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STAFF APPRAISAL REPORT

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

April 8, 1983

Transportation Division
Projects Department
East Asia & Pacific Regional Office

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CURRENCY EQUIVALENTS

Currency Unit - Won (W)

US$1	=	W 745 (as of January 1983)
US$1.34	=	W 1,000
US$1 million	=	W 745 million
US$1,340	=	W 1 million

FISCAL YEAR

January 1 - December 31

WEIGHTS AND MEASURES

1 meter (m)	=	3.2808 feet (ft)
1 kilometer (km)	=	0.62 mile (mi)
1 square kilometer (km^2)	=	0.3861 Square miles (sq mi)
1 hectare (ha) = 0.01 km^2	=	2.4711 acres (ac)
1 kilogram (kg)	=	2.2046 pounds (lbs)
1 metric ton (m ton)	=	2.204.6226 pounds (lbs)
		1.1023 short tons (sh tons or 2,000 lbs)
		0.9842 long tons (lg ton or 2,240 lbs)

PRINCIPAL ABBREVIATIONS AND ACRONYMS USED

BPR	-	Bureau of Public Roads
CTC	-	Centralized Traffic Control
DHCC	-	Dae Han Coal Corporation
EPB	-	Economic Planning Board
GOK	-	Government of Korea
KHC	-	Korea Highway Corporation
KMPA	-	Korea Maritime and Ports Authority
KNR	-	Korean National Railroad
MOC	-	Ministry of Construction
MCI	-	Ministry of Commerce and Industry
MOER	-	Ministry of Energy and Resources
MOF	-	Ministry of Finance
MOHA	-	Ministry of Home Affairs
MOT	-	Ministry of Transportation
TCC	-	Transport Coordination Committee
TOC	-	Terminal Operating Company

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

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This report is based on the findings of an appraisal mission comprising Messrs. Paul Levy, Financial Analyst; Emile Karman, Railway Engineer; Ismail Mobarek, Port Engineer; and Jacques Yenny, Economist, which visited Korea in April 1982.

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INTRODUCTION

The Government of Korea has requested Bank Group assistance in the financing of a program to improve the distribution of coal and cement in the country. The objective of the proposed project is to provide the necessary capacity in rail, ports and inland terminals to efficiently handle forecast coal and cement traffic and make a start in addressing system inefficiencies in coal and cement distribution. Nearly 20 million tons each of coal and cement are distributed annually in Korea, and these quantities are expected to grow significantly in the future in line with the country's economic growth and energy conservation policy, which includes greater reliance on coal in substitution of petroleum. Rationalizing the distribution systems for these commodities can lead to substantial transport and other cost savings as well as energy savings.

The Ministry of Transport (MOT) was responsible for the coordination of project preparation which involved the Korean National Railways (KNR), the Korea Ports and Maritime Authority (KMPA), the Ministries of Energy and Resources (MOER), Commerce and Industry (MCI) and the Economic Planning Board (EPB). A study by local consultants RDRI/KIST was conducted in 1979 and 1980 under financing of the Sixth Railway Project (Loan 1542-KO).

I. TRANSPORT SECTOR

A. Geographic and Economic Setting

1.01 The Republic of Korea has a land area of 98,500 sq km. About 70% of the land area is mountainous and agriculture is confined to about 22,600 sq km, or 23% of the total area, mainly in the river valleys, lower hillsides and coastal plains. The climate is seasonal with very cold dry winters and hot humid summers. Annual rainfall averages 800 mm to 1,400 mm with about 60% falling between June and September. The land mass is drained by a well developed river system with seasonal variations in flow which give rise to frequent flooding. The rugged terrain, river system and severe winter climate make the construction of transport facilities, particularly roads, difficult and costly.

1.02 The population is presently estimated at 38.2 million and growing at an annual rate of 1.9%. Population density is estimated at 382 per sq km of total area or 1,670 per sq km of agricultural land. Urban population is estimated to be growing at an annual rate of 4.9% and has increased from 40.7% of the total in 1970 to 54.8% in 1982. The increasing urban population has created significant transport demand in the areas around the cities and industrial centers and particularly in the Seoul greater metropolitan area.

1.03 Korea's export-led industrialization has been among the most successful examples of economic development in recent history. During 1962-78, real GNP grew by 10% p.a. and per capita income more than trebled in real terms. Coupled with industrialization and urbanization, major developments and changes in the transportation sector complemented and supported the transformation of Korea's economy. Passenger traffic tripled between 1964 and 1971 and tripled again by 1981; freight increased nine times and five times respectively during the same periods.

B. The Transport System

1.04 Throughout much of the past 20 years, the transport system has been strained by the demands of rapid growth and it has required massive public sector investments in transport infrastructure. The Government has been allocating regularly, since the beginning of the Second Plan in 1967, about one quarter of its total capital expenditure to expand and modernize transport infrastructure. Investments have been concentrated on the Seoul-Busan axis where most industrial development is taking place and other corridors serving the northeastern and southeastern parts of Korea.

1.05 Substantial changes in the modal distribution of traffic are illustrated by traffic statistics for the 1961 to 1981 period (Tables 1.1 and 1.2). Freight traffic moving by rail, although showing growth in absolute terms, fell from 88% of total ton-km to 46%, while the road and coastal shipping shares increased from 8% to 21% and from 3% to 32%, respectively. For passenger traffic, the rail share of total passenger-km fell from 53% to 25% over the same period, while the road share increased from 45% to 73%. These changes reflect both the economic advantages of the various modes and the different growth rates experienced among industries served, as rail and coastal shipping increasingly were concentrated on long distances and bulk commodities, while road transport handled the short distance and more general cargo. In addition, rapidly expanding personal consumption generated large increases in personal travel, further fueled by changes in consumption patterns. Road transport has been the main beneficiary of these increases.

1.06 The Government of Korea's (GOK) basic objective over the past has been to increase the capacity of the system in line with projected traffic growth and to avoid major bottlenecks. This objective has been largely achieved. The present system is reasonably balanced and there is no substantial uneconomic allocation of traffic among the various modes. Investments in transportation have been linked to broader concerns in Korea's spatial and economic planning. For example, considerable efforts have been made to develop new industrial complexes in coastal areas, to take advantage of Korea's natural potentials in harbors and to exploit low-cost coastal shipping while avoiding excessive congestion on road and rail. Similarly, in its efforts to ensure that appropriate development priorities were reflected in the allocation of scarce transportation means among the competing claims, the Government has maintained fairly tight regulations in the sector, involving strict licensing of operators in road transport and shipping, and administered pricing for all transport activities. Korea's vehicle fleet has been kept small due to a policy of high taxation of domestic cars and high prices for gasoline.

1.07 Large investments in transportation infrastructure have been complemented by a considerable effort to improve the efficiency of the transportation system, through the establishment and strengthening of institutions to plan, construct, maintain and operate the facilities and services. In the public sector, institutions such as the Korean National Railroad (KNR), the Bureau of Public Roads (BPR) in the Ministry of Construction (MOC), the Korean Highway Corporation (KHC), the Korea Maritime and Port Authority (KMPA) have been strengthened or established in many instances with increasing financial and managerial responsibility as semi-autonomous public corporations. In the private sector, a highly efficient contractor system has evolved for civil works which reflects both the insistence on competitive bidding in the award of contracts as a matter

of policy, and the large volume of construction work that has been carried out in Korea during the past 20 years. There are now some 500 firms capable of handling a broad range of public works. Furthermore, with Government encouragement, the major construction firms have successfully expanded their construction activities overseas; in 1981, Korean contractors won overseas contracts valued at US$13.6 billion.

