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Electric Power Grid Interconnection in Northeast Asia

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Abstract

Despite its regional closeness, energy cooperation in Northeast Asia has remained unexplored. However, this situation appears to be changing. The government of South Korea seems to be very enthusiastic for power grid interconnection between the Russian Far East and South Korea to overcome difficulties in finding new sites for building power facilities to meet its need for increased electricity supplies. This paper analyzes the feasibility of this electric power grid interconnection route. The issues addressed include electricity market structures; the prospects for electric power industry restructuring in the Russian Federation and South Korea; the political issues related to North Korea; the challenges for the governments involved and the obstacles anticipated in moving this project forward; project financing and the roles and concerns from multilateral and regional banks; and institutional framework for energy cooperation. While there are many technical issues that need to resolve, we think that the great challenge lies in the financing of this commercial project. Thus, the governments of the Russian Federation and South Korea involved in the project need to foster the development of their internal capital markets and to create confidence with international investors. To this end, on energy side, this involves defining a clear energy policy implemented by independent regulators, speeding up the already started but delayed reform process of restructuring electric power industry and markets, and establishing a fair and transparent dispute resolution mechanism in order to reduce non-commercial risks to a minimum. The paper argues that establishing a framework for energy cooperation in this region will contribute positively towards that end, although views differ regarding its specific form. Finally, given that North Korea has a crucial transit role to play and faces a very unstable political situation, it is concluded that moving the project forward needs to be contingent on a resolution of the North Korea's nuclear crisis.

Keywords: Electric power grid interconnection; Northeast Asia; Energy Charter Treaty

1. Introduction

Northeast Asia (NEA) is part of larger Asia-Pacific community. It includes China, Japan, Mongolia, North Korea, the Russian Federation, and South Korea. In spite of regional closeness, energy cooperation in NEA has remained unexplored. Energy cooperation in NEA, especially in the power sector, has so far been considered only a subject for discussion and research among related professionals. Even though power sector cooperation in NEA has a great potential, there has not been much progress. By contrast, in other parts of the world, such as in Europe, Southeast Asia, South America, North America, and even in Africa, power sector cooperation has been specifically enforced and has provided good results (APERC, 2000; Uprety, 2002; Bernard et al., 2003).[1] The benefits from power sector cooperation in these regions are jointly shared.

Regarding the possibility of energy cooperation in NEA, there are strong complementarities between the energy production and consumption structures of this region (Bae, 2004). On the one hand, the Russian Federation is the only country in the region with energy capacity to export to other countries. On the other hand, China, Japan, the Democratic People's Republic of Korea (North Korea) and the Republic of Korea (South Korea), as energy consuming countries, are seeking stable energy sources within the region to diversify their sources of traditional energy supplies.

Nevertheless, the heterogeneous structures between NEA countries as well as the differences in economic development are among factors impeding energy cooperation including power sector cooperation. Especially, a disagreement due to the division of North Korea and South Korea is a unique factor that acts to impede peace and economic cooperation in NEA compared to other parts of the world. However,

[1] The successful examples of cross-border power sector cooperation include NordPool and power exchanges between England and France in Europe, Thailand-Lao PDR, Peninsular Malaysia-Singapore, and Peninsular Malaysia-Thailand interconnections in Southeast Asia, OLADE (Organización Latinoamericana de Energía) in South America, power trading between Canada and PJM (Pennsylvania-New Jersey-Maryland) in North America, and SAPP (Southern African Power Pool) in Africa.

these impeding factors provide good opportunity to produce more profits through cooperation. Put to good use as a tool for peace, energy cooperation in NEA could relieve tensions between North and South Koreas, contribute to regional and global peace and security, and allow these countries to enjoy the accompanying economic benefits.

The situation appears to be changing along with the inception of natural gas pipeline projects and electric power interconnection plans. In the NEA countries, there are growing interests in energy cooperation. The development of gas fields in Sakhalin, or the Korean Peninsula Energy Development Organization (KEDO) project in North Korea has exemplified large-scale energy cooperative projects progressing in NEA. Recognizing the importance of such cooperation, a joint declaration was drawn at the inter-governmental meeting (organized by the United Nations Economic and Social Commission for Asia and the Pacific) in Khabarovsk, Russia in October 2001, reflecting the opinions of the NEA countries. There is an article on the major agendas of that declaration, which states that a cooperative committee will be formed with government officials to deliver a realistic cooperation plan on energy, including power sector cooperation. Also, a preliminary meeting to form the committee was held in Seoul, South Korea. Even though there has been no indication of progress after this preliminary meeting, it is significant in that there was a specific attempt to form the committee in a short period of time.[2]

There is no doubt that there are economic, social and environmental benefits to reap from any power grid interconnection project. Such a project will help lower financial requirement for infrastructure development, improve energy resource allocation for environment, and bring in monetary gains from regionally competitive pricing. Not only these measurable benefits, but also such intangible benefits as strengthening energy security and regional ties with neighboring countries may well

[2] Starting from December 2002 to November 2005, the South Korean Ministry of Commerce, Industry and Energy has sponsored a comprehensive project titled as "Development of Cooperational Infrastructure for Northeast Asia Region Electrical System Ties (NEAREST)." This project includes construction of data base, technical feasibility, economic feasibility, and market feasibility of NEAREST. For further information, see the project's web site at: http://nearest.keri.re.kr.

be generated from the project.

Despite these potential benefits of power grid interconnection, the attitude of the countries involved do differ. Given that 70% of its territory is covered with mountains and the residents are reacting extremely negatively to the construction of power facilities, South Korea faces great difficulties in finding new sites for power facilities. To overcome such difficulties in meeting the need for increased electricity supplies, the government of South Korea seems to be very enthusiastic for power grid interconnection between the Russian Far East and South Korea, although the government has not officially endorsed it yet.

