (The OECD average for nuclear power and natural gas together was 38% in 1998.) In China, by contrast, coal- and oil-fired power generation occupies the major percentage (90% for the two combined). In addition, looking at power plant facilities, we find many old, small-scale thermal power plants in China, whereas in advanced nations, most of the power plants are large (more than 500,000 kW), and possess much greater efficiency in power generation.

Table 3 shows the progress of electrification in China, South Korea, Japan, and the OECD nations. Looking at the production of electricity per person and the ratio of electricity in final energy consumption, we see that China as a whole is in the initial stage of electrification, and South Korea, which has become a member of the OECD, is still in the process of electrification.

Table 3. Electrification in China, South Korea, Japan, and OECD, 1997

Economy	Generation (TWh)	Population (100 million)	Per Capita (kWh)	Electrification (%)
China	1,134	12.27	924	12.1
South Korea	244	0.46	5,304	14.8
Japan	1,029	1.26	8,167	23.1
OECD	8,839	10.95	8,072	18.6

Source: Institute of Energy Economics, Japan.

Table 4 shows the outlook for electricity demand in China and South Korea, and it can be seen that in both countries electrification will progress rapidly in the future. According to the outlook for demand, both countries will need to almost double their 1998 levels of power generation capacity (kW) and electricity generation (kWh) in 2015.

Table 4. Outlook for electricity demand in China and South Korea, 1998–2015

Economy and item	1998	2000	2010	2015
China				
Capacity (GW)	277.3	309.7	450	520
Demand (TWh)	1,158	1,250	2,010	2,342
South Korea				
Capacity (GW)	43.4	49	74.6	79
Demand (TWh)	215.3	250.6	384.2	426.8

Sources: Energy Research Institute, China. Korea Energy Economics Institute.

Even if electrification progresses in both countries, energy consumption as a whole will also grow, and it will impact on the environment. Therefore, we should take the structure of electricity source and thermal efficiency in power plants into consideration in order to mitigate the environmental burden. In short, not just electrification but *environmentally friendly* electrification is necessary in Northeast Asia.

Cooperation in the Clean Use of Coal

Coal reserves are so abundant that it is said that we can continue to mine coal for more than two centuries. In addition, coal is a resource that is spread all over the world. Coal is therefore completely different from oil, which is unevenly distributed, is concentrated in the Middle East and, it is claimed, will be exhausted within several decades. Price per calorie also differs between the two energy sources: the price per calorie of coal is much lower than that of oil or liquefied natural gas (LNG). According to a survey conducted by the Institute of Energy Economics in Japan the prices of crude oil and LNG per 1,000 kcal in December 1999 were 1.74 yen and 1.62 yen, respectively, while that of coal was 0.58 yen. Because of these characteristics, coal is considered an appropriate energy source in terms of energy security. In addition, as coal is the biggest internal energy source for China to supply on its own, it is likely that it will remain an important energy source for Northeast Asia in the twenty-first century.

However, since coal contains more ash, carbon, and sulfur than other fossil fuels, it may cause serious pollution in the region. Northeast Asia is expected to consume more coal in the future, and it will be essential to make efforts to ensure that it can be used as cleanly as possible. It is expected that coal use at the household level will decrease in China in the future, as a result of efforts aimed at promoting its clean use, and it is therefore likely that coal will be used mainly in power plants. This means that it is important for power plants to adopt effective

environmental policies, such as those aimed at desulfurization and improvement of thermal efficiency.

Although the introduction and promotion of the flue gas desulfurization unit is considered a particularly urgent and important task for China, this paper will focus on the improvement of thermal efficiency, because it is also effective in terms of reductions in CO_2 emissions. Many coal-fired power plants are being constructed in Japan at present, because electric power companies are interested in the improvement of thermal efficiency. In Japan, thanks to technological advances, thermal efficiency is expected to be more than 40%, when the coal-fired power plants currently under construction are completed. On the other hand, in China the thermal efficiency of coal-fired power plants remains at 33% on average (as of 1997).

Since it is certain that the number of power plants will increase in China, as electrification progresses in the near future, improvement of thermal efficiency will become an increasingly important issue. Meanwhile, for Japan, which is an advanced country in terms of clean coal technology, China is regarded as a promising market because of its increasing electrification. As such, a complementary relationship exists between Japan and China with regard to the thermal efficiency of coal-fired power plants, making cooperation a strong possibility. If advanced technology could be introduced to China, coal consumption, air pollutant emissions, and generating cost per kWh would be reduced. The savings from the cost reduction could be applied to the introduction and operation of flue gas desulfurization units.