1.08 The Bank has played an active role in advising and assisting the Korean authorities in pursuing their transport objectives. Since 1962, the Bank Group has assisted the KNR through seven railway loans amounting to US$434 million. The first six projects have been satisfactorily completed and a seventh is almost fully disbursed. Cost comparisons indicate that rail transport is still the most economic means of moving bulk cargo over medium and long distances, and for passenger traffic over long distances. Bank-supported investments have concentrated on improved capacity and service relating to these functions. KNR's efficiency is among the highest of any rail system in the world, with staff productivity per employee of 800,000 traffic units (passenger-km plus net ton-km) in 1981. The Bank has also maintained an active dialogue on the railway's financial situation, investment plans, level and structure of tariffs. After some deterioration in the 1970s, Government agreed to implement a financial recovery plan for KNR as part of the seventh (ongoing) railway project. Discussions of a revised plan, following the severe downturn of the economy in the early 1980s, are continuing. The coal and cement distribution project now proposed would strengthen the capacity of the railways, ports and inland terminals to cope with the expected increase in transport of these commodities, resulting partly from large coal imports to substitute for oil.

1.09 Substantial assistance has also been extended for port development. In part related to Korea's export drive, freight traffic through the ports has increased from about 13 million tons in 1966 to over 120 million tons in 1981. This large increase resulted in serious port capacity problems, particularly at Busan, the biggest port, which handles 30% of the country's external trade and is chronically congested. Containerization was introduced in Busan with the assistance of the Bank under two port loans totalling US$147 million; the Saudi Fund for Development participated with the Bank in the financing of the first Busan Port Project. A third ports project, to further improve container handling capacity, has been studied. This would be in addition to port works under the proposed project.

1.10 The first four Bank-financed highway projects have had a major impact in assisting Government with the improvement and expansion of the national and provincial road networks and with institution building in MOC. Significant policy changes, relating to the highway subsector, which were effected through the highway projects include the adoption of more

appropriate road standards, revisions of regulations governing vehicle weights and dimensions, and a modified Government policy on toll roads. MOC's organization to maintain the national road network was established and strengthened through the provision of technical assistance and road maintenance equipment. Korean consulting firms have benefitted through their association with foreign consultants on the design of road projects. Results of the three projects that have been completed are highly satisfactory.

C. Transport Objectives and Issues in the 1980s

1.11 The period of rapid and sustained growth in the Korean economy came to an abrupt close in 1979, following the second major oil price increase, the subsequent worsening of the international environment, and the political transition. Near stagnation, accompanied by severe inflation and balance of payments problems were experienced between 1979 and 1981. A modest recovery is now in progress, with benefits from Government's determined efforts to master inflation (which declined from 29% in 1980 and 12% in 1981 to about 5% in 1982), plus a remarkable improvement in the balance of trade. Nevertheless, the medium-term prospects for a resumption of Korea's former rapid progress remain uncertain. The impact on the transportation sector is two-fold. On one side, the timing of investments needed to sustain further improvements in transport capacity and quality of service will be influenced by growth-induced traffic expansion. On the other side, the capacity of the public sector to finance the necessary upgrading and extension of infrastructure and facilities in transportation may be sharply constrained by budgetary limitations. For the medium term, the Fifth Five Year Plan projects a GNP growth rate of 7.6% p.a. over the period 1982-86, with a corresponding increase in transport demand estimated at about 47 billion passenger-km and 10 billion ton-km, respectively 50% and 30% above fourth plan period outcomes. Investments in transportation (public and private) are expected to increase by about 45% and remain at close to 14% of the total planned outlay as in the fourth plan. They will amount to some US$16.3 billion, calculated at 1980 prices and exchange rates. However, investments in subways and aviation will absorb a larger fraction of the total as will road vehicles and ships. Hence, real investment in the railway system, road and port infrastructure would increase by less than 20% above fourth plan outlays.

1.12 Whether or not economy-wide growth, transport demand and investments conform to plan expectations, it seems clear that the period of most rapid development in Korea's basic transport infrastructure is now over. On the other hand, the increasingly complex traffic patterns and higher traffic densities, the growing requirements for maintenance of the expanded system,

and the need to conserve energy, will call for even greater efforts to maximize efficiency of service and the use of scarce investment capital in this capital-intensive sector. Policies relating to pricing and regulation of transport plus improved planning in respect of system development, are crucial in the now more demanding economic environment. The preliminary findings of the Bank's recent sector survey suggest that there is scope for improvement in several areas.

1.13 Despite considerable efforts, spatial planning of the transportation system is still hindered by generally inadequate interagency coordination, a comparatively limited expertise in planning and economic appraisal techniques, and in the capacity to undertake appropriate longer-term preinvestment studies. World Bank efforts to provide support and encouragement for these activities has met with mixed success. In 1970, a study financed under a Transport Credit recommended that transport planning and coordination be placed in the Economic Planning Board (EPB). However, Government decided to set up a Transport Planning Office in the Ministry of Transport (MOT). The Government tried further, in 1975, to improve transport coordination via a Transport Coordination Committee (TCC) with representation from the various ministries most directly concerned. The TCC, however, has not, in practice, been able to carry out its responsibilities for the coordination of transport sector investment very satisfactorily. More effective mechanisms are yet to be worked out. Meanwhile, the Budget Bureau, located in EPB, exercises considerable influence on year-to-year transport investment decisions through its budgetary control powers. Currently, a Bureau of Project Evaluation, established in 1976 in EPB, is showing interest in transport planning, spurred by the necessity to cut back the public sector investment program. However, its responsibilities are at present limited to reviewing individual major investment proposals submitted by executing agencies on a piecemeal basis. The Bureau's capability in project analysis has been strengthened under the Bank's 1981 Structural Adjustment Loan.

1.14 The Bank has also through various projects, provided active support and finance for technical assistance for a range of feasibility and planning studies relating to national transport development, urban transportation needs, inter-modal alternatives along major traffic axes (such as the Seoul-Busan corridor) in addition to more conventional engineering design work for proposed projects. Here too the record of accomplishment is patchy, with experience tending to show a pattern of relatively slow progress, reflecting in part the difficulties of sectoral planning and transport coordination in the Korean context.

1.15 Pricing policy and the regulatory framework have been a feature of Bank-Government dialogue for many years. In the 1970s, emphasis was given to supporting Government's efforts to establish agencies such as KNR, and KMPA on a sound financial basis, with investment planning linked to

appropriate tariffs and charges in regard to rail transport and ports. The role of the Bank has been quite effective in this regard, although the priority given to reducing inflation in the past two years has led to some reluctance to raise tariffs - for example in rail transportation - in line with changes in costs. The Bank has also assisted Government in the review of transport and traffic regulation, notably in regard to licensing of common carriers, road vehicle taxation, axle loading and similar issues relating to road transportation.