Several possible electric power interconnection routes have been proposed. One route is the link between the Russian Far East and South Korea directly via North Korea, as shown in Figure 1. Simply, this route assumes trading of electricity between the Russian Far East and South Korea with the construction of high voltage direct current (HVDC) transmission lines passing through North Korea.[3] According to the preliminary analysis by KERI (2004), the approximate distance of this interconnection route would be 1,260 kilometers. Also, it is assumed to take five years to construct the interconnection line, and its life expectancy will be 30 years. Assuming 4 GW-capacity interconnection, the total investment cost is estimated to be US$ 2.51 billion, of which the line construction cost is estimated to be US$ 1.06 billion and the converter cost US$ 1.45 billion (KERI, 2004).

Compared with alternative routes of Russia-China-North Korea-South Korea route or Russia-Japan-South Korea route, this route has received much attention from academic scholars and practitioners in recent years. The alternative routes are considered to be more expensive due to even lengthy interconnection distance and technical difficulty involved in constructing submarine cables.

This paper aims to analyze the feasibility of this electric power grid interconnection route. The issues addressed include electricity market structures; the prospects for electric power industry restructuring in the Russian Federation and South Korea; the political issues related to North Korea; the challenges for the governments involved and the obstacles anticipated in moving this project forward;

[3] HVDC is a proven technology employed for power transmission (APERC, 2000; KERI, 2003).

project financing and the roles and concerns from multilateral and regional banks; and institutional framework for energy cooperation. On the basis of in-depth analysis of the aforementioned issues, the paper suggests a strategic approach to implementing power grid interconnection between the Russian Far East, North Korea and South Korea, the most promising power grid connection in Northeast Asia.

Figure 1. Alternative routes of power grid interconnection in NEA
Source: Park et al. (2004).

2. Electricity markets in NEA

2.1. Rising electricity demand along with rapid economic growth

The NEA countries have begun full-fledged political, economic and social exchanges since the end of 1980s. It was after abandoning the adversarial relations that were persistent throughout the most part of the 20th century. The volume of personnel exchange and commodity trade has demonstrated robust growth over the last two decades. This inter-regional trade has contributed to accelerating the regional economic growth.

As a consequence of the increased economic activities, the NEA countries have witnessed the rapid growth of electricity consumption. By 2002, total annual

electricity consumption of the four big NEA countries amounted to 3,979 TWh (terawatt hours) (IEA, 2004). Of this total, 1,675 TWh, or 42% of the above total, is attributable to China. The corresponding total electricity generation capacities in 2002 amounted to 919 GW (gigawatts) (IEA, 2004). This figure approximates that of the United States and is about one third more that that of the European Union (681 GW in 2002).

In the case of South Korea, electricity consumption has increased rapidly along with high economic growth, growing at about 10% annually between 1973 and 2003. The peak demand in 2003 reached 47 GW, and electricity sales were 322 TWh. The installed generating capacity that coped with peak load in 2003 was 56 GW. Of the total, nuclear accounted for 28%, coal for 28%, natural gas for 26%, oil for 8%, and hydropower for 7% (KEEI, 2004).

In Russia, the electricity output amounted to 889 TWh in 2002. The corresponding installed generating capacity was 223 GW. Natural gas is the main fuel input to electricity generation, accounting for 40% of the total installed capacity in 2002. Coal-fired power accounts for 23%, hydropower for 20%, nuclear power for 9%, and oil for 7% (IEA, 2004).

Electricity demand is projected to continue to grow rapidly in NEA in the next three decades. For the four big NEA countries, their total electricity demand is projected to rise to 8,945 TWh, growing at an annual average rate of 2.94% between 2002 and 2030. In the mean time, the world electricity demand is projected to grow at an annual average rate of 2.5%. The highest increase will be in China, whose demand is expected to increase by 3,898 TWh, a quarter of the world's projected increase (IEA, 2004). Due mainly to intensified industrialization and urbanization with rising personal income in the region, demand for electricity will grow faster than that of primary energy. In order to cope with rising electricity demand, the NEA countries have to actively implement their own long-term energy and/or electricity demand and supply plans, which need to be carefully crafted to achieve long-term efficiency. They could also act collectively cross borders in response to rising electricity demand. It is in this context that electric power grid interconnection in NEA is suggested as an option in planning long-term power supplies. Both the historical power consumption and projected future power demand in NEA underline the importance of this option.

