Economic and Military Aspects of North Korea' s Nuclear Program

Vladimir Andrianov*

To define the place and importance of the nuclear energy sector in the general structure of the DPRK economy it seems expedient to analyze the modern state of North Korea' s economy, including a comparison with South Korea' s economic development.

In recent years the DPRK economy has been saffering through a deep economic crisis. Beginning from the late 1980s the GDP has continuously fallen: in 1991, 3.0%; in 1992, 7.6%; in 1993, 5.4%; and in 1994, 1.7%. The crisis situation in the DPRK economy is preconditioned by a whole number of causes, among which one may point out a chronic deficit of energy resources, fuels and raw materials, an abrupt fall in the volumes of trade and economic cooperation with foreign countries, exceedingly high military spending, and a non-rational utilization of financial and material resources.

The industrial production share in North Korea' s GDP is 50%, with up to 40% of the country' s population being employed in this sector. The recent years have seen a fall in production in practically all leading industrial sectors, including the basic and export-oriented ones. In particular, in the 1992-1994 period, there was a reduction in the production of steel and steel items, fabrics and textile pieces, foods and goods of mass consumer demand.

In South Korea, which belongs to the category of the newly-industrialized countries, quite high economic growth rates still remain, which were among the highest in the Asia-Pacific region in the early 1990s. The average annual GDP growth rate in South Korea was: in 1991, 9.1%; in 1992, 5.1%; in 1993, 5.8%; and in 1994,

* Dr. Vladimir Andrianov is a professor of International Economics, Moscow State University.

8.4%.

Industrial production in South Korea is developing at even faster rates, its dynamics being in sharp contrast to the industrial production stagnation in North Korea. At present South Korea occupies one of the leading places in the world regarding the volume of production of a whole number of industrial goods. As of mid-1990s South Korea was the world' s 2nd biggest producer of ships, TV sets, transistors, synthetic fibers and fabrics, the 4th biggest producer of electronic and electric goods, the 5th biggest producer of ethylene and naphtha, steel and steel items, and the 6th biggest producer of cars.

In our estimates, practically all sectors of the DPRK industry are at the technological level South Korean industry was in the late 1970s-early 1980s. A serious lagging-behind is evident in the production of consumer electric appliances and semiconductors, and in almost all petrochemical and oil-processing sectors. The production of communication means and computers is limited to their assembly process. There is a significant gap between the two countries regarding the production of such consumer goods as textile goods made of synthetic fabrics, and food-stuff goods. The DPRK produces cement and glass, but their quality is at a low level due to the obsolete equipment.

The situation in the DPRK metallurgy and metal-processing industry is comparatively better, first of all due to the introduction of a relatively modern technology in non-ferrous metals production, which to a large degree is oriented to produce materials for defense industries and is comparable to that of South Korea.

Agriculture was once one of the DPRK' s strongest sectors. By the late 1980s, however, grain production was insufficient, forcing the country to import 10% of its demand. In 1989 grain production grew up to 5.48 million tons, but the next year production fell dramatically. This downward trend continues. Low grain production might be a result of an oil shortage-induced decline in chemical fertilizers and insecticide production or of long-term overuse of chemical fertilizers exhausting the naturally poor soil. Of course, aging agricultural machinery and fuel deficiency also have played their

role. Economically the grain production decline causes concern, because often it is the agricultural sector that determines market growth. With agricultural profits rising, the simple goods market grows as well. If agriculture is in stagnation, markets grow slowly, with the gap between domestic and foreign technologies and production costs widening.

One-third of 20% of arable land is utilized for rice cultivation, with the rest devoted to a variety of grains, vegetables and fruit, such as maize, barley, wheat, millet, oats, potatoes and soybeans. Due to a combination of unusually cold weather and economic production limits the total 1993 grain production amounted to just 3.9 million tons. Grain imports from Canada, Australia and China increased in 1991. Those imports from China continued to go up in 1992 in parallel with imports from Turkey. Efforts by Pyongyang to increase grain imports are not sufficient, however, to compensate the deficit, estimated to be 1.1 million tons(17% of demand) in 1992 and 1.2 million tons(19% of demand) in 1993. Grain production improved a little bit in 1994, but imports of 2.8 million tons were needed still(42% of demand). In 1995 further deficits are expected. The limited natural provision of arable land has suggested a 300,000 ha tidal land reclamation plan, the result of it being unknown.