1.16 It is expected that the Bank's policy dialogue would be strengthened in future years through the increasing emphasis being given to a sector and subsector approach in transport lending in Korea. The recently approved provincial and county roads project will deepen and broaden our involvement in the road subsector by extending assistance, for the first time, to the Ministry of Home Affairs (MOHA) which deals with the maintenance of provincial roads and the maintenance and improvement of county (gun) roads. This new involvement will also provide the Bank with an opportunity to improve coordination of road planning between MOC and MOHA, and will strengthen the basis for a possible highway subsector loan. Similarly, the recently completed ports study examined broadly which ports should be developed to handle the nation's traffic through the next decade and may lead to a port subsector loan. For railways, the Bank has traditionally made sector type loans, financing time slices of KNR's investment plans with the sixth and seventh railway projects covering respectively 1978/79 and 1980/81 investments.

1.17 Besides these subsector operations, we are assisting the Government in developing multimodal projects. The first is the Coal and Cement Distribution Project now proposed, involving railways, ports and inland terminals. It will be followed by projects directed toward increasing the capacity of the system in certain high priority areas and corridors rather than expanding the system as a whole. The Bank will assist in developing an integrated modal approach to meet the very high transport demand near main urban areas where a dense network of facilities are needed. The complementarity of the various modes will be promoted by developing interconnecting terminals so as to facilitate the use of the most economical and efficient transport system. To this effect three separate multi-modal transport studies have been discussed with Government: one concerning the Seoul-Busan transport corridor and the feasibility of rail capacity increase between Seoul and Daejon is about to start; the second concerning the Seoul Metropolitan region covering the Gyeonggi province is to follow in 1984; and the third covering the southeast coastal region from Suncheon to Pohang, where most heavy industries are concentrated, will follow later.

1.18 Bank transport projects also contain specific components to promote the local transport consulting industry. A Korean consultant was

responsible for both a coal and cement distribution study and a national comprehensive transport study. Korean consultants are assuming an increasing share of the work and responsibilities for studies under the Bank's railroad, port and road projects. The development of a competent consulting industry in the transport sector is likely to lead to significant import substitution and export of such services.

II. COAL DISTRIBUTION

A. Background

2.01 The Coal Bureau of the Ministry of Energy and Resources (MOER) is responsible for the administration of the coal mining industry and for controlling coal imports in Korea. The Coal Bureau directly controls Dae Han Coal Corporation (DHCC) the only public enterprise engaged in mining domestic coal. DHCC contributes to about 21% of the national production. It is also in charge of importing anthracite needed for bridging the gap of domestic demand and supply. All other coal mining companies are privately owned and operated.

Domestic Production

2.02 South Korean coal is exclusively anthracite; there are no known reserves of bituminous coal. Coal mines are concentrated in the Taebaeg region, about 250 km east of Seoul. This area has the largest mines which, together, produce some 75% of the country's output. Remaining production is in the center of the country and on the west coast. A characteristic of domestic production is the large number of small mines. As shown in Table 2.1 below, 85% of the mines account for only 17% of the production.

Table 2.1: 1981 COAL PRODUCTION BY SIZE OF MINE

Mine size (000 t/yr)	1981 annual production million tons	%	No. of mines	%
More than 500	11.19	56	7	3
100 to 500	5.30	27	25	12
less than 100	3.37	17	179	85
Total	19.86	100	211	100

Source: Korean Institute for Energy and Resources (KIER).

2.03 Domestic coal production increased rapidly in the early 1970s from 12.4 million tons in 1970 to 17.6 million tons in 1975. Since then, however, production stagnated around 18 million tons until 1981, when it exceeded 19 million tons for the first time. The earlier goal of 24 million tons by 1981 set for the Fourth Five Year Plan was revised downward; the present forecast is 21.5 million tons by 1986. At this rate, total minable reserves evaluated at 630 million tons would last about 30 years; however, annual production is expected to decline somewhat in the 1990s.

2.04 Domestic anthracite is used primarily to make briquettes for household heating and cooking as can be seen in Table 2.2. Briquettes are the primary form of energy used by lower income households in the cities as well as in the rural areas. Briquettes are manufactured throughout Korea by simple technology. Coal fines are pressed into 3.6 kg briquettes without any special bonding material as Korean coal, with its high ash content, is suitable for this purpose. The calorific content of domestic coal is low, with 80% of the production in the range of 4,200 to 5,300 kcal/kg. The stipulated minimum calorific content of briquettes is 4,500 kcal/kg.

Table 2.2: USES OF DOMESTIC ANTHRACITE - 1981

	'000 tons	%
Briquettes	15,507	86.5
Power	1,432	8.0
Industry	787	4.4
Others	205	1.1
Total Consumption	17,931	100.0
Storage	1,934	
Total Production	19,865	

Source: MOER.

Imported Coal

2.05 Anthracite. To supplement the stagnant domestic production, Government started anthracite imports in 1978. Imported anthracite has a minimum calorific value of 5,500 kcal/kg and thus enhances domestic coal which is mostly around 4,500 kcal/kg. However, with the present briquette type and manufacturing techniques, it is not possible to blend more than 15% imported anthracite since most of it does not have the same high bonding characteristics as domestic coal. Imports have been larger than necessary

to meet demand as the Government chose to double the anthracite stockpile during the last three years; this stood at about five million tons by end-1980.

Table 2.3: ANTHRACITE IMPORTS
(Million tons)

Actuals				Forecast	
1978	1979	1980	1981	1986	1991
0.6	2.0	2.7	3.5	3.4	3.2

Source: MOER.

2.06 Forecast of anthracite imports for briquette making are 3.4 million tons by 1986 and 3.2 million tons by 1991 on the basis of a slight decrease in briquette consumption as more households, particularly in large cities, shift to fuel oil and natural gas. Coal briquettes are inconvenient to handle: they are dirty, they have to be changed a few times during the day and sometimes during the night, and the burnt briquettes have to be disposed of. Some anthracite will continue to be imported to fire existing power plants at Busan and Ulsan. New power plants will, however, use steam coal.

2.07 Bituminous Coal. No bituminous coal is produced in Korea. Imports of coking and steam bituminous coal started in 1973 with the commissioning of Korea's first steel plants. Imports were 5 million tons in 1981, (up from 0.6 million tons in 1973) of which 4 million tons is coking quality, and 1 million tons steam coal. In 1980, the cement industry started its conversion from fuel oil to coal for kiln firing. In 1981 the industry received over 1.3 million tons of bituminous coal. Coal consumption by the cement industry is expected to reach 2.7 million tons in 1986 and 3.3 million tons in 1991.

2.08 The Government is now encouraging other industries to convert their boilers from oil to coal. As indicated in para. 5.01, savings are substantial. The proposed goal is to have 40-50% of all industrial boilers, except in Seoul City, burning coal by 1991. Besides the cement industry and industrial boilers, large quantities of bituminous coal will be imported for new power-generating plants and for steel making. The latter are all located on the coast and have their own ports facilities to receive coal; therefore no inland transport will be required for either steel or power. Table 2.4 shows a forecast of imports of bituminous coal.