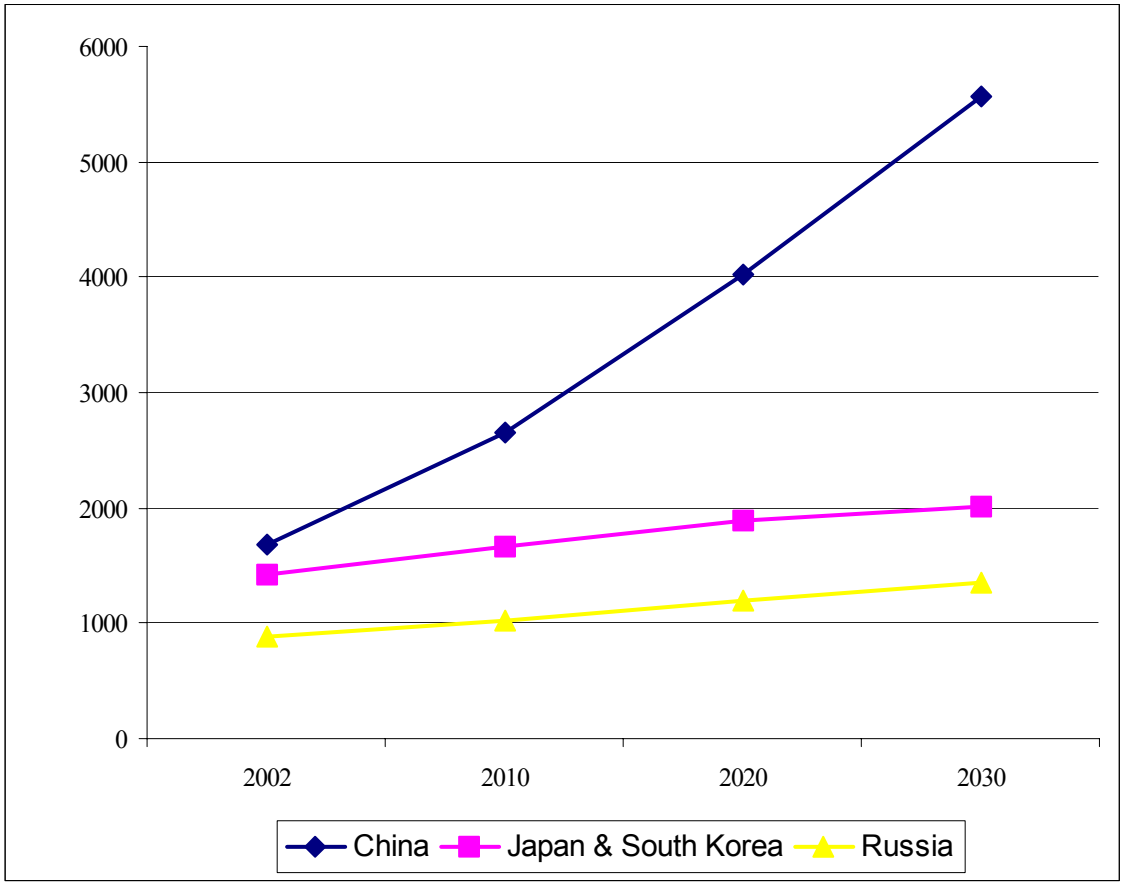

Figure 2. Long-term forecast of electricity demand in the four big NEA countries

Source: Drawn based on the data from IEA (2004).

2.2. Load difference and electricity tariffs

One of the primary benefits from interconnecting electric power grids between countries would be the reduction in the costs of delivering power by reducing overall addition to generating capacity and by taking greater advantage of generating options with relatively low costs according to peak load differences among countries. The demand for electricity differs by hour, day, and month, and shows typical regional differences as well. If economic dispatch is enforced using such peak load differences, the costs of delivering power can be reduced. In other words, by utilizing electricity produced by inexpensive foreign generators at peak times, and exporting during low points, mutual benefits can be realized. In addition, power sector cooperation will

greatly help in alleviating difficulties in finding locations for power plants in South Korea, which results from scarcity of suitable land and public protests.

Figure 3 shows the seasonal diversity of maximum loads in the Russian Far East and South Korea. Even though the NEA countries are situated in the Northern hemisphere, there are notable differences in climate. As a result, the electricity demand peaks during the summer in South Korea and Japan, whereas there is an excess of power generating capacity during the winter. By contrast, the Russian Far East has a demand peak during the winter, whereas facing an excess of power generating capacity during the summer. Clearly, interconnecting power grids between the Russian Far East and South Korea will bring about substantial benefits through joint utilization of their mutually supplementary seasonal excessive capacities. Podkovalnikov (2002) estimates that this proposed interconnection would reduce demand for generating capacity through 2020 by 8 GW, or a quarter of new capacities to be commissioned if power systems are separately operated. As a result, while the interconnection itself would be estimated to cost about $2 billion, it would reduce expenditures on new generating capacity by about $14.3 billion, leading to the overall capital cost savings of about $12.3 billion. Annualizing these capital cost savings at a discount rate of 8% and adding operating savings to them, the total cost savings from the proposed interconnection would be estimated to amount to about $2 billion per year.

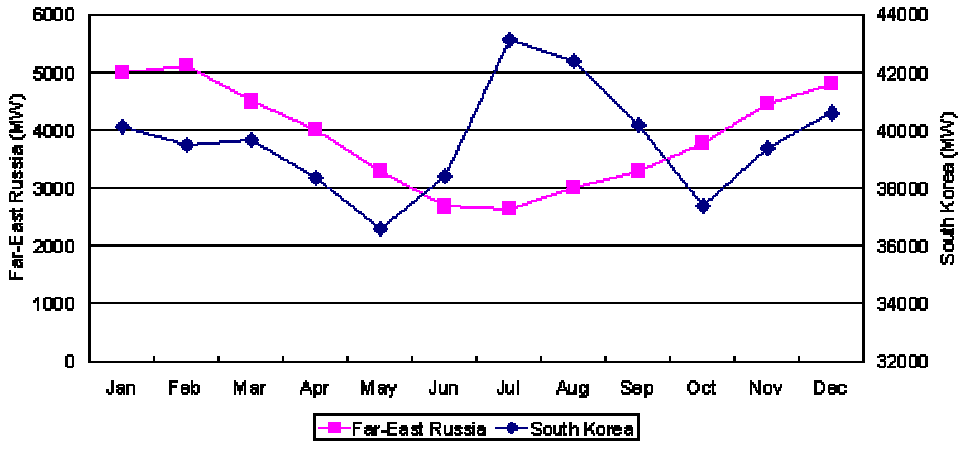

Figure 3. Seasonal difference in load curve

Sources: Drawn based on the data collected from the various sources of Energy

System Institute, Siberian Branch, Russian Academy of Sciences, Irkutsk, Russia and Korea Power Exchange, Seoul, South Korea.

The Russian Federation and China have revealed their plans to create a national level wholesale market for electricity after unbundling the vertically integrated electricity utilities into generation, transmission and distribution, and sales of electricity. At the same time, they plan to connect all local power networks into a single transmission network run by independent system operators. It is not difficult to anticipate that electricity tariffs will fall in the long-run, eventually converging to international market prices once these plans are implemented seamlessly.