The DPRK farming populations in 1990 was 37.8% of the total population, it being only 15.1% in the ROK. North Korea's present-day farming population is almost the same as that of South Korea in 1978, which then was 35.3% of the ROK total. Estimated from 1993 data, the DPRK total revenues from agriculture, forestry and fisheries constituted 27.9% of its GNP as compared with 7.0% in the ROK.

As concerns forestry, about 75% of the DPRK territory is covered with forests and woodlands, but top-quality timber is rare. Moreover, for timber industry progress there is a need for not only up-to-date equipment purchases, but the realization of a significant reforestation plan as well.

Regarding fisheries, the DPRK Third Seven-Year Plan ambitiously set the marine products targets at 11 million tons, including 3 million tons of fish, to be completed by 1993, but the estimated

coastal and deep-sea fishing yielded only 1.7 million tons of fish in 1993. The fisheries sector has been given generous state investments, but bigger yields are hampered by limitations in ship-maintenance, ship-building and fishing technologies.

In the field of livestock production the Third Seven-Year Plan envisages the increase of the annual egg production to 7 billion eggs and that of meat to 1.7 million tons with the aim of improving the food supplies to the population. Unfortunately, the total 1993 meat production, including poultry products, was just 227,100 tons, which in itself means a decline from 255,000 tons in 1992.

The mining sector of North Korea, by estimates, still accounts for 8.2% of its GNP, although the production of anthracite coal, iron ore and non-ferrous metals is on a decline. As for the ROK, its mining sector provides just 0.3% of its GNP. The DPRK's natural potential of minerals and metals enables it to preserve its advantage over the ROK in per capita production of iron ore and coal, the ratio being 11:1 and 1.5:1 respectively.

Infrastructure: The DPRK transportation system depends heavily on railways, by which 90% of total freight is transported, with only 7% by roads and 3% by marine transport. South Korean situation is more balanced, with about half of its freight being transported by road. North Korean infrastructure is comparatively underdeveloped. Road pavement is estimated to be at 8.5%, with only 2.2% being highway. By estimate, there are 5,000 km of railroad tracks, of which 98% is single track and 60% electrified. Most seaports are in need of improvement and expansion. At present the ports of Chongjin, Rajin and Sonbong are the objects for modernization of handling capacities and equipment and for upgrading of storage facilities. The estimated capacity of North Korean ports is 35 million tons, 14% of South Korea's total. As mentioned above, the DPRK's car and shipbuilding production is low, it further limiting transportation services, and energy shortages present a great obstacle to the infrastructure development.

Services and construction: The North Korea's services sector is relatively small, and in 1993 it accounted for 25.8% of the

GNP. Moreover, 16.8% of it belongs to government services. In the same year the South Korean services sector accounted for 49.9% of the ROK GNP. The DPRK' s construction sector as a share of the GNP declined by 9.7% in 1993 as compared with the previous year (from 9.1% down to 8.5%). The ROK' s construction sector share is rather higher, being 13.6% of the GNP.

Significant differences in the material production sphere of the North and the South are reflected in the character of their foreign economic ties. While South Korea uses the extrovert model of export orientation, in North Korea the domestic market priority and self-reliance are still preserved.

The world-wide rating of the countries according to their foreign trade volumes is a consequence of their use of different economic development models. While South Korea by its volume of export-import operations(US$ 198 billion in 1994) is among the world' s greatest trade powers, North Korea with its foreign trade volume of US$ 21 billion occupies one of the last places in the world.

In recent years, though, certain changes have been noted in the sphere of the DPRK economic and foreign economic policy. First of all it concerns the policy of foreign capital attraction, and the creation of joint-stock ventures and free economic zones. North Korea' s government has made a decision to create the Rajin-Sonbong Free Economic Zone. It is situated in the northeast part of the DPRK; its area is 746 sq. km, and its population is 130 thousand (in 1995). In the Zone the DPRK is trying on new forms and methods of cooperation with foreign investors.

The Free Economic Zone is being organized in order to utilize the natural and geographic advantages of the so-called 'Golden Triangle' and to create a center for transit trade and international business activities in Northeast Asia. The Zone is adjacent to Russia and the PRC; goods from North Eastern China will be transported through it towards sea-ports. There are two ports in the Zone—Sonbong and Rajin, and to the south there is the free trade port of Chongjin. All the three ports are ice-free.