In the later part of this paper, I will introduce the results of a thermal efficiency improvement project, which was conducted in China by an electric power company in Japan.

Cross-border Transmission of Electricity

In response to improvements in living standards, the peak load of electric power during the summer period is currently becoming an acute problem in China. In order to cope with this situation, a plan to interconnect small local power networks and establish a nationwide electric power network was proposed. By establishing such a network, it would become possible to send electric power to areas that lack electricity from areas where it is abundant. In addition, when the construction of the world's largest hydropower station, the Three Gorges hydropower plant, is completed, clean hydropower could be efficiently utilized in a broader area.

It would also be possible to establish an international power network by connecting the transmission lines beyond national borders. The results produced

by an international network would far exceed those from a domestic network. For example, Europe has a wide-area power network, and it is common for European nations to import or export electric power, depending on the location of resources.

Looking at Northeast Asia, there are abundant water resources in Eastern Siberia. This area is capable of generating a large surplus of electricity by utilizing this hydropower. If such surplus electric power could be sent to China's northeastern region, electrification might start to progress in this old and seriously polluted heavy industrial region. In addition, the cost of hydropower generation is economically attractive for China. Therefore, Chinese local government is showing an interest in it.

Meanwhile, given the fact that eastern Russia has abundant natural gas, it would also be possible to construct a power plant near the gas fields and send electricity from these locations through cross-border transmission lines. Where the gas fields are not very large or the demand for natural gas is small, it would be more appropriate to generate electricity than to construct a natural gas pipeline. For example, in the case of Mongolia, a country with a small population, importing electricity from Russia is likely to be more efficient than importing natural gas.

Given that eastern Russia's capacity to export electricity generated from water resources and natural gas is considerable, it is possible that transmission lines connecting Siberia and China's northeastern region may be extended to the Korean peninsula. Utilizing surplus electricity generated from a clean energy source to promote energy cooperation with North Korea would be beneficial for Northeast Asia as a whole. In addition, if power supply to South Korea became possible, it would make significant contributions to the current situation in South Korea where the construction of new power plants is becoming difficult because of residents' opposition, despite the fact that the demand for electricity will surely increase in the future.

Japan, however, is not likely to be connected to the power network, because Japan is an island country and therefore the cost entailed by power supply from overseas would be high. In addition, demand for electricity is not expected to increase drastically in the future. However, a cross-border power network should be constructed at least on the continent, from the perspectives of promoting the efficient use of electricity, and encouraging clean energy sources in a wider area.

Even if Japan is not directly connected to the regional power network, Japan, with environmental benefits in mind, should cooperate by providing various technologies, including those related to transmission efficiency, frequency conversion, which differs among countries, and network operation.

Cooperation to Promote a Safety Culture in Nuclear Power

Nuclear power is an attractive option for Northeast Asia where each country has great concerns about energy security and energy-related environmental problems. In Japan, the government promotes nuclear power development as a pillar of its energy policy, and ten plants are expected to be built in the near future (though local residents' opposition is increasing). As Figure 5 shows, China and South Korea also have a positive attitude toward nuclear power. Furthermore, North Korea will also have nuclear power when the KEDO project is completed.