However, in the short run, electricity tariffs could rise due to temporarily increased transactions cost from the forced transition. In the case of the Russian Federation, the current level of electricity tariffs is well below long-run marginal costs. There are also enormous cross-subsidies between industrial and household consumers. In 2002, the average industrial electricity price was 45% higher than the average paid by households in Russia, whereas in OECD Europe, the average prices charged to industry are around 50% lower than those paid by households (IEA, 2004). Given that natural gas is the main fuel input to power generation (accounting for 43% of the total generation in 2002) and that its share is projected to rise in the future, electricity tariffs will, almost certainly, rise in the next 10 years as the Russian government has planed to relinquish subsidies for electricity by lifting price controls on generation fuels, in particular, natural gas.[4] The Russia government has carried out legislative

[4] European Union (EU) resistance to Russia's WTO bid specifically centered on natural gas prices. Europe has charged that Gazprom – Russia's state-owned natural gas monopoly, the world's largest natural gas producer and single largest supplier of natural gas to Europe -- indirectly subsidizes the domestic economy by charging Russians significantly lower prices than it charges Europe. Currently, the average domestic price is less than 20% of the average natural gas price that Russia charges at the European border (IEA, 2004). In May 2004, Russia agreed with the EU to raise its domestic gas tariffs in return for EU backing of Russia's entry into the World Trade Organization (WTO). From the $27-28 per thousand cubic meters that the Russian firms currently pay, the Russian government promised to raise its average gas prices

efforts to create or revise necessary laws and regulations to implement its plan to reform electricity and gas pricing.

Investing in energy projects can be highly risky, because of technical, economic and geo-political factors. The growing inter-linkages between energy projects, such as trans-national natural gas pipelines and electric power grids magnify these risks, because of the high capital cost associated with projects and the long-term horizon over which possible risks have to be assessed (Kemper, 2004a). These risks will introduce additional uncertainties over investment toward power sector (Hasnie, 2004). In this context, electricity tariff is a crucial element determining whether electric power grid interconnection takes off the ground, because the average generation cost and the level of power prices in the receiving market will serve as the benchmark for imported power. As of 2003, the average generation cost and electricity price are 4.1 and 6.2 cents per KWh in South Korea, respectively, whereas the average electricity tariff in European Russia was reported to be around 1.0 cent per kWh as of the late 2001 (Korea Power Exchange, 2004; Belyaev et al., 2003). This substantial differentials in electricity prices suggest that substantial cost savings could be achieved through gird interconnection and power trade between the two countries. However, as said early, electricity price in Russia has historically determined in large part by state-owned enterprises and has not fully reflected the costs of generating and delivering power. As bidding mechanism is introduced, competition among suppliers in power market will become intensified and price would be expected to rise towards market levels. Consequently, the apparent differentials in electricity prices between South Korea and Russia as currently observed would become less in the future. This picture may change or at least the prices may not converge that quickly if electricity tariff includes externality costs, such as environmental costs associated with generation and transmission of power. This is because of the increased share of hydropower in the total generating capacity in the Russian Far East. Currently, hydropower accounts for about 20% of the total.

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to industry to between $37 and $42 in 2006, and further to between $49 and $57 in 2010. While Russian prices will still be roughly half what Europe pays by that time, this increase puts Russian prices far above production costs, a key demand from the EU (Stratfor, 2004).

As the Russian government has made hydropower generation a priority, particularly in the Russian Far East (EIA, 2004), this share is estimated to rise to more than 35% in 2025 (Podkovalnikov, 2002). So, if the environmental and social benefits derived from the cleaner energy supply, such as hydropower, would be internalized to the electricity tariffs, this would correct distorted competition and increase the competitiveness of electric power grid interconnection and power export from the Russian Far East.

3. Electric power industry restructuring

3.1. Status of electric power industry restructuring

The process of electric power industry restructuring in the Russian Federation has showed a confusing situation -- there were ten times changes in related policies during the period of early 1990 to 2001. During 2000 to winter of 2001, there was a severe power interruption, and the necessity for restructuring was invoked. After many years of debate, in 2003, Russia embarked on the restructuring of its power industry. In March 2003, President Vladimir Putin signed six bills into laws that establish basic rules governing liberalized markets and the remaining state-controlled monopolies (EIA, 2004). The Russian government also approved the restructuring plan to unbundle the United Energy Systems (UES)[5] into separate generation, transmission, and distribution businesses. Under this plan, the generation assets of UES will be spun off into ten wholesale generation companies (gencos). The national system operator, responsible for dispatch, has already been created as a separate company within UES. The plan also provides for the restructuring of the energos, with the creation of 14 territorial generating companies, up to 5 inter-regional distribution companies and a large number of supply companies (IEA, 2004). The

[5] Prior to the restructuring plan, the UES monopolizes Russia's power industry. The UES is 52%-owned by the Russian government, controls about 70% of the country's distribution systems, and oversees Russia's 72 regional electricity companies, the so-called energos (EIA, 2004).

implementation of the restructuring plan is underway. Once completed, wholesale and retail supply will be separated from transmission and distribution activities, and competitive wholesale and retail markets will be created. This will create conditions that will encourage both investment in new capacity and greater efficiency of power production and consumption through the operation of market forces (IEA, 2004).

The power sector in South Korea is now in the initial stage of the restructuring and privatization process. The government announced the "Basic Plan for Restructuring the Electricity Supply Industry" in January 1999. Amendment of the Electricity Business Law and the enactment of a special law to promote the restructuring process were completed in December 2000. The Korea Power Exchange (KPX) was open in April 2001 as system operator and market operator. The Korea Power Commission (KPC) was established and started its role of regulatory oversight and dispute resolution in April 2001.

This basic plan contains four stages of restructuring (KEPCO, 1999). In the first phase (January - December 1999), preparatory work was to be done while maintaining the existing business structure where the Korea Electric Power Corporation (KEPCO) monopolizes the industry with a few independent power producers supplying all their generated power to KEPCO. In the second phase (2000 - 2002), competition of power generation was to be introduced by separating generating arms of KEPCO from transmission and distribution, with KEPCO being the monopolistic supplier of transmission and distribution.[6] The distribution business is to be separated from KEPCO and competitive distribution is to be introduced in the third phase (2003 - 2009), while open access to distribution and competitive retail supply are to be implemented in the last phase (after 2009).