Processing and handling of goods will take place, and tourism will be developed in the Zone. It will be created during the period

of 18 years in three stages: 1993-1995, 1996-2000, 2001-2010. In the first stage a modern infrastructure of roads, railways and ports will be created. In the second stage, attention will be paid to a further development of the ports, construction and reconstruction of industrial enterprises oriented at foreign markets. The third stage will see the development of all sectors of the economy of this Zone, as well as that of tourism. By 2010 the ports will be able to process 100 million tons of cargo, and its population will be 1 million.

Any firm of the world may invest capital in the development of the Zone. The DPRK is ready to host investments from state and private companies, financial structures, from international organizations and private persons, including those from Japan, the USA and other countries.

In the Zone it is permitted to create enterprises with 100% foreign participation, and investments in any form will be admitted—supplies of equipment and materials, investments in cash, etc. Capital can be invested into infrastructure development, building of hotels, services sector enterprises and, even more so, into construction of heavy and consumer goods production industries.

The program for the Zone creation is managed by the Committee headed by the DPRK Administrative Council Premier. The legislative basis to regulate foreign companies' activities in the Zone has been already prepared—20 normative acts have been adopted, including laws on the Zone itself, on rent, on foreign enterprises and others.

Big privileges are granted to those investing their capital into foreign market-oriented enterprises, into imported raw materials processing, into completing items production. Foreign investments into science-intensive industries will be free from taxes for the first three years. Tax on profits is 14%. Foreign businessmen in the zone may rent land and real estate for a period of up to 50 years. The government guarantees a stable rate of exchange of foreign currencies into the DPRK won. No-visa arrangement for entry or exit is implemented in the Zone.

The Zone establishment is an integral part of the Tumen River Basin Development Program. Many companies of the world intend to participate in the Zone development program. For instance, con-

tracts amounting to US$ 65 million have been concluded with PRC companies investing into roads and railways construction and ports reconstruction. There are proposals from leading South Korean companies.

Energy sector: The DPRK' s energy-intensive industries are much dependent on domestic energy sources, thus being extremely vulnerable to power shortages. Though the fast-flowing rivers of North Korea provide a stable hydro-electric power source, coal is the major domestic source of energy. All power plants run on coal(except the Rajin-located one that was closed for several years because of oil deficits), with the majority of manufacturing plants using coal as a fuel source. Oil is a rare import good being used for transport vehicles and as a raw material for the chemical industry only.

According to 1990 data, North Korea' s main energy sources are coal(84.1%), oil(9.3%) and water(6.5%). Those sources in the ROK are more diverse—oil(54.8%), coal(26.3%), nuclear power(14.9%), gas(3.2%) and water(0.6%). Because both countries lack explored sources of crude oil or gas, the deficits of energy will be determined by a decline in production of energy based on domestic sources and by the possibility of oil and gas imports.

Thus, the DPRK' s present-day lack of energy is a consequence of the fall in coal production and a dramatic decrease in oil imports since 1988. That year crude oil imports were 3.16 million tons; since then their gradual decline resulted in 1.3 million tons imported in 1993. The PRC is still North Korea' s biggest and most sure oil supplier. The DPRK got about 1.2 million tons of crude oil from China in the late 1980s, but those supplies gradually declined to drop to 0.2 million tons in 1994. Iran provided 1.0 million tons in 1990, thus becoming North Korea' s second biggest crude oil supplier, but in 1992 those imports declined to 0.2 million tons. Russia exports crude oil to the DPRK, but 0.2 million tons from Russia in 1993 are just a shadow of the guaranteed approximate amount of 0.85 million tons that was supplied annually before 1987, so the DPRK is still in need of finding a reliable substitute for the loss of the former Soviet guaranteed crude oil supplies.

The quick decrease in oil imports is due in part to the policy changes of the DPRK' s major trade partners. For instance, prior to 1990 North Korea could buy oil from China at a 'friendly' price of about US$ 60 per ton, i.e. approximately a half of the world market price. But both the former USSR(after) and the PRC(after 1991) in 1990 made the DPRK pay for it in hard currency at the world market prices. North Korea' s inability under the present terms to pay for larger oil and gas imports, aggravated by the domestic coal production decline, has brought about the energy deficit rendering damage to North Korea' s total industrial and chemical production, as well as to those sectors, such as fisheries and agriculture, that depend on transportation.