Table 2.4: FORECAST IMPORTS OF BITUMINOUS COAL
(Million tons)

	1981 Actual	1986 - Forecast -	1991
Cement industry	1.3 /a	2.7	3.3
Industrial boilers	n.a.	2.2	5.9
Steel /b	5.9	7.7	14.4
Power /b	-	6.8	6.8
Total	7.2	19.4	30.4

/a Industry only partially converted to coal in 1981.

/b Coastal plants, no inland transport required.

Source: MOER, KIER.

B. Coal Distribution - Issues and Objectives

2.09 In general there are two major distribution patterns: one for domestic coal and one for imported coal. Domestic coal is distributed from mines located mostly in the eastern mountains to large urban areas of the west and south coasts. It is only recently that significant amounts of coal were imported by users other than the Pohang steel mill which has its own port. This coal will move inland from the coasts, i.e., in the opposite direction of the domestic coal, thus providing return loading for some of the railway coal cars.

2.10 Almost all domestic coal is distributed by rail, with the exception of 1.6 million tons, from a mine near the east coast, which go by coastal shipping to the southern areas of Korea after being transported by rail to the port of Mugho. In 1981, coal transport accounted for over 40% of KNR's traffic in ton km. Road transport is used mainly between mineheads and railway stations and for the distribution of briquettes to consumers. Some road transport is also used to distribute locally the production of small mines on the west coast. The average transport distance by rail is around 210 km, that for coastal shipping is 330 km.

2.11 The main flows of coal are thus concentrated on a few railway lines connecting the Taebaeg area with Seoul, Daejon and Daegu. In 1981, Seoul City alone consumed over 40% of Korea's domestic coal, and the other five large cities another 28% leaving 32% for the rest of the country.

Domestic Coal Distribution

2.12 The main issue in domestic coal distribution is its complexity resulting from the fragmentation of the mining industry and of the briquette-making industry. There are over 210 mines and 280 briquette plants. Furthermore, until mid-1982 coal was produced and sold under 24 different categories, according to its calorific content. The end product, however, is uniform since briquettes have to comply with the minimum calorific content of 4,500 kcal/kg set by Government. Therefore, briquette makers arrange purchases of different coal grades from different mines for blending at the plant in a way that minimizes their costs, but not necessarily transport costs.

2.13 Over the last few years, the Government began to deal with the above problem by fostering the consolidation of the briquette industry. In 1976, there were still some 600 briquette plants in the country versus 280 now (Table 2.5 in Annex). The consolidation happened mainly in large cities where the number of plants was reduced to one third from 118 to 38 since 1978. Consolidation is expected to continue, and the Bugog terminal included in the project will permit consolidation of briquette plants in the rapidly urbanizing areas of Gyeonggi Province south of Seoul while the Seonbug terminal will do the same in the northern suburbs. The Government confirmed at negotiations that briquette factories will be installed in the coal terminal by the end of 1986 (para. 7.01).

2.14 During preparation of the project, the point was made that, from a transportation point of view, it would be desirable to reduce the number of coal categories. MOER agreed to review the coal grading and pricing system for domestic anthracite to improve quality control while simplifying the present transport and distribution system. In July 1982, a new grading system was introduced, including a reduction of the number of categories from 24 to 9. This consolidation should enable KNR to gradually increase the number of unit trains between the mines and the large cities. The project also includes special side dump cars that will enable faster unloading of coal at briquette plants and speed up the turnaround time of freight cars.

Imported Coal Distribution

2.15 As mentioned above, the distribution of imported coal is a recent development. For instance, anthracite imports jumped suddenly from 0.6 million tons in 1978 to 2.0 million tons in 1980 (para. 2.05); and no facilities were available to efficiently handle such large quantities. The main

issue regarding imported coal distribution is thus the lack of efficient handling and transporting systems. The proposed project is addressing this problem by combined port and railway investments.

2.16 Anthracite. Imported anthracite will be distributed from the ports of Incheon, Ulsan and Mogpo (MAP 16509). Rail transport will be used mainly from Incheon to the Bugog terminal and to the Daejon area via the Su-In line, which will be extended and widened under the project. Agreement was reached during negotiations that land rights for the Su In line will be obtained by July 1, 1986 (para. 7.01). Some coal will also go by rail from Ulsan to Busan and Daegu, and from Mogpo to Gwangju. The remainder will go by truck directly to briquette plants in the vicinity of the ports.

2.17 Bituminous. Until more industrial boilers are converted from oil to coal, the main inland users of imported bituminous coal will be the cement plants in the Jecheon area. Given the concentration of origins, at the ports of Incheon and Ulsan, and of destinations, 5 plants in Jecheon area, all this coal will go by rail. In the case of both ports, coal cars, which are now returning empty to the mining areas from the Seoul or Busan areas, will obtain a return load: they will be loaded with domestically-mined anthracite on their departure from the mining area and with imported bituminous coal on their return to the Jecheon area, which is close to the mining area. From Incheon, bituminous coal will also use the Su-In line referred to above.

III. CEMENT DISTRIBUTION

A. Background

3.01 The Ceramic Industry division of the Ministry of Commerce and Industry (MCI) is the Government body in charge of supervising cement related matters. The installed capacity of the Korean cement industry, entirely private owned, was 23.5 million tons p.a. at the end of 1981 more than three times above the 1971 capacity of 7 million tons. Except for two small plants, the cement industry is concentrated in the north-eastern corner of Korea (Map 16509). Five plants, located near Jecheon, some 180 km east of Seoul, account for 42% of the presently installed capacity while two plants, on the east coast near Bugpyeong account for 53% of the capacity. About half of the capacity of the coastal plants was added during the last five years. One plant is now rated at 8.8 million tons p.a. (37.6% of the country's capacity) which reportedly makes it the largest in the world. The nine plants in the country are owned by seven companies, with the largest owning about 50% of the capacity.

3.02 The domestic demand for cement increased rapidly in the 1970s; from 6.1 million tons in 1971 it peaked near 16 million tons in 1979. It then contracted abruptly following the general economic downturn, reaching only 12.4 million tons in 1981, with some recovery taking place in 1982. Total average annual production over 1978-81, has been around 17-18 million tons, production in excess of domestic demand was exported (Table 3.1). Since the energy price rise in 1979 such exports barely cover variable costs. Capacity utilization in terms of domestic demand reached a peak of 92% in 1978, but as new capacity came on stream at the time of weakening demand, it fell to 53% in 1981. As a result the cement industry is presently in difficult financial condition. The conversion from oil to coal, virtually completed, provides substantial fuel cost savings to the industry. These are estimated at about US$6 to 8 per ton of cement.

Table 3.1: CEMENT INDUSTRY - CAPACITY, PRODUCTION, DEMAND
(000 tons)

	71	76	77	78	79	80	81
Installed capacity	6,920	12,980	14,750	16,000	20,400	23,450	23,450
Production							
Including clinker	6,870	11,870	14,500	16,860	18,690	18,570	17,500
Operating ratio	99.3	91.4	98.3	105.4	91.6	79.2	74.6
Demand							
Domestic	6,102	8,983	11,117	14,762	15,825	13,170	12,440
Exports	757	2,782	3,358	1,869	1,775	4,410	5,770
Total	6,859	11,765	14,475	16,631	17,600	17,580	18,210
Domestic demand in % of capacity	88.2	69.2	75.4	92.3	77.6	56.2	53.0

Source: MCI, EPB.