It should be pointed out that the second phase denotes the generating competition stage. This phase was planned to be completed by the end of 2002, but it has not finished yet. In other words, the privatization of generating companies was scheduled to start in 2002, but is delayed without any definite timetable. In addition,

[6] The division of power generating plants of KEPCO and the establishment of six generating subsidiaries had completed in April 2002. Now, the generating subsidiaries except nuclear and hydro company are competing in wholesale power supply.

by the end of 2002, the distribution companies were supposed to be unbundled. However, the original plan was rejected in May 2004 on the basis of the recommendation by a special task force team. At this moment, it is uncertain whether even the schedule will be fully carried out as originally planned.

It thus follows that, despite the strong governments' will for electricity sector reform, the road ahead may well be bumpy as witnessed in several developed countries. Electricity sector is only a part of the industry fabric interwoven socio-economically with many other sectors in a society. Its reform could have some repercussion on other groups or sectors in the society. Thus, the reform effort will face societal resistance, which could place a prohibitively high transactions cost. For example, in the Russian Federation, the frequent political discord between the Federal government and the Duma (the Lower House of the Russian Parliament), and the lack of coordination among different government agencies may pose an insurmountable stumbling block for the reform. In South Korea, the reform process has encountered the resistance of the KEPCO's trade-union. This has already led a delay in the process of electric power industry restructuring. Moreover, the large financial requirement for the reform will constitute a severe obstacle. Anatoly Chubais, CEO of the UES, estimated in April 2003 that $55 billion in investment would be needed over the next 10 years for maintenance and modernization efforts (EIA, 2004).

3.2. Potential effects of electric power industry restructuring

The ongoing electricity sector reforms in NEA would display an encouraging sign for the regional power interconnection. Once competition is introduced in electricity market, market participants will put all available options on the table and select the very best option to survive in the market. Once the domestic power network is completed, a cross-border power interconnection will become an unmistakable next step for consideration of the electricity suppliers and traders. In addition, the reform in power industry would make it easier to determine the appropriate price of bulk electricity.

Up to now, the NEA countries have never experience the "competition" in real sense because institutional inflexibility has made them unable or, at times, unwilling to look for opportunities beyond their national borders. The ongoing electricity sector

reform in the NEA countries is to advance the cross-border projects more rapidly and promote healthy competition. However, there is one important precondition for planning cross-border projects. This is that the current political stalemate needs to be resolved regarding North Korea, which happens to be located geographically at the very center of NEA.

Since the power market can provide a basic framework for power trade, we could expect that power cooperation will be actively carried out. One of the European Union's objectives concerning electric power industry restructuring is to make one huge power market. In this context, the formation of a domestic power market in each country is needed as a first step into the power grid interconnection of the NEA region. As the transparency in power trade and the efficiency of power system operations would increase through power market, it is anticipated that power sector cooperation among the countries will follow naturally.

Moreover, through power industry restructuring, the industry itself will operate privately from public initiation. This will help attract private funds into the power industry. Promoting power sector cooperation would need a large-scale investment, and restructuring electricity supply industry will act positively rather than negatively towards this end. On the other hand, we should recognize that it might be difficult to promote large-scale investment due to a strict appraisal for economic feasibility and increased investment risks on the side of private sector.

In sum, the introduction of competition through electric power industry restructuring would achieve many benefits. One of them is the power trade through regional power grid interconnection, which would arise naturally. Indeed, as demonstrated in Norway, the United States and Australia, even before power industry restructuring took place (before 1990), significant benefits were achieved through regional trading arrangements (Hasnie, 2004).

4. Political issues

The KEDO was created in March 1995 in order to implement the Agreed Framework between the United States and North Korea, under which North Korea

agreed to freeze and ultimately dismantle its existing nuclear program. In return, the KEDO was to provide North Korea with alternative sources of energy, in the form of two 1,000 megawatt light-water reactors, by a target date of 2003, and 500,000 metric tons of heavy fuel oil annually until the reactors were operational, to replace the potential energy supply from the suspect nuclear projects on which North Korea was to suspend construction under the Agreed Framework. Upon completion of the reactors, North Korea was to begin repaying the cost of these new reactors over seventeen years, after a three-year grace period.[7]

It is fair to say that the KEDO helped reinforce the important triangular relationship among the United States, Japan and South Korea, and helped forge inter-personal ties, mainly technical, between North Korea and the outside world (Calder, 2004). However, this organization failed to prevent North Korean subversion of the Agreed Framework through its Taepodong missile launch of August 1998 or, more seriously, through its continuing covert heavy uranium nuclear program that was admitted by North Korea in October 2002. This damaging step led to suspending heavy fuel oil deliveries to the North Korea in December 2002, and to freezing the construction of the Kumbo reactor project itself in November 2003. Indeed, when the KEDO operated in North Korea, we should have considered the possibility of suspension or even termination of the project caused by political instability in the first place, because North Korea is under the dictatorship regime and has not normalized relations with the rest of the global community. Therefore, when considering this kind of multinational project as well as power grid interconnection project as we discuss here, we must consider such exceptional risks in the planning stage. On the other hand, North Korea should give up any attempt to poison the atmosphere for cooperation. Rather, it should recognize that resolving the nuclear weapons program could be a starting point for joint business with foreign countries in the future. In other words, on its side, if North Korea can cooperate and solve nuclear issue, the international community would support such a project as a part of an aid program with terms very favorable to North Korea.