The DPRK economy has been always dependent on domestic coal production, as well as on foreign coal and crude oil imports. Though North Korean coal reserves are sufficient, the country does not produce crude oil, and so its energy production is much biased towards coal. More than 80% of North Korea' s energy is coal-based. According to South Korean estimates, its coal production gradually declined after 1989, when it totalled 43 million tons, and fell to 27 million tons by 1993. That coal production decline can be explained by the country' s general economic crisis. The structural limitations of the DPRK economy prevent the necessary capital generation needed to maintain or replace the obsolete and worn-out equipment and machines or to buy enough coal and oil in hard currency to compensate the domestic deficit and the loss of Soviet oil imports.

The DPRK nuclear energy sector: Nuclear energy sector development in North Korea began rather early, approximately in the mid-1950s. The sector development was based mainly on the science and technology achievements of the Soviet Union and China, rendering their assistance to the DPRK within the framework of science and technology cooperation agreements.

As early as in 1956 the Agreement on cooperation between the DPRK and the USSR in the field of peaceful use of nuclear energy was signed. Dozens of specialists from North Korea underwent training in the USSR, and practical work training in China. With

the USSR and PRC assistance, the scientific-technical center was established in Yongbyon, where applied military research began in parallel with works in the field of nuclear energy.

In 1965 the Soviet-supplied 5 Mw research reactor was put into operational mode there. In the beginning of the 1980s they undertook the installation of a 50 Mw nuclear reactor in Yongbyon that was to be put into operation by the end of 1995.

It should be emphasized that the lack of a real energy basis and the DPRK' s strong dependence on energy imports predetermined the importance of atomic energy sector development for the country. In our estimates, in early 1980s the DPRK' s dependence on energy imports was about 98%, that being almost 5% higher than the same South Korean indicator. North Korea, just like South Korea, is totally dependent on imports of oil and natural gas and partially so on anthracite coal imports(See Supplement 2).

Thus, the atomic energy sector development for North Korea may be one of the directions of energy problem solution. For example, in South Korea, which also is quite heavily dependent on energy imports, the share of atomic power plants in the overall volume of electric energy production is 38.2%, with the atomic energy sector providing 12.1% of primary consumption of energy resources. But the DPRK nuclear energy sector is in its formative period as compared to that of South Korea where 9 atomic reactors with total power amounting to 76 million Kw, and 7 such with planned total power amounting to 61 million Kw are under construction.

Among North Korean nuclear energy facilities there are scientific-research centers—the experimental nuclear physics laboratory at the Pyongyang University and the laboratory of the Radiochemistry Institute in Yongbyon, as well as industrial facilities—fuel cores production plant, uranium mines in Pakchon and Pyongsan and two uranium enrichment plants. The uranium natural deposits are evaluated to be of 26 million tons of ore(more than 15 thousand tons of uranium).

Presently two reactors function in North Korea—5 Mw research reactor and 50 Mw reactor, both situated in Yongbyon. The scheduled operation of the natural uranium-using 200 Mw gas-graphite reactor in Tongchon has been canceled and it will be

replaced by light-water reactors. Plans exist for construction of three other energy reactors of 635 Mw each.

Due to the lack of official data on the DPRK nuclear energy facilities funding it seems very difficult to evaluate the country' s aggregate and annual spendings for these purposes. However, the annual military spendings in North Korea, which have reached 26% of the GDP by the mid-1990s, from 5 to 10% of the GDP, according to our estimates, might be spent for the purposes of nuclear energy sector development.

However, the present state of this sector development is proof of a very low efficiency of capital investments into the nuclear energy sector and of a wasteful nature of the state funds allocation for these purposes. While in South Korea the nuclear energy sector plays an important role in the country' s overall energy balance, in North Korea it is a matter of a distant future.

Military aspects of the DPRK nuclear program: In the opinion of specialists, the reactors functioning in North Korea can be used both for electric energy production and for weapon-grade plutonium output. Presently, the construction of simplest nuclear charges having ceased to be a secret, the availability of the necessary quantity of fissionable material is the crucial element of military nuclear problems. That is why the answers to the questions concerning the quantity of plutonium that has been produced by now and the prospects of its production in the nearest years provide the main criteria to assess the extent of advancement of North Korea' s military nuclear program.