3.03 The Fifth Five Year Investment Plan indicates that the installed capacity will reach 30.5 million tons by 1986, a 30% increase over the capacity at the end of 1981. Domestic consumption is forecast at 26 million tons on the basis of an 8.2% annual increase from a 15 million tons level. The forecasts have not been adjusted as a result of the unusually low

domestic demand experienced in 1981. At present, however, only 1.35 million tons capacity increase is underway (a new one mt plant is under construction on the east coast and a plant in the Jecheon area is being modernized for .35 million tons); and it is likely that the industry will defer further capacity increases until clear signs of demand materialize.

3.04 The cement industry with its capital intensiveness cannot readily adapt to wide fluctuations in demand. Rapidly increasing demand in the early 1970's led to a doubling of capacity between 1971 and 1976. However, in 1976 domestic demand amounted to only 69% of installed capacity versus over 88% in 1971. As a result, in 1976, the cement industry formed a cartel for the distribution of cement in Korea. The cartel fixes the price, which is uniform throughout Korea. In December 1980, the Government introduced the "Monopoly Regulation and Fair Trade Law" which among other things set the stage for dismantling the cement cartel. The enforcement decree of April 1, 1981 (Presidential Decree 10267) states that "collaborative activity to overcome depression" shall only be allowed for one year periods at a time after which the situation will be reviewed by Government. In accordance with the above law, the cement cartel was legally abolished in May 1982. Under the enforcement decree, EPB has granted the cement companies a one-year exension of cartel-like arrangements, in view of the very depressed state of the industry. It has also set the following guidelines upon which such one-year exensions might be granted in the future: when domestic demand falls below 80% of capacity, production, shipment, and sales territory arrangements may be permitted and when domestic demand falls below 70% of capacity price arrangements may be permitted.

B. Cement Distribution - Issues and Objectives

3.05 The distribution of cement is fairly complex. The product moves from production plants in three forms: clinker, bulk and bagged cement. Clinker and some bulk cement go through branch plants for further processing, storage and some bagging while the rest of bulk cement and bagged cement go directly to final consumption areas. The total amount transported is thus greater than the total consumed. In 1981, transported tons were about 28% more than domestically consumed tons. Each of the three subproducts are transported by rail, road and coastal shipping. Table 3.2 below summarizes the modal allocation by subproducts.

Table 3.2: 1981 CEMENT TRANSPORT BY MODES
(million tons)

Product	Total	Rail	Road	Coastal shipping	Ocean shipping (export)
Clinker ex-factory	3.87	1.34	-	-	2.53
Bulk Cement					
Ex-factory	5.90	2.90/a	0.86	2.06	1.20
Ex-branch plant	2.32	-	2.32	-	-
Subtotal	8.22	2.90	3.18	2.06	1.20
Bagged Cement					
Ex-factory	8.44	3.98	2.00	0.42	2.04
Ex-branch plant	2.73	0.14	2.36	0.23	-
Subtotal	11.17	4.12	4.36	0.65	2.04
Total	23.26	8.36	7.54	2.71	5.77
Modal Shares					
% of domestic transport by modes (excluding exports)		45	40	15	
Of which ex-factory	18.21	8.22	2.86	2.48	5.77
% of domestic transport by modes		61	21	18	

/a Includes 1.12 million tons moving 12 km from plant to port for coastal shipping and exports.

Source: MCI.

3.06 As seen in Table 3.2, rail is the main mode of transport for cement, accounting for over 60% of the products ex-factory. In 1981 cement accounted for 17% of KNR's traffic in ton-km. Road transport, however, plays the main role in distribution from branch plants (93% of the indirect tonnage). The modal allocation reflects the advantages of the various modes, with rail and coastal shipping carrying long distance clinker and

bulk cement, while road transport plays a larger role in ex-factory transport of bagged cement as well as in final distribution from branch plants. The average transport distance of cement is around 325 km for coastal shipping, 210 km by rail and 75 km by road.

3.07 Cement consumption is concentrated in the large urban centers. In 1981, the Seoul-Incheon metropolitan area accounted for 45% of domestic consumption, the next four largest cities of Busan, Daegu, Daejon and Gwangju together consumed 35% of the total, and the rest of the country only 20%. The location of branch plants reflect the concentration of consumption, with 80% of them located in the large cities.

3.08 The main issue in cement distribution is the relatively low proportion of bulk handling which is more efficient than bags. Bulk distribution offers substantial cost savings in handling and transport, the latter due to faster turnover of equipment. It also saves the cost of bags and bagging. While some move toward more bulk transport has occurred in recent years, as shown below, the share of bulk is still far from the proportion common in industrialized countries, namely 75% to 80%.

Bulk Cement Transport in Korea

	Ex-factory	To final consumer
	in % of total	
1978	40	20
1981	49	27

The reasons for this relatively low proportion of bulk distribution are:

(a) shortage of bulk cement rail cars;

(b) same rail tariffs for bulk and bagged cement; and

(c) restrictions on expansion and development of ready-mix concrete (Remicon) installations.

3.09 The proposed project addresses all these points and the proportion of bulk transport is expected to increase gradually. Rail cars will be financed by the project and bulk and bagged tariffs will be differentiated (para. 6.05); the cement industry has plans to install new silos, including at the Bugog Terminal, which is a part of the proposed project. Regarding installation of Remicon plants, the land use planning regulations were amended at the end of 1981 and no further restrictions exist.

IV. THE PROJECT

A. Objectives

4.01 The objectives of the proposed project are: (a) to provide the necessary capacity in rail, ports and inland terminals to efficiently handle the forecast coal and cement traffic through the 1980s; and (b) address system inefficiencies in coal and cement distribution. The main system inefficiencies described in paras. 2.12 for coal and 3.08 for cement are: (a) for coal: the complexity of the distribution system due to the fragmented coal mining and briquette industries; and (b) for cement: the large proportion of cement still transported and distributed in bags rather than in bulk.

B. Project Description

4.02 The project would consist of:

(a) Investments to increase capacity in:

(i) specialized intermodal freight terminals for coal and cement;

(ii) railways and ports infrastructure at Incheon and Ulsan; and

(iii) specialized cars for coal and cement transport.

(b) Measures to address system inefficiencies

(i) policy measures regarding transport pricing of anthracite and bituminous coal and of bulk and bagged cement. These are discussed in Chapter VI;

(ii) operational improvements in train operations and locomotive utilization;

(iii) operational improvements in the two project ports; and

(iv) studies, technical assistance, and training.

A detailed project description is given in Annexes 4.1 and 4.2.

Intermodal Terminals

4.03 Both coal and cement are heavy commodities transported in large quantities over fairly long distances in Korea. The small size of many

users, however, does not generally justify the cost of private rail sidings. Therefore, the delivery of smaller volumes is better handled by truck, which calls for adequate intermodal terminals. Two are envisaged in the Seoul area: Bugog to the south and, later, Seongbug to the northeast. Bugog will have a capacity of 10 million tons per year, and civil works have started, financed under KNR's budget. The Bugog terminal will be completed during the project period and rails and ties will be financed by the proposed loan; equipment for coal handling and for signalling will be financed from the Government budget and cofinancing.

