NORTH KOREA'S ELECTRIC POWER CONDITIONS & INTER-KOREAN COOPERATION

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Critical electricity shortage in North Korea

North Korea's electricity shortage is the starting point of the country's economic collapse as well as the greatest obstacle to rebuilding the economy. The electricity shortage is bringing a vicious cycle of poverty: less energy leads to lower factory operation, resulting in lower production and exports, which reduces the inflow of foreign currency, which in turn lowers the ability to import oil. The North Korean authorities announced after 1998 that resolving the electricity crisis was the most urgent task for building the socialist economy. In the April 5, 2001 meeting of the Supreme Peoples' Congress, the authorities stated that reviving the electricity and coal industries is crucial for invigorating the national economy.

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The issue of South Korean electricity support for the North, along with Kim Jong-Il's planned visit to Seoul, are expected to be the key variables in inter-Korean relations this year. One of the main points of President Kim Dae-Jung's Berlin Declaration last year was that the South Korean government would actively help expand North Korea's infrastructure, and Kim Jong-Il also requested electricity aid at the South-North summit in June 2000. This indicates the seriousness of North Korea's electricity shortage and the importance of electricity to the country's economic recovery. In this regard, the electricity issue is an urgent and essential to realizing the goal of "balanced development of the Korean economy" reached at the summit.

North Korea's electricity shortage and its causes

In 1999 North Korea generated 28.7% of its generation capacity of 7.39 million kW, and the amount of electricity generated was 18.6 billion kWh, a 33.1% fall from production in 1990 and 7.8% of South Korea's production. With most generating facilities becoming old, operational facilities amount to only 2 million kW. In the country's Third Seven Year Plan (1987 to 1993), generation capacity and generation targets were set at 17 million kW and 100 billion kWh respectively. Assuming that this is the basic demand for industrial production, and considering that actual generation capacity and generation in late 1999 amounted to 7.39 million kW and

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Table 1. Generator Facilities in South and North Korea

(Unit: thousand kW, billion kWh)

		1965	1975	1985	1990	1995	1998	1999
Generation Capacity	South Korea (A)	769	4720	16,137	21,021	32,184	43,406	46,978
	North Korea (B)	2385	4530	5,915	7,142	7,237	7,387	7,387
	(A/B)	0.32	1.04	2.71	2.94	4.45	5.88	6.36
Generated Energy	South Korea (C)	3.3	19.8	58.0	107.7	184.7	215.3	239.3
	-Hydro	07	1.7	3.7	6.4	5.5	6.1	6.1
	-Thermal	2.5	18.2	37.6	48.4	112.2	119.5	130.2
	-Nuclear	-	-	16.7	52.9	67.0	89.7	103.1
	North Korea (D)	13.2	18.3	25.1	27.7	23.0	17.0	18.6
	-Hydro	7.2	9.8	12.3	15.6	14.2	10.2	10.3
	-Thermal	6.0	8.5	12.8	12.1	8.8	6.8	8.3
	(C/D)	0.25	1.08	2.31	3.89	8.03	12.66	12.87

Source: National Statistical Office (December 2000), 『Comparison of South and North Korea's Economies』

18.6 billion kWh, North Korea's factory utilization rate is estimated to be within 18.6% to 43.5%. This estimate corresponds to a report[1] stating that North Korea's total electricity demand (for normal economic activity) is about 50 to 60 billion kWh. Actually, most factories in North Korea have capacity utilization rates of 20% to 30%, and visitors report that even in the winter, Pyongyang's major hotels lack heating and streetlamps are operating on a part-time basis.

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North Korea's electricity shortage was caused by decreased distribution of energy sources, aging facilities due to an economic policy of self-sufficiency, and an inadequate transmission system. It can be said that self-sufficiency is currently impossible for the country. Regarding the decreased distribution of energy sources, the quality and quantity of coal has fallen due to the dependence on coal, exhaustion of coal veins, and outdated equipment. The oil supply has also fallen with the collapse of the communist economic bloc, which decreased aid in the form of oil shipments and cancelled the preferential price system. In particular, the supply of coal and petroleum, which account for about 80% of primary energy supply, have decreased by 40% from 1990.