Specialists use a rather simple formula for approximate calculations of the quantity of plutonium produced by reactors: in 24 hours a reactor produces one gram of plutonium per megawatt of its power. In other words, the 5 Mw reactor in Yongbyon can produce 5g of plutonium daily or 1.8kg annually. With the fifty megawatt reactor made operational, this capacity will become about 20kg per year. That would be enough to produce 4 military-purpose charges.

However, despite the seemingly easy way of calculations, intelligence services of the world' s leading countries differ widely in

their assessments of plutonium possessed by the DPRK. It follows from a statement by the US CIA Director G. Woolsey that North Korea possessed a quantity of plutonium suffcient to produce a military-purpose nuclear charge as early as in 1993. In his opinion, in 1995 Pyongyang is to be able to produce 5-6 warheads.

KGB Chairman V. Kryuchkow' s memorandum signed on February 22, 1990 and addressed to the USSR leadership said that the development of the first atomic explosive device had been completed at the nuclear research center in Yongbyon. It was also pointed out that Pyongyang was yet abstaining from undertaking tests, because it could immediately disclose the state of nuclear weapons works.

The Foreign Intelligence Service(FIS) of Russia evaluated the advancements of the DPRK military nuclear program much more modestly. Its report prepared in autumn of 1993 states: "At present time the DPRK does not possess nuclear weapons. Widely spread assessments claiming 'a breakthrough' in creation by the DPRK of its own nuclear weapons cause serious doubts."

A country deciding to secretly create nuclear weapons faces quite a few scientific-technological problems. Among them there is the problem of choosing the military-purpose fissionable material predetermining, in its turn, the peculiarities of the nuclear charge construction, as well as the composition of the whole nuclear infrastructure.

The production of military-purpose nuclear charges on the basis of enriched uranium demands for construction of huge enrichment enterprises, the secrecy of which is practically impossible to ensure. As for plutonium production, it is much easier to be hidden under the veil of the civil industrial energy sector. Moreover, as American specialists' research shows, not pure weapon-grade plutonium, but rather that produced as a result of regeneration of fuel used by industrial APPs can be utilized as a fissionable weapon-grade material.

At the same time, the creation of a plutonium-based military charge represents a more complicated construction task than in the case of uranium being used. Due to the complexity of such a device, the requirements for synchronization of operations of all

automatics of the charge, with precision calculated in microseconds, are extremely high.

Thus, the specialists in the DPRK face a rather difficult task. Even having created and stockpiled several military-purpose charges there, they will have to carry out tests necessary to verify their safety and to determine their military characteristics. That would be an open demonstration of a military nuclear program, because under the state of control system even underground tests cannot be hidden.

Delivery means are an integral part of nuclear weapons. North Korea' s leadership has long been striving to obtain missile weapons. As early as in the 1960s they bought Frog-5 and Frog-7 tactical missiles equipped with conventional warheads and with the ranges of 50km and 70km respectively. Later they armed themselves with Soviet Scud missiles with up to 300 km range. And it was in 1984 that flight-tests started of North Korea-made Scud missiles. In 1985 the DPRK started serial production of a new model. Iran actively participated in financing of the work. The range of the improved missiles was increased to 340 km, with the payload growing by 15%.

During the Iran-Iraq War the DPRK specialists got acquainted with the debris of Iraqi Al-Hussein missile, which also was a development of Soviet Scud missiles. The additional information rendered a good service, and in 1989 production of experimental Scud-C model missiles was started, with the next year seeing its flight-tests. The range of the new missile reached 600km with a warhead mass of 700kg.

Testing of North Korea' s new No-dong 1 missile in May 1993 was a big surprise to foreign specialists. It caused much anxiety among the world public, especially in connection with the fact that in March the DPRK declared its intent to withdraw from the Nuclear Non-Proliferation Treaty.

A demonstrative merging of the two most important-nuclear and missile-programs took place. Iran and Libya participated in financing the No-dong program. The range of the new missile is up to 1000km. The fact means that it covers not only the whole territory of South Korea, but Japan' s Western areas as well.

Study of the DPRK missile-nuclear programs brings about a inevitable question: what were Pyongyang' s motives in getting involved with such a risky undertaking? Pyongyang' s first goal was to obtain nuclear power status, thus boosting its international rating. That explains the DPRK attempt to withdraw from the Non-Proliferation Treaty, to break loose from under the IAEA control, calculating to present the world with a fact accompli.