4.04 The Bugog terminal will provide intermodal services for coal and cement. In the coal area, land has been reserved for the future installation of briquette manufacturing plants, some of which would be relocated from their present sites in downtown Seoul, thereby reducing urban pollution and pursuing consolidation of the industry. Land has also been reserved for building cement silos. Part of the terminal will also be used for intermodal transfer of containers in order to combine the advantage of lower costs for rail transport between the Seoul area and Busan and the flexibility of door to door pick-up and delivery by truck. The project will provide an ample paved storage area and the container handling equipment will be purchased by the operating company. The Government confirmed at negotiations that land rights for the installation of briquette factories and for construction of cement silos will be granted not later than January 1, 1984 (para. 7.01).

4.05 At negotiations the Government confirmed also, that it would provide the Bank not later than thirty days after loan effectiveness with timetables for completion by December 31, 1986 of (a) the Bugog terminal including the access road; (b) the Incheon and Ulsan port coal terminals; and (c) the widening of the Su-In line.

Investments in Railways and Ports Infrastructure, and Specialized Cars

4.06 Railway investments would increase carrying capacity and reduce overall transportation costs on the lines carrying the main coal and cement traffic (Tables 5.5 and 5.7). They comprise: the electrification of a 64 km section of the Jung Ang line, the upgrading of the signalling on 126.8 km of the Taebaeg line, the widening of the Su In line (53.2 km) from narrow to standard gauge together with the building of a 10 km section to reconnect it to Incheon port, and the acquisition of specialized rolling stock: 261 coal and 320 cement tank cars. Details are given in Annex 4.1.

4.07 Due to their proximity to consumption areas, the ports of Incheon, Ulsan, Mogpo and Bugpyeong were selected to handle imported coal traffic for household and industrial uses other than those of the steel mill or large power plants which have their own ports. New terminals are needed at these ports to handle the expected coal traffic. Only the terminals at Incheon and Ulsan are included in this project, the other two ports will be developed later since they are less urgent. Civil works construction at these are

presently designed to handle 4.5 and 3 million tons per year respectively. These capacities could be increased later should the traffic warrant it. Details are given in Annex 4.2.

Operational Improvements

4.08 One of the objectives of this project is to further improve the already good operational performance of KNR in transporting coal and cement. To this end, specialized coal cars will be procured including a trial order of side-dumper cars, a technological improvement to be used for the first time in Korea. Also, more cement tank cars will be added to the fleet, to increase the percentage of cement transported in bulk. By speeding up loading and unloading operations, and by making more use of these specialized cars in unit trains, the turnaround time and resulting transportation costs will decrease.

4.09 During the preparation of the project, the utilization of KNR's locomotives was analyzed in detail. In general, both the availability and the utilization of the locomotives are better than in most railways in the world. Availability is in the 88-90% range for both diesel and electric locomotives. Diesels run a high average of 156,000 km per year while electrics run between 117,000 and 120,000 km per year, still a good performance. However, the electrics are less utilized than the diesels, because the fleet is large in relation to the length of the electrified network (90 units for 429 km). During discussions with KNR, the conclusion was reached that, provided lighter passenger trains presently hauled by electric locomotives are hauled by smaller diesel units, the present fleet of electric locomotives would be adequate to haul all of KNR's freight traffic on the extended electrified network, including the additional 64 km of the Jung Ang line to be electrified under the project. Since light passenger trains would be hauled by medium power diesels and heavy freight trains by high power electrics, a better use would be made of the motive power available. The more efficient use of existing motive power will lead to substantial cost savings. Furthermore, only five diesels will be needed after 1986 to cope with the expected traffic increase, instead of 13 should the Jung Ang line not be electrified.

4.10 Another objective of this project is to improve the operational performance of KMPA in handling coal in the ports of Incheon and Ulsan. Towards this end, a coal terminal is already under construction at each port. Specialized equipment such as unloaders, conveyor belts, stackers, and reclaimers will be procured. This will result in speeding up coal unloading operations and in lowering port costs.

Studies, Technical Assistance and Training

4.11 These include:

(a) Consulting services to assist KMPA in preparing technical specifications and tender documents for items to be procured under ICB;

(b) Training of KMPA personnel in operation and maintenance of coal terminals; and

(c) Seoul metropolitan region (Gyeonggi-do) integrated transport study;

Study (c) is not related to this project, but is part of a set of sector studies aimed at preparing future developments of the Korean transport system (Annex 4.3).

C. Cost Estimates

4.12 The total cost of the project is estimated at W 357.2 billion (US$479.4 million equivalent) of which the foreign exchange is estimated to be about 50% or about US$242 million. Taxes and duties are about 10% of total project cost. The cost of civil works is based on final engineering. Unit prices of equipment are in line with prices experienced by KNR and KMPA in recent procurement and consistent with prices for similar items procured under Bank loans. Physical contingencies of 5% are included for all items except rolling stock, maintenance equipment, ports equipment, studies and technical assistance. Annual price escalation rates were applied to local and foreign costs in accordance with Bank guidelines, as follows: 8% in 1983, 7.5% in 1984, 7% in 1985 and 6% in 1986. An exchange rate of Won 745 to the US dollar was used for the calculation of the US dollar equivalent costs.

4.13 The total cost of providing 19 man-months of consultant time to KMPA for assistance in procurement and layout design for the coal terminals is estimated at about US$326,000 of which US$228,000 is foreign exchange. The average man-month cost including salary, international travel, subsistence and overhead would be about US$12,000. In addition, $58,000 would be earmarked for training KMPA personnel abroad.

4.14 Summary project cost estimates are as follows (detailed estimates are given in Table 4.1):

SUMMARY OF PROJECT COSTS
(March 1983 prices)

	Project years 1983-86 /a							
	Local	Foreign	Total	Local	Foreign	Total	% Foreign Exchange	% of Base Cost
	(Won million)			(US$'000) /a				
Project Components								
Railways	83,499	74,612	158,111	112,080	100,149	212,229	47	51
Intermodal Terminals	42,696	20,130	62,826	57,310	27,020	84,330	32	21
Port Terminals	26,760	60,796	87,556	35,919	81,605	117,524	69	28
Studies	0	447	447	0	600	600	100	0
Technical Assistance	73	213	286	98	286	384	74	0
Total Base Cost (March 1983 prices)	153,028	156,198	309,226	205,407	209,660	415,067	51	100
Physical Contingencies /b	2,987	2,051	5,038	4,009	2,752	6,761	41	
Price Contingencies /c	20,937	21,739	42,676	28,103	29,180	57,283	51	
Total Project Cost	176,952	179,988	356,940	237,519	241,592	479,111 /d	50	
Front-end Fee on Bank Loan	0	227	227	0	304	304	100	
Total Financing Required	176,952	180,215	357,167	237,519	241,896	479,415	50	

/a Exchange rate: US$1 = Won 745.
/b Physical contingencies of 5% are included for all items except rolling stock, maintenance equipment, ports equipment, studies and technical assistance.
/c Price contingencies are: 8% in 1983, 7.5% in 1984, 7% in 1985, and 6% in 1986.
/d Taxes and duties amount to about $47.9 million.