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Along with the lower supply of energy sources, isolationist economic policies and lack of funds for investment have led to outdated electrical facilities and to problems in acquiring new parts, making the country unable to respond flexibly to

1) Cho, Sung Bong (1996), "Approaches to International Cooperation in Electricity Industry", *Research Report* 96-11, Korea Energy Economics Institute, p. 69. According to this standard, North Korea's electricity generation in 1999 was to 18.6 billion kWh. This amounted to 31.0% to 37.2% of the total energy demand of 50 to 60 billion kWh, and is in the mid range of 18.6% to 43.5%.

changing market conditions. 73% of the total 739kW of electrical facilities need to be replaced or repaired, and only 16.6% of all facilities, or 1.23 million kW, were built after 1987 (940 thousand kW in hydro, 290 thousand kW in thermal). In addition, the transmission system is inadequate, without being computerized or automated, leading to unstable frequencies and voltages, as well as breakdowns. The faulty transmission system, along with underground wiring, leads to short-circuits (the loss rate from short-circuits in North Korea is about 16-50%, compared to 5% in South Korea).

For the North Korean economy to reach a normal level of activity and recover the level of industrial production seen in 1990, electricity generation needs to be increased by about 50%. The estimate of North Korea's excess electricity demand of 8.5 billion kWh a year2) reflects the fact that North Korean economy went into minus growth in 1990. The Construction Association of Korea3) estimates that the North will have to double its generator facilities to reach South Korea's level in 1980. The Korea Energy Economics Institute4) estimates that by 2005, North Korea will need 1.7 times the amount of primary energy it had in 1989.

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Limits of North Korean Policy

To resolve the electricity shortage, North Korean authorities are exploring the possibility of increased coal production and greater use of low quality coal, water, wind, and solar energy, and creation of smaller generators in the 100kW to 1000kW range. In addition, the authorities have introduced periodic and rolling blackouts, and have appealed to public frugality. However, the lack of foreign currency and the economic crisis have made it impossible to modernize by building new generators or introducing new facilities, and the electrical shortage remains to be resolved in a fundamental way. In addition, completion of the KEDO light water reactor that was scheduled for 2003 will probably be postponed until after 2006.

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In this situation, one practical approach has been the request for electricity support from South Korea. In response to the South's proposal for energy support made at the Berlin Declaration and the South-North Summit, Kim Jong-Il has requested 500 thousand kW of electricity from the South.

2) Soon-Jick Hong (June 2000), "Prospects for Social Overhead Capital Investment Demand by Category", *North Korea's Social Overhead Capital Investment Strategies*, Seminar at the Construction Association of Korea.
3) Tae-Hwang Kim (May 2000), "Demand for Primary Infrastructure Investment estimated at 4.3 trillion Won", *The Construction Forum*, Construction & Economy Research Institute of Korea, pp. 29~33.
4) Ryu, Ji Chul (September 2000), "Energy Cooperation with North Korea and Approaches to International Cooperation", *The Journal of Economic Policy*, Vol. 2 No. 3. The Research Institute for International Affairs, pp. 133~177.

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Table 2. Government's Power Cooperation Approaches

Cooperation	Scale of Cooperation	Cost	Period	Intended Yearly Output
Supplying Coal	1.2 million tons (400 thousand tons yearly)	42 billion won	immediate	1.05 billion kWh
Supplying Crude Oil	750 thousand tons (250 thousand tons yearly)	112.5 billion won	immediate	1.05 billion kWh
Helping Repair Generator Facilities	hydroelectric generators 200 thousand kW	8 billion won	1 year	500,000 kWh
Restoring Capability of Old Power Plants	hydroelectric generators 200 thousand kW	40 billion won	27 months	500,000 kWh
Transfer of Idle Generators	8×4000kW diesel generators	14 billion won	1 year	170,000 kWh
Building Small Scale Plants	3×40,000kW internal combustion generators	130 billion won	22 months	630,000 kWh
Building Large Scale Thermal Plants	2×20,000kW generators	400 billion won (crude oil generator) 700 billion won (smokeless coal generator)	60 months	2.1 billion kWh
Improving aged Transmission Lines	Improving North Korean transmission lines in the short term	200 billion won	?	Expanded distribution capacity Reducing losses in transmission
Extension of South Korean Transmission Lines	154kV transmission lines: 200,000 kW 22.9kV distribution lines: 10,000 kW	40 billion won 4 billion won	34 months 6 months	1.1 billion kWh
Extending High Voltage Power Lines	345kV transmission lines 1 million kW	280 billion won	49 months	5 billion kWh
Creating Basis for Inter-Korean Electricity Grid	Building needed facilities throughout North Korea	5.2 trillion won	10 years	Standardization of electricity grid on the peninsula

Source: Electric Power Corporation (October 2000), *Approaches to South-North Energy Cooperation*

South Korea's plans for electricity aid to the North

In October 2000, the South Korean government, through the Ministry of Commerce, Industry and Energy and the Korea Electric Power Corporation, examined 11 scenarios to provide 6.5 trillion won of electricity to the North.[5)]

5) Ahn, Young Keun (Oct. 27, 2000), "Inter-Korean Electricity Cooperation should be Transparent", National Assembly Report on State Affairs.