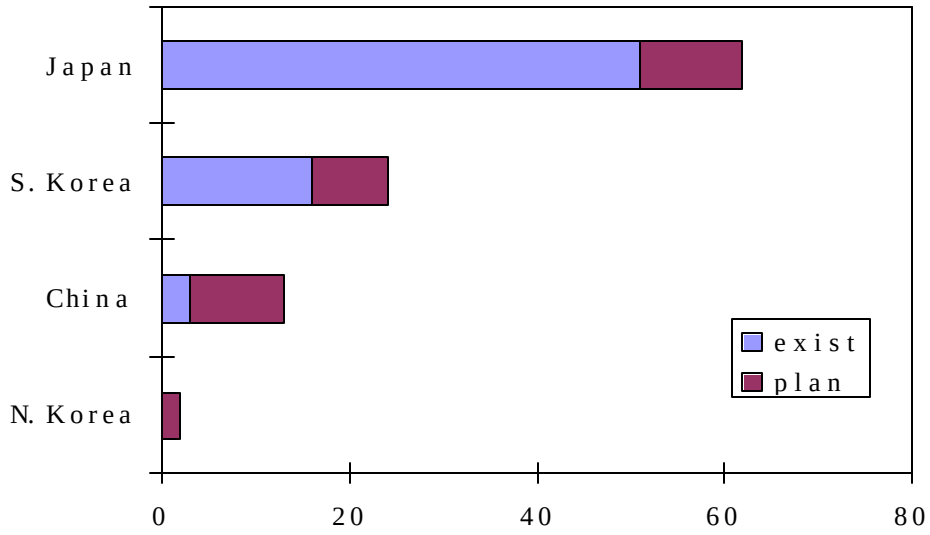

Figure 5. Nuclear power plants in Northeast Asia (number of units)

Therefore, in Northeast Asia it is necessary to promote a culture of safety in nuclear power operation. In Japan, the Nuclear Safety Network, which is composed of electric power companies, plant manufacturers, and research institutes, was founded in the wake of a fatal accident in Tokai Village in 1999, and it has been bearing fruit steadily. In my opinion, Northeast Asia also should establish a regional organization for information exchange and peer review (mutual inspection) like the Nuclear Safety Network in Japan.

Nuclear power plants have been operated in Japan with no fatal accidents for more than 30 years (though Japan has experienced some trouble in the nuclear industry that requires self-examination). In addition to efforts to ensure safe operations, Japan has been making efforts to establish a nuclear fuel cycle

(including reprocessing) for the effective utilization of uranium resources, leading to improvement in energy security.

Japan has much experience with nuclear power, and therefore it can contribute to future safe use of nuclear power in Northeast Asia. Considering that many developing countries throughout the world will consume more and more fossil energy, Northeast Asia where a technical base of nuclear utilization exists, should develop nuclear power while establishing a culture of safety by sharing experiences and information.

THE ROLE OF THE CLEAN DEVELOPMENT MECHANISM

The clean development mechanism (CDM) is one of the flexibility mechanisms adopted in COP3. When an industrialized nation conducts a project aimed at reducing emissions of greenhouse gases in a developing nation, part of the emission credits gained from this project will be returned to the industrialized nation. Therefore the CDM is thought to be a promising measure to reduce emissions in developing nations. In fact, the World Bank has created the Prototype Carbon Fund to conduct CDM projects, and some industrialized countries have begun to study model CDM projects.

The CDM is expected to play an important role in Northeast Asia because there is a complementary relationship between industrialized nations and developing nations seeking environmental technologies. If the energy projects previously mentioned in this paper—such as enhancing the use of natural gas, improving the thermal efficiency of coal-fired power plants, and the project to connect transmission lines to allow clean electricity to be utilized in a wider area—are all approved as CDM projects, credits for the reduction of greenhouse gases will be generated from these projects, and therefore the projects will prove economically efficient. This implies that industrialized nations can make investments in these projects more easily. Meanwhile, developing nations are considered a favorable CDM market for industrialized nations, because greenhouse gas emissions can be reduced in these nations at a low cost. Therefore, when the CDM comes into force, various environmental technologies will be introduced to developing nations. The CDM will make significant contributions to improving the environment in developing countries.

On the other hand, many voluntary projects aimed at improving the environment are being developed in Northeast Asia. For example, organizations in China are managing many afforestation projects, and in North Korea, the Nautilus Institute (under the leadership of Dr. Peter Hayes) has attempted to introduce wind power generation. The CDM is also useful in terms of promoting voluntary

projects such as these. For non-profit organizations (NPOs), officially certified greenhouse gases emission credits will serve as a kind of mark of status or legitimacy. NPOs will also be able to sell emission credits in the market and use the money earned in the continuation or expansion of other projects aimed at improving the environment.

However, a number of problems need to be resolved in order to use the CDM in efforts to improve the environment in Northeast Asia. One of these is "additionality," which is emphasized by developing nations. This concept implies that funds and technologies related to a CDM project should be additional to those related to other projects. However, the understanding of additionality is quite different between industrialized and developing nations. For example, ODA is not considered additional funding and therefore a project funded by ODA is not regarded as a CDM project. In China, afforestation in general is not considered a CDM project for technological reasons. Moreover, a project aimed at improving the efficiency of power plants through the independent power producers (IPPs) using conventional technologies is regarded as merely a commercial investment.