D. Financing

4.15 The total cost of the project is estimated at US$497.4 million with a foreign exchange component of US$241.9 million. It will be financed in part by Government budget allocations to KNR and KMPA. The proposed Bank loan will contribute US$122.0 million equivalent toward the foreign exchange cost (Table 4.2). Cofinancing is being arranged for the balance but will not be needed before end 1984. The proposed Bank loan would be used for financing (a) part of the foreign component of the project's railway component; (b) a share of the ports component; and (c) studies, technical assistance and training. The cofinanced borrowing would be applied to the Ports components including the financing of any contingencies. Assurances on this were obtained during negotiations (para. 7.01). The front-end fee of about US$0.3 million (W 2 million equivalent) would be financed from the Bank loan and is included in the loan amount.

Terms of Loans

4.16 GOK will repay the Bank loan over a 15-year period including an initial three-year grace period at the standard variable interest rate. It is proposed that a portion of the Bank loan will be onlent to each KNR and KMPA, through subsidiary loan agreements at the same interest rate and terms as the Bank loan. KNR and KMPA will bear the foreign exchange risk for their respective shares of the loan. Government will pass on the responsibility for repayment of the front-end fee to KNR and KMPA for their respective portions of the loan. These transactions will be covered under subsidiary loan agreements, the signing of which would be conditions of loan effectiveness (para. 7.01). These arrangements were confirmed during negotiations.

E. Implementation

4.17 To coordinate the goals and actions of the various government agencies and private firms concerned, the Government established a Project Coordinating Committee comprising all parties interested in the project. Under the chairmanship of the Director General for Transport Coordination, MOT, members of the Committee represent MOT, MOF, EPB, MCI, MOER, KNR and KMPA. The role of the Committee is only consultative, but its recommendations carry weight since the most influential ministries and Government agencies are represented. Assurances were obtained at negotiations that the Committee would meet at least four times a year (para. 7.01).

4.18 The Coordinating Committee took an active part in the last phase of the preparation of this project and was instrumental in ironing out differences of opinion between some agencies involved. During implementation of the project, its role will be equally important. To help the Chairman of the Coordinating Committee, a Project Administrator has been

hired. He is a Korean civil servant whose qualifications, experience, and terms of reference are acceptable to the Bank. The Project Administrator will be supported in day to day project administration by an assistant assigned full time to the Project. Agreement on this was confirmed at negotiations (para. 7.01). The Project Administrator participated in negotiations.

4.19 The project will be implemented by KNR for the railway related components, and by KMPA for the port related components. Under its present status KNR is vested with powers and a degree of financial freedom which allows it to conduct its operations in a satisfactory manner. Further legal powers and financial freedom will be needed for improving KNR's efficiency. KNR will be given such powers by January 1, 1987 under the Seventh Railway Project (Loan 1836-KO). KMPA does not enjoy the same degree of freedom, a situation which adversely affects its productivity and related financial performance. To improve the latter it was agreed at negotiations that GOK would not later than January 1, 1986 vest KMPA with legal autonomy needed for (a) incurring debt; (b) prepare and submit its budgets and accounts in a commercial form; (c) have reasonable flexibility in adjusting approved operating budgets to meet cost changes resulting from unexpected fluctuations in port traffic; and (d) open an account with the Bank of Korea for revenue receipts and payment of obligations (para. 7.01).

4.20 The Coordinating Committee would be responsible for coordination between them and other ministries involved (mainly MOER and MCI). Both KNR and KMPA have enough competent staff to ensure that the project is implemented correctly and on time. Some external specialized technical assistance to KMPA would be required for drafting technical specifications for the coal handling equipment to be acquired, to assist during the procurement process, and for training port staff in coal handling. Assurances for this were obtained at negotiations (para. 7.01).

F. Procurement

4.21 All civil works contracts are or will be awarded by KNR and KMPA in accordance with the country's procurement procedures which are satisfactory. Civil works will not be financed by the Bank. Equipment items to be procured under the loan and estimated to cost about US$103.2 million without contingencies, will be subject to International Competitive Bidding (ICB), in accordance with Bank guidelines. For bid evaluation, Korean manufacturers will be allowed a preferential margin of 15% of CIF costs of competing imports or the relevant prevailing level of customs duties, whichever is lower. For non-Bank financed items, the Government's or cofinancing entities' procurement procedures will apply.

4.22 The various components of the port coal handling equipment must be integrated and will therefore be procured under two tenders, one for each port. The Ports equipment will be partially financed by the proposed loan, the rest by cofinancing.

4.23 Technical assistance to KMPA for the drafting of technical specifications and preparation of tender documents for coal handling equipment will be selected on the basis of a short list with terms of reference agreed with the Bank. Training of personnel in coal terminal operations outside Korea will be arranged by the Government. The foreign cost of this training will be covered by the loan.

G. Disbursement

4.24 Disbursements will be made on the following basis:

(a) 100% of foreign expenditures for directly imported equipment and materials for the railways, and 100% for directly imported equipment and materials for the ports;

(b) 100% of local expenditures (ex-factory price) for locally manufactured equipment and materials for the railways and 100% of local expenditures (ex-factory price) for locally manufactured equipment and materials for the ports;

(c) 100% of the costs of foreign and local consulting services; and

(d) 100% of the cost of overseas training.

4.25 Bank disbursements are expected to be completed by June 1987. An estimated quarterly schedule of disbursements is given in Table 4.3. The disbursement schedule is based on project implementation schedules with provision for minor delays. The disbursement profile is similar to that for previous projects in Korea.

H. Environment

4.26 No negative impact on the environment is anticipated from the project. The inland transport of large amounts of imported coal by rail will prevent the pollution that would result from moving such quantities by road, particularly through the large Seoul-Incheon metropolitan area. Also, the establishment of briquette factories in Bugog will help reduce the pollution in the Seoul metropolitan area. The electrification of the 64 km section of the Jung Ang line will reduce pollution in the area.

V. ECONOMIC EVALUATION

A. Main Benefits and Beneficiaries

5.01 The project would help improve the efficiency with which coal and cement are transported and distributed in Korea. It would also contribute to the effort made by Korea in diversifying its energy sources i.e., substituting coal for oil. Port facilities, inland terminals and the railway lines connecting them have to be developed or upgraded to cope with this new coal traffic. Each ton of imported bituminous coal can substitute for about 2/3 of a ton of fuel oil. At 1982 CIF Korea prices of US$70 per ton for coal and US$207 per ton for fuel oil, each ton of bituminous coal used represents savings of about US$70. Imports of bituminous coal through the ports of Incheon and Ulsan, included in this project, are forecast at 2.6 million tons in 1986 and 6.1 million tons in 1991. The foreign exchange cost savings for the year 1986 alone would be almost US$180 million. While other investments are needed to convert industrial boilers from oil to coal, the annual savings are indeed large in relation to the investment costs in transport and industry. Studies made by MOER and the cement industry indicate that the cost of conversion to coal can be recouped within 2-3 years.