In response to North Korea's request for 500,000kW of electricity aid, the South wants to survey the conditions before supplying aid. This is in contrast with the North, which will allow a limited survey only after it receives aid. South Korea is concerned about the differences in transmission systems and voltages as well as the possible diversion of electricity for military purposes. Therefore, it wants to create a "Joint South-North Electricity Survey Committee" to survey North Korea's electricity shortage. In an ideal world, the South should supply electricity unconditionally to promote the balanced development of the Korean economy as mentioned in the South-North Joint Declaration well as out of sympathy for fellow Koreans. However, electricity has a strategic aspect and public opinion in the South is cautious. Besides criticism by the opposition party, only 7.7% of South Koreans favor supplying electricity unconditionally, while 81.1% think that electricity should be supplied only if the North fulfills certain conditions. [6] While the North has accepted the South Korean request for investigation of the North's electricity conditions, so far there have been no contacts for this purpose.

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Stages of Inter-Korean electricity cooperation

In the short term, electricity cooperation will have to begin in the form of aid. In the mid to long term however, the two sides will have to examine ways to cooperate for mutual profit. Factors such as construction periods, cost efficiency of generation, and promising regions for investment by South Korean businesses should be considered, and in the mid to long term, projects should mainly focus on ways to achieve profit. North Korea can compensate the South for generator repair or construction by reciprocating in goods, rights to develop or operate under ground resources or potential tourist locations, or the free use of industrial areas by South Korean companies for a given time.

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In the short term, cooperation should focus on improving operation rates by supplying equipment for mining and providing parts needed to repair existing generators rather than building new generators. If South Korea supplies its 10 million ton inventory of smokeless coal over ten years, the North can increase its generation by 1.8 billion kWh a year, a 10% increase from the North's current generation of 18.6 billion kWh. In the mid to long term, the South can consider extending its transmission lines to the North or creating a basis for an electricity grid on the peninsula, as well as building medium to large scale generators. However, these plans will have to take into account the future completion of the 2 million kW KEDO light water reactor as well as the industrial composition of each area to eventually create a South-North economic community and unified economy.

6) Hyundai Research Institute (March 2001), "Public Opinion Survey on Inter-Korean Relations and Prospects" *Unification Economics*, pp. 82~83.

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In particular, the power line extension from South Korea can be pursued in conjunction with the efforts to restore the Kyongeui railway and connect highways between the two Koreas. This effort also warrants consideration in its strong symbolism for South-North reconciliation and cooperation. In addition, this method can help the North at relatively little cost because the two Koreas have similar time patterns for electricity demand, and it can be pursued in conjunction with development of the Kaesong industrial area in the North. The South can operate generators to supply electricity to the North during off-peak or night hours, and in the future, when electricity is standardized between the two Koreas, the lines can be used as connection lines.

In 1996, the South Korean government explored the possibility of providing 200 thousand kW of electricity to the North by connecting the Munsan generator in the South and the Pyongsan generator in the North, which are only 60km apart and use the same 154kV voltage. In the current Kaesong industrial area, if increased electricity demand causes the existing lines to be deficient, additional generators (40,000kW internal combustion generators or 10,000 to 20,000kW thermal generators) can be constructed, and if electricity demand is urgent, the idle internal combustion generator in North Cheju can be transferred and installed, or transmission lines can link Kaesong to the Munsan generator. VIP

Table 3. Stages of South-North Energy Cooperation

First Stage (2001~2002) Preparing for Economic Cooperation	Second Stage (2003~2005) Broadening Economic Cooperation	Third Stage (After 2005) Setting Basis for Economic Unification
-Supplying smokeless coal for generation	-Extending South Korea's transmission and distribution lines	-Creating basis for inter-Korean electricity grid
-Supplying idle mining equipment	-Creating long distance high voltage transmission lines	-Unification and Standardization of electricity grid
-Supplying crude oil for generators	-Building mid size and large thermal generators	
-Support for repairing generator facilities		
-Recovering functions of aged generators		
-Transfer of idle generators		
-Building small generators		
-Improving aged transmission facilities		