Given that KEDO will find it much harder to survive North Korean major, direct violation of the Agreed Framework on the one hand and that there are

[7] For further information, see the KEDO's web site at: http://www.kedo.org.

substantial suck costs associated with the KEDO on the other, it seems that there is a pressing need to re-configure the KEDO. In this regard, Calder (2004) proposes a post-KEDO energy development body for North Korea, which includes all the nations currently involved as central members of that organization, with a central role for the United States. This proposal is focused on the development issues, such as trans-national natural gas and electric power grids that naturally involve neighboring nations as well as North Korea. Calder argues that, by including all the nations now involved in the six-party talks on the North Korean nuclear crisis, a "KEDO II" could appropriately institutionalize the six-party forum to promote the long-term energy development of the NEA region as a whole. All such planning, of course, needs to be contingent on a resolution of the nuclear crisis consistent with the imperatives of global security.

Despite the feasibility of the KEDO II proposal, there still exist a few unclear conditions including high political risks related to energy cooperation in the NEA region. In this sense, a consortium of government and private sector would be realistic in planning and implementing any energy cooperative projects in the NEA region. In other words, the private sector should lead the concerned projects in the stages of planning, financing and implementing. The involved governments should try to alleviate the uncertainties surrounding the projects. In addition, they should support the private sector through governmental agreements.

Countries in NEA very well recognize the importance of substantial cooperation, especially in the energy sector. However, the political instability of North Korea makes such cooperation difficult. Moreover, it is inevitable to cooperate with the United States that has become the superpower even in NEA. As a result, it is important to build a council among countries to secure stability, and at the same time a kind of government-private consortium should be promoted as North Korea gradually achieves its political stability.

In addition, South and North Koreans power cooperation would bring about mutual economic benefits. It is an important priority that creates the foundation for energy resource trade through power networks. For this reason, a continuous dialogue between South and North Koreas is needed for power sector cooperation.

5. Strategic approach to the NEA electric power grid interconnection

5.1. Feasible option for implementing

Economic feasibility of a power interconnection project depends on financial feasibility, priority in national policies, and economic impact on other industries. Even a financially infeasible project could become economically feasible if it is of high priority in national policies and/or it has positive ripple effect on other industries. Besides, intangible political and environmental benefits can also improve the economic feasibility. Therefore, a decision on whether the project is economically feasible cannot be purely objective. In order to carry out cross-border projects in a seamless manner, at least the followings issues have to be well thought out and made operative: harmonized national policies, transparent law, rules and regulations, and reciprocally agreeable dispute settlement process.

In order to implement the electric power grid interconnection project in NEA, we should decide whether this proposed project should be financed by public investment or private investment. Related to this issue, we need to define the nature of the proposed project as a pure commercial project rather than government level cooperation. This option should be accompanied by governmental cooperation in the aspects of political and energy security. The reason for this argument is based on the fact that governmental projects usually involve longer time in resolving political and institutional obstacles in advance before launching a project, as currently witnessed in the aforementioned KEDO case.

By contrast, a commercial project mainly driven by the private sector, for example, a scheme of project financing or multinational consortium, has an advantage that the economic feasibility of project could be easily verified by the market in the first place. Also, if implemented in terms of private and onerous contracts, the project could be protected by these legal binding contracts related to electricity trading and transmission usage.

There are many frameworks for project financing related to the Russian Far East-North Korea-South Korea route. One framework is that the transmission lines would be constructed with various sources of external investments. The investors would recover their investments in terms of direct costs and fair returns on the

investment for the lifetime of network facilities. These three countries could participate in the construction works. North Korea would collect the transit fees or the tariffs for land usage of transmission lines to offset the otherwise depressed state of its domestic economy. The Russian Federation and South Korea would pay for the tariffs of using power system network.

Political uncertainty or risks should also be considered in the current case of project financing. While there is some consensus on the soundness of macro-economic situations for international financing in other NEA countries, this is certainly not the case for North Korea (Higashi, 2004). Thus, it is especially necessary to have North Korea to sign on a contract that is designed to guarantee the stable use of transmission lines on the side of South Korea. With this arrangement, there would be little harmful situation to South Korea in using power system network infrastructure even though some political turbulence occurs.

When considering the foregoing option of project financing or multinational consortium, we should not ignore the inevitable roles of international financial institutes including multilateral and regional development banks, such as the World Bank and Asian Development Bank. In fact, the involvements of these financial institutes in financing the project would enhance the credibility and administrative transparency of the project, which helps to induce more external investors. Devapriya and Alfen (2003) argue that, in order to capture the potential debt capacity of project companies financed through project finance arrangements in weak institutional environments, the participation by multi-lateral/bilateral institutions would be required for the creditworthiness of the concerned project. And, this feature is frequently supplemented with specifically created institutional and informational infrastructure. This common practice highlights the effectiveness of institutional and contractual arrangements in long-term investment schemes in infrastructure development.

The role of additional financial intermediation functions could be emphasized as a measure to manage risks emanating from informational and institutional factors surrounding project financing arrangements. The exact functional forms would include credit enhancement and/or guarantees provided by multilateral agencies, third party guarantees for off-taker's creditworthiness, and extensive use of export credit facilities for capital intensive imports, etc. In fact, all of them have become the norm

for mobilizing (almost exclusively) bank-led syndicated loans for project companies in the Asian developing countries (World Bank, 2003).

5.2. A regional framework for energy cooperation

To materialize the aforementioned potential benefits from power sector grid interconnection and trade in NEA, there are many issues that need to resolve. There could be technological problems due to differences in standards and quality of power by country, such as different frequencies and voltages. There is also a great concern about the reliability of interconnected power grids, because their malfunctioning may lead to costly and hazardous blackouts, as evidenced by huge blackouts that occurred in North America and Europe in the summer of 2003.[8] This concern may has led some NEA countries like China (Zhao, 2004) to take very cautious stance on importing power from the Russia Far East.[9] In addition, the question of how to finance the construction of transmission lines remains unanswered. Certainly, these technical and finance concerns are valid, and pose great challenges. Nevertheless, it seems that institutional differences are the biggest obstacle to implement power grid interconnection in NEA.