However, when the technology required is highly advanced, the technology offered often proves immature. This results in the increase of risks, which will make it more difficult for financial institutions to make investments in the project, which in turn makes it more difficult for the project to make progress. The industrialized nations will have to respect the opinions of developing nations in general when determining which project to conduct as a CDM project. However, if China becomes too strict with regard to determining projects to adopt, it is quite probable that investment from industrialized nations may flow toward other developing nations that offer less strict conditions. This in turn will result in the stagnation of environmental improvement in Northeast Asia.

Another problem is how to determine the baseline (the volume of emissions generated if the CDM project were not adopted), which is essential in terms of evaluating the volume of reduction of greenhouse gas emissions achieved by adopting the CDM project. Although the specific measure to be used to determine the baseline is as yet undecided, if a very strict standard is set, the economic efficiency of the project will decline. On the contrary, if the standard is too lax, the emissions credits generated by the project will be far larger than the appropriate amount. This means that the project would be unable to make contributions to eliminating global warning. The determination of the baseline is an extremely difficult problem, which needs to achieve both incentives for investment for industrialized nations and the preservation of the global environment.

In order to utilize the CDM as an effective means of contributing to the improvement of the environment in Northeast Asia, the priority issue is cooperation between the major players: China, South Korea, Japan, and Russia. It will be important to accumulate demonstrable results by designing model projects and developing simulations on the basis of this cooperative relationship. This will in turn enhance a deeper understanding of CDM in these nations, eliminate the gap between the different understandings of additionality, and provide a greater diversity of information concerning the baseline.

RECOMMENDATIONS

Thus far, most of the projects to improve the environment have been based on assistance or the volunteer activities of organizations from industrialized countries. However, what these efforts can do is obviously limited. For example, Japan is still suffering from a prolonged recession, and it seems that Japan cannot provide sufficient environmental assistance to Northeast Asia. Under these circumstances, it is difficult to expect a remarkable improvement of the environment through assistance and volunteer activities.

In order to deal with this problem, we should try to attract private companies in industrialized countries. Table 5 shows the results of a thermal efficiency improvement project, carried out at a coal-fired power plant in Shangdong Province in eastern China, by the Kyushu Electric Power Company in western Japan. It is remarkable in terms of environmental and economical improvement. However, since the Kyushu Electric Power Company carried out this project on a voluntary basis, the company, which bore all costs, gained only the experience, whereas the electric power company in China enjoyed a large profit without actual investment. If this kind of project does not bring any profit to the investor, similar projects will never take place.

Table 5. Coal-fired power plant thermal-efficiency improvement project

Efficiency		Reduction			Project Cost
Before	After	coal consumption	running cost	CO_2 emissions	n.a. (some million dollars est.)
33.17%	37.57%	88,000 tons/year	US$3 million/year	212,000 tons/year	

Source: Denki Shimbun (Electricity Newspaper), Japan.

In this regard the CDM is very useful to resolve the issue. If this project were conducted as a CDM project, and if the greenhouse gas emission credits could be traded at the price of US$10 per CO_2 ton, the economic value of the reduced CO_2 would reach more than US$2 million per year. Although the detailed cost of the project is not known, the return from this project is thought to be satisfactory for the investment, and it will encourage a variety of private companies to conduct that kind of project.

Thus, it is extremely important to create conditions that will encourage and facilitate private sector environmental investment in Northeast Asia. For example, establishing a carbon fund for Northeast Asia is a promising idea. Most private companies regard environmental investment in Northeast Asia as relatively risky and difficult, a carbon fund with the know-how of project management can minimize risk and difficulty. If this kind of fund is set up, it becomes easier even for cautious private companies to invest in environmental projects.

The carbon fund can also disseminate its own experiences gained from the project that the fund itself facilitated, and therefore, it can contribute to a common understanding of the possible benefits of the environmental investment in Northeast Asia. This fund would, of course, be open to countries without greenhouse gas reduction targets, such as South Korea and the United States. Personally I hope the United States will return to the Kyoto Protocol. But even if it does not do so, the US can contribute to improving the environment in Northeast Asia by being involved in the fund.