They were aware in Pyongyang that findings by the IAEA experts of nuclear preparations might lead to a situation where, even prior to its obtaining of new weapons, the DPRK would share the fate of Iraq. One should not rule out that after the start of production of weapon-grade plutonium and possibly even nuclear charges Pyongyang could have organized their clandestine sales to its traditional buyers of missiles and to other totalitarian regimes persistently striving for the atomic bomb.

Another and, perhaps, a more probable goal of Pyongyang' s nuclear ambitions was its intent to exchange its nuclear program for significant political and economic concessions on the part of the USA, Japan and South Korea at the highest rate possible. At that the DPRK leadership presumed that the farther its efforts on nuclear weapons had advanced, the higher price those countries would have to pay for the DPRK abandoning it. Among possible demands on the part of the DPRK there could have been a reduction or even the liquidation of the American military presence on the Peninsula, doing away with the political and economic discrimination, and rendering of economic assistance to the Republic.

North Korea' s recent agreements with the KEDO testify to the fact that the DPRK seems to have quite successfully played its nuclear card, achieving the set goals. According to the agreement between the DPRK and the USA, both parties undertook to cooperate in order to substitute the graphite nuclear reactors and the related facilities in the DPRK for light-water nuclear reactors. The aggregate energy power of those light-water reactors may reach 2000 Mw by 2003.

In accordance with the US President' s guarantee letter of October 20, 1994, the USA in representation of the international consortium, will conduct work in order to compensate the quantity

of electric power which will not be produced due to the freeze of the DPRK graphite reactors and the related facilities, for the whole period up until the completion of works on construction of the first light-water power block. To provide the DPRK with alternative sources of power the USA undertook to supply to North Korea the volume of up to 500 thousand tons of heavy oil annually.

The dismantling of the DPRK graphite reactors and conservation of the related objects will be completed by the moment of the light-water reactors being put into operation. The USA and the DPRK agreed to cooperate in search for a means of safe preservation of nuclear fuel that will be used in the experimental reactor (of 5 Mw of energy power) during the period of construction of the light-water nuclear power blocks. Safe ways of using that fuel that would rule out possibilities of its reprocessing on the DPRK territory are planned to be developed.

The history of North Korean nuclear problem settlement is close to its completion: the DPRK and the Korean Peninsula Energy Development Organization (KEDO) at last agreed on widening the framework of the previous agreement on supplies of the militarily safe light-water reactors to North Korea. The consortium consented, in addition to two nuclear units supply, to assist the DPRK in the creation of the accompanying infrastructure (including road construction and power transmission lines building). By such additions to the previous agreement Pyongyang preconditioned its consent to nuclear re-equipment based on 'ideologically harmful' South Korean reactors.

With this issue settled all the problems impeding the project realization have been done away with. According to the data by South Korean newspaper, *Hanguk llbo,* its realization total costs have grown from the previously set US$ 4 billion to US$ 6 billion. EKR

Supplement 1

Comparative characteristics of main economic indicators of South and North Korea (1994)

	South Korea	North Korea
Territory(thousand sq.km)	99.3	122.1
Population(million persons)	44.5	22.9
GNP(US$ billion)	376.9	21.2
GNP per capita(US$)	8483	92.3
GNP growth rates(%)	8.2	-1.7
Production:		
electric power(million Kw)	147.8	7.1
steel(million tons)	33.7	1.7
cement(million tons)	43.0	4.7
fertilizers(million tons)	4.2	1.4
ships(million tons)	5.2	0.05
cars(thousand pcs)	2312	10
fabrics(million sq.m)	7.3	0.17
textile items(million tons)	1.7	0.04
Extraction:		
coal(million tons)	12.0	29.2
iron ore(million tons)	0.2	5.7
Yield:		
cereals(million tons)	5.1	1.5
rice(million tons)	3.5	1.0
fish(million tons)	3.3	1.2
Railroads length(thousand km)	6.5	5.1
Highways length(thousand km)	73.8	23.2
Exports(US$ billion)	96.0	0.8
Imports(US$ billion)	102.3	1.2
oil imports(million tons)	69.3	1.5
Foreign debts(% of GNP)	15.1	50.3
Military spendings(US$ billion)	12.6	5.5
(% of GNP)	3.3	26.7

Source: compilation based on *Korea and the World Key Indicators 1995*. Seoul, Republic of Korea, 1995.