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[8] Leaving tens of millions of people without power, these blackouts were largest in the history, but far from the first. While the underlying cause of such blackouts is a systematic underinvestment in transmission grids as demand for power grows and trading for power becomes more widespread, the immediate cause may be operational in nature, with slow reactions to a failure in one part of an interconnected system leading to rapidly cascading failures in much of the rest of the system (APERC, 2004).

[9] This raises another issue: is there other alternative to diversity power supply? For example, power cooperation may be not limited to interconnecting power grids among the NEA countries. Instead, other means of cooperation, e.g., building nuclear power with the support from Russia and importing power equipments from Russia are worthwhile exploring. But as far as South Korea is concerned, the other means may be irrelevant because South Korea faces great difficulties in finding new sites for power facilities as discussed earlier.

Considering the institutional differences, there would be a great difficulty in agreeing on the transmission tariffs and transit charge. In a country where there are many cross-subsidization policies on energy, it is difficult to collect a return on investment since the electricity tariffs in the concerned countries are relatively low. And, it would be difficult to attract external investment since the government controls investors' profit by regulating the return on investment. In addition, the transmission lines must go through the North Korean territory, and thus there is a possibility of confrontation regarding transit fees, because of a lack of clearly established criteria for the setting of tariffs for energy flows in transit. This, together with a lack of transparency in the conditions for access to export capacity in gas pipelines and the phenomenon of illegal taking of gas in transit, has been main problem associated with cross-border energy flows and has been experienced over the last ten years in Eurasia.[10]

In fact, the fundamental elements of energy cooperation, such as the electric power grid interconnection in NEA, would require many practical considerations. First, we need to build up confidence, trust and consensus among the countries involved through informal and formal consultative process. In particular, a governmental consultative framework needs to be provided for the design of regional power cooperation. Second, we should form legal frameworks and institutional arrangements, and then contractual frameworks. Major subjects of legal frameworks, focusing on inter-governmental policies and measures, would help to reduce or share the political and financial risks involved in a cross-border project. The legal frameworks and institutional arrangements are important, given that much of the capital needed for energy projects will have to come from private and foreign sources than in the past, and that private capital flows are very sensitive to macroeconomic conditions and to the nature and stability of government policies (IEA, 2003).

One of the key tasks for the NEA governments involved in energy cooperation

[10] The Transit Protocol to the Energy Charter Treaty, which is currently being negotiated, aims to address these problems. Although a wide degree of agreement has been achieved on nearly all substantive aspects of the draft text, the Transit Protocol remains unfinished, because of differences in position between the European Union and Russia regarding the aforementioned three issues (Kemper, 2004b).

would be to create a stable climate for energy investments. In doing so, they could reduce the level of non-commercial risks associated with the energy projects in NEA. In view of both the large potential benefits of interconnected power grids and the considerable uncertainty that corresponds to their magnitude, it is important for the NEA governments to reach a consensus on which grid enhancements are worthwhile. In this regard, the highly collaborative planning process involved in the ASEAN (Association of Southeast Asian Nations) Power Grid project, clearly backed by governments and supported by power system experts, is a valuable model. If the proposed power grid interconnection in NEA is to achieve sufficient support and momentum to be realized, a similar process with political backing may be needed (APERC, 2004). To make energy cooperation more effective, the governments of the NEA could go further by establishing a regional framework for energy cooperation. This framework sets up a common set of the rules of the game, and the countries involved are obligated to observe these rules in practice.

From a legal perspective, the most significant outcome of the aforementioned Khabarovsk meeting was the creation of a working group to study the need for the NEA Energy Charter (Bradbrook, 2002).[11] The participants in that meeting showed a strong awareness of the advantages of the European Energy Charter,[12] and recognized that a separate agreement would be necessary to promote power cooperation among the NEA countries. They felt that there is a need for an "Asian solution" to this problem, which will be significantly different from the past negotiations on energy cooperation elsewhere.

As the first step to seek this creative solution, the NEA governments would be

[11] The Khabarovsk Communiqué is attached to the Annex in Bradbrook (2002).

[12] In 1990, the then-Dutch Prime Minister Ruud Lubbers proposed to his colleagues in the European Community the idea of a charter, setting up the principles to which all European governments would subscribe in the area of energy cooperation. This initiative was endorsed by the European Council in 1990 and eventually culminated in the signing of the European Energy Charter in The Hague in December 1991 by all of the states in Europe, Australia, Canada, Japan and the United States (Kemper, 2004a). The European Energy Charter is a political declaration of intent regarding international cooperation.

to create a NEA Energy Charter. This Charter is a political declaration of intent regarding to energy cooperation in the Charter's member states. Just like the Energy Charter Treaty (NCT) proceeds from the European Energy Charter, the NEA Charter's signatories would start negotiations on developing a legally binding foundation for their energy cooperation, with the aim to create the NEA Energy Charter Treaty. The key feature of the NEA ECT is legally-binding rules for energy cooperation based on openness, transparency and non-discrimination. The NEA ECT will create a legal framework which will promote long-term co-operation in the energy sector, including exploration, production, transit and trade, the protection of investments based on a guarantee of national treatment or most favored nation treatment (whichever is the more advantageous), and the transfer of profits. It sets out dispute resolution procedures, which allow for binding international arbitration in the event of disputes between states, or between states and individual companies.

In discussing the option of establishing the NEA ECT, the interesting question that needs to be addressed is that, given that Japan and Mongolia have already joined ECT, and China and South Korea have taken seats as observers in ECT, is there a specific need to establish the NEA ECT rather than all 6 NEA countries become members of ECT? To address this issue, let us briefly discuss the background why the ECT was founded. The ECT was created against background of mutual interest in energy cooperation in post-Soviet Eurasia. Russia and many of its neighboring countries were rich in energy resources but needed major investments to ensure their development, while OECD energy consuming countries were looking for new sources to diversify their sources of energy supplies and reduce their potential dependence on any single area. The ECT was signed in December 1994 and entered into force in April 1998. To date, 51 states cross Europe and Asia have signed or acceded to the ECT (Kemper, 2004a).