Supplement 2

Estimated raw material reserves of DPRK

Raw materials	Unit	Reserves
Iron ore	billion tons	2~4
Tungsten	million tons	0.2~0.3
Manganese	million tons	0.1~0.3
Nickel	thousand tons	20~30
Molybdenum	thousand tons	1~3
Coal	billion tons	8
Anthracite	billion tons	5.5
Lignite	billion tons	2.5
Lead	million tons	4~6
Zinc	million tons	10~20
Gold	thousand tons	12
Silver	thousand tons	3~5
Magnetite	billion tons	3~4

Source: National Unification Board(ROK)

Supplement 3

Supply of primary energy, DPRK and ROK (Oil Equivalent)

Unit : thousand TOE

	DPRK(A)	ROK(B)	(B/A)
1982	22645	45625	2.0
1990	27292	93622	3.4
1991	23463	103622	4.4
1992	21834	116008	5.3

Source: National Unification Board(ROK)

Supplement 4

Supply share of primary energy, DPRK and ROK (Oil Equivalent)

Unit : thousand TOE

	DPRK	ROK
Coal	84.1	26.3
Petroleum	9.3	54.8
LNG	_	-3.2
Nuclear	_	-14.9
Hydro	6.5	0.6
Total	100.0	100.0

Source: *IEA Energy Statistics and Balances of Non-OECD*

Supplement 5

Comparative characteristics of levels of import dependence on selected types of raw materials (1991%)

	NK	SK	Japan	USA
Energy sources	98.0	93.6	82.6	22.8
Oil	100.0	100.0	99.6	46.6
Natural gas	100.0	100.0	96.0	11.4
Coal	13.5	78.6	94.7	11.7
Iron ore	35.8	99.3	100.0	14.0
Copper concentrate	100.0	100.0	98.9	6.0
Tin	100.0	100.0	100.0	99.7
Bauxite	100.0	100.0	100.0	97.3
Nickel	100.0	100.0	100.0	72.5

Imports dependence index=

$$(\text{imports-exports}) \div (\text{domestic production+imports-exports}) \times 100$$

Source: calculation based on OECD, *Energy Balances; World Metal Statistics; Korea Yearbook of Energy Statistics;* for respective years.

Supplement 6

Structure of electric power production and power consumption in South Korea (as of 1993)

Electric power production	million Kw	%
Total	147.8	100.0
including by:		
thermo-electric power plants	86.4	58.5
nuclear electric power plants	56.5	38.2
hydro-electric power plants	4.9	3.3
Primary consumption of energy sources	**million tons of oil equivalent**	**%**
Total	124.0	100.0
including by:		
oil	77.3	62.6
coal	25.5	20.6
nuclear energy	15.0	12.1
natural gas	5.7	4.6
hydro-energy	0.5	0.4

Source: calculation based on : *Statistical Review of World Energy*, 1994

Supplement 7

The world nuclear energy production capacities(as of June 1993)

	Operative		Under construction or planned	
Countries	Number of reactors	Power in million Kw	Number of reactors	Power in million Kw
USA	108	103.4	8	10.0
France	55	58.9	8	11.7
Japan	43	34.6	12	11.8
Germany	21	23.6	-	-
Former USSR	25	20.3	28	20.4
Canada	21	13.9	3	2.8
Great Britain	37	13.2	4	4.8
Sweden	12	10.4	-	-
South Korea	9	7.6	7	6.1
North Korea	1	0.05	1	0.5

Source: Kohuseisha, *Nihonkokuseizue*, Tokyo, 1994

Supplement 8

Major nuclear facilities in North Korea (as of the end of 1994)

Scientific-research centers:

-Experimental Nuclear Physics Laboratory at the Pyongyang University

-Laboratory of the Radiochemistry Institute in the city of Yongbyon (Pyenangpukto Province)

Industrial facilities:

-fuel cores production plant (city of Yongbyon)

-fuel cores storage facility (city of Yongbyon)

-uranium mines (cities of Pakchon and Pyongsan)

-two uranium enrichment plants

Nuclear reactors:

-5 Mw research reactor (city of Yongbyon)

-50 Mw research reactor (city of Yongbyon)
(putting into operation was suspended in 1995)

Source: compilation based on Russian and foreign media materials