While the ECT is the only multilateral investment treaty in the energy sector that provides a high level of investment protection, critics argue that the charter process has failed to justify the expectations that accompanied its birth. Critics also pointed to the protracted negotiations on the Transit Protocol, and to the fact that the Russian Federation has signed, but not yet ratified the ECT. Given that Russia has a pivotal role to play in the future of European and global energy cooperation, Russian Federation's non-ratification would limit the potential of the ECT that plays. These

criticisms are certainly valid. However, whether they should lead to establish the NEA ECT is a matter of opinion. Clearly, views do differ. On the one hand, Secretary General of the Energy Charter Secretariat keeps talking the Asian dimension to the charter process (Kemper, 2004a,b). This can be interpreted as hoping to get all six NEA countries acceded to the ECT. On the other hand, Russia is very pessimistic about the ECT. In relation to the ECT, on its side, Russia is very concerned about the scope of obligations that Russia should shoulder with regard to energy transit and other issues, which may not be balanced with an adequate list of potential advantages derived from the treaty. From the Russian standpoint, the ongoing dialogue on energy cooperation with EU provides a number of examples of imbalances, including (1) the need to continue the practice of long-term contracts for natural gas exports, (2) avoiding numerical limits set on specific fuels imported from Russia, (3) a request to continue honor contracts for nuclear fuel supplied to the new EU member states, and (4) opening of the EU market for electricity generated in Russia (Ivanov, 2004). At this stage, it is too early to say which option is likely to be more effective, practical and politically acceptable to NEA. But it is not to early to say that, even if the six NEA countries decide to establish the NEA ECT to promote even closer energy cooperation among the NEA countries, the experience of the Energy Charter process provides a reference for regional cooperation in the NEA region. Taken together, these various instruments should be seen as complementary parts of an integrated international efforts to strengthen global energy cooperation and security.

6. Conclusions

Interconnecting power grids among the NEA countries holds the significant promise to lower the overall cost of their power generation, mitigate its impacts on the environment and diversify sources of their power supply. To materialize these benefits, several proposals have been made for power grid interconnections in the NEA region in the context of planning long-term power supplies. However, given the fact that none has received what might be termed official endorsements by the corresponding governments, it is perhaps too early to speak about the development of large-scale energy cooperation in the NEA region, such as power grid interconnection.

We do have still too many "*ifs*" and "*whens*." Nevertheless, considering the potential impact of the NEA energy cooperation on world energy security, it is clear that future development of the NEA energy cooperation will have a positive effect on overall global energy cooperation and security. Moreover, the magnitude of such effect is expected to be of great scale, given the size of energy sector of the region in the world.

While there are many technical issues that need to resolve, the great challenge lies in the financing of the power grid interconnection project in the NEA region. In many developing and transition countries, the domestic banking sector and capital markets are unable to provide the necessary funding for such a large-scale energy project. As a result, much of the investment needed will have to be financed by capital inflows from industrialized countries. However, the external financier faces not only the sovereign, geopolitical, and regulatory risks, but also economic risks such as an immature capital market, inflation, and risks of currency exchange – the risks that are typical for developing countries. Added to these risks are many uncertainties surrounding the reform process of restructuring electric power industry and markets, in which both Russia and South Korea have encountered delays. They include the pace at which tariffs are raised to full-cost levels, cross-subsidies are eliminated, wholesale and retail supply is separated from transmission and distribution activities, and competitive wholesale and retail markets are created. Inappropriate actions could undermine the investor's confidence on financing this electric power grid interconnection project.

Thus, the challenge for the governments of the Russian Federation and South Korea involved in the proposed electric power grid interconnection project will be to foster the development of their internal capital markets and to create confidence with international investors. To this end, on energy side, this involves defining a clear energy policy implemented by independent regulators, establishing a fair and transparent dispute resolution mechanism, and speeding up the already started but delayed reform process of restructuring electric power industry and markets. These countries may also need to draw on support from other developed countries in their efforts to mobilize financing resources from international investors. Any potential investor will need assurances of the sincerity of cross-border, upstream and downstream contracts and a credible dispute resolution mechanism in order to reduce

non-commercial risks to a minimum. Clearly, establishing a framework for energy cooperation will contribute positively towards that end. Such a framework will create a stable climate for energy investments and could reduce the level of non-commercial risks associated with the trans-national energy projects in NEA.

Indeed, the lack of institutional framework has been one of the major obstacles impeding the electricity sector cooperation among the NEA countries. In this region, there is no any overall trade agreement or convention, such as the GATT, which binds all the involved six countries. In addition, there is no trade or economic-focused organization, such as APEC (Asia-Pacific Economic Cooperation) or the WTO, which includes all six countries as its members. Therefore, creation of such framework is of more importance to energy cooperation among the NEA countries. However, views do differ regarding the specific form of such a framework. Some favor the option that all 6 NEA countries become members of ECT, whereas others support the establishment of the NEA ECT. At this stage, it remains uncertain which option will prevail in the end. But it is safe to say that, even if the six NEA countries decide to establish the NEA ECT to promote even closer energy cooperation among the NEA countries, the experience of the Energy Charter process provides a reference for regional cooperation in the NEA region. Taken together, these various instruments should be seen as complementary parts of an integrated international efforts to strengthen overall global energy cooperation and security.

Finally, it should be pointed out that North Korea has a crucial transit role to play in moving this proposed trans-national electric power grids project forward. Although this project would yield it ongoing revenues to offset the otherwise depressed state of its domestic economy, North Korea constantly poisons the atmosphere for cooperation through its continuing covert heavy uranium nuclear program. This will magnify risks associated with this project. Thus, in the absence of a resolution on the North Korea's nuclear crisis, which is consistent with the imperatives of global security, it is obviously premature to move this multinational project forward.

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