5.02 Besides its contribution to a reduced energy import bill for Korea, the project will also help increase productivity in the distribution of two widely consumed commodities, domestic coal and cement. Over 85% of domestic anthracite goes to make briquettes, the primary energy source of urban and rural lower income households. Transport cost accounts for 15-20% of total briquette cost. The project would thus assist Government in its constant endeavor to keep briquette prices as low as possible. Similarly, cement is a component of most projects and any cost savings in distribution will be reflected throughout the economy.

5.03 Of the total project cost, roughly 57% will go to investments necessary to handle imported bituminous coal, while the remainder will go to improve the distribution of domestic coal and cement. Included in the latter is the Bugog terminal, which will serve both domestic and imported coal, cement and also container traffic. The detailed economic analysis of the major project components is given below. Some project components are closely interrelated and can only be analyzed jointly since the benefits would not occur if only some of the components were implemented.

B. Investments Related to Imported Coal

5.04 These investments include the coal facilities at the ports of Incheon and Ulsan, the widening of the Su-In line and its connection to Incheon, and part of the Bugog terminal. The coal traffic forecast through the two ports and the allocation by mode for inland distribution from the

ports are given in Table 5.1; the detailed traffic forecast for anthracite and bituminous coal on the Su-In line, is given in Table 5.2. The coal arriving in Incheon will generally be used in the Seoul-Daejon area and that arriving in Ulsan in the southeastern industrial area. The exception is the bituminous coal for the cement plants of the Jecheon area (Map IBRD 16509) which will arrive through both Incheon (2/3), and Ulsan (1/3). Using Incheon and the Su-In line is very attractive, as domestic coal cars coming from the mining areas to Seoul will obtain a return load of imported bituminous coal instead of returning empty as at present (Annex 4.1 para. 9).

5.05 Incheon Port and Su-In Line. The port of Incheon is presently not equipped to receive large quantities of coal and ad hoc lighterage has been used since anthracite imports began in 1978. The process is very cumbersome and expensive. Ships anchored outside the port unload their cargoes with their own gear into lighters, which then have to be unloaded on a wharf, where storage is done by trucks and bulldozers. Coal is then reloaded on trucks for distribution within the metropolitan area. Trucks also bring coal for longer distance transport to the Incheon rail station. This multiple handling is not only costly but highly polluting in dense urban areas. The proposed coal terminal would be able to receive efficient size coal carriers namely 100,000 DWT ships versus 25,000 DWT without the project; it would also have proper stacking/reclaiming of coal and loading into rail cars for direct transport to Bugog and the Jecheon area via the widened Su-In line. The coal pier and its rail connection to KNR's network the Su-In line - form a whole which can only be analyzed jointly. Benefits in terms of transport and handling cost savings, including shiptime savings, would yield an ERR of 22% (Table 5.3). As the anthracite traffic is expected to decrease somewhat between now and 1986, and the cement plants are virtually converted to coal already, the only uncertainty on the benefit side is the forecast bituminous coal traffic for other industrial users. Assuming that only 50% of that forecast traffic occurs, the ERR would fall to 18%. On the cost side, a 20% increase would reduce the ERR to 19%.

5.06 Ulsan Port. The present situation is similar to that of Incheon. The same type of benefits as above yield a return of 28% (Table 5.4). Again assuming that only 50% of the bituminous coal traffic to industrial users other than the cement plants materialize, the ERR would fall to 18%, while a 20% cost increase would reduce the ERR to 25%.

C. Investments Related to Domestic Coal and Cement

5.07 Tae-Baeg Line Signalling and Coal Cars. This is the direct line between the Seoul area and the major Korean coal fields. The line also carries some cement from the east coast, and the first section east of Jecheon, the cement from two of the five plants in the area. The remaining

three plants are on the section of the Jung-Ang line proposed for electrification and discussed below. Traffic forecasts on the line are given by commodity and by section in Table 5.5. In 1981, freight traffic on various sections ranged from 6.5 million tons (86% coal) to 11.5 million tons (60% coal, 23% cement); and passenger traffic from 1.0 to 1.4 million passengers. Beyond the first section to the cement plants, the line is in very mountainous terrain and approaching capacity. Centralized Traffic Control (CTC), which exists from Seoul to Jecheon, would be extended to the Tae Baeg Line. The central control of the entire line would remove capacity bottlenecks for the traffic forecast until 1991, by increasing line capacity by some 15 to 20%. This would enable the line to carry just under 1 million ton more coal than now. To carry this coal will also require additional coal cars. No other transport alternatives exist; and to develop any would be much more costly than the proposed project. The next best alternative would then be to substitute imported anthracite for domestic coal which could not be transported and therefore not produced. At present, the cost of domestic coal is estimated at US$57 per ton including subsidies and quality differential and that of imported anthracite at US$66 per ton (US$60 CIF plus US$6 distribution costs). The project would also enable transport of more cement both from the east coast and from plants in the Jecheon area. The benefits of the project in terms of coal import cost savings and cement transport cost savings yield a rate of return of 25% (Table 5.6). Increases in either the coal traffic or in the cement traffic could be nil, or costs could triple before the ERR would fall below 10%. The coal import cost savings have been assumed to decrease by 50% between 1986 and 1996, to reflect the expected cost increase in real terms of coal mining in Korea.

5.08 Jung-Ang Line Electrification. In 1981, traffic on this 64 km section of the Jung Ang Line proposed for electrification ranged from 6 to 7 million tons (coal 35%, cement 40%), and passenger traffic was about 2 million. Traffic forecasts are given in Table 5.7. Electrification would permit improved utilization of electric locomotives presently in service on the western section of the line and the Tae-Baeg line. It would also generate energy cost savings, and maintenance and labor cost savings. These benefits would yield an ERR of 22% (Table 5.8). The high rate of return is due in part to the better utilization of existing electric locomotives. Other benefits could jointly decrease by 50%, or costs could increase by 50% before the ERR would fall below 10%.

5.09 Cement Tank Cars. The utilization of cement tank cars is much better than that of box cars which transport cement in bags. Due to the difference in turnaround time (Annex 4.1 para. 12), the capital cost of box cars that would be needed to transport the same amount of cement as the proposed tank cars would be W2 billion (US$2.7 million) more than thee cost of tank cars (Table 5.9). Furthermore, tank cars provide for further savings in loading and unloading. Including the cost of silos necessary to implement the conversion to bulk transport, the ERR is estimated at 68%. This ERR does not depend upon cement traffic growth since the project applies to a fraction of existing cement traffic only.

D. Overall Evaluation and Risks

5.10 When the costs and benefits of all the above elements are combined, adding also the costs of the two multi-purpose, multi-modal terminals fo Bugog and Seongbug, and some track maintenance equipment, the overall ERR of the project is 19% (Table 5.10). These terminals are linked with the various project components analyzed above and no further benefits are assigned to them separately. Also, this overall return this does not include benefits from improved container transport made possible by the Bugog terminal.

5.11 All project components involve proven technology that has been in extended use in Korea and other parts of the world; technological risks connected with the project are therefore small. In addition, training is provided under the project for KMPA personnel involved in operating the new coal handling equipment. The sensitivity of project component returns has been described in the respective component analysis above and the risk is very low that the rate of return would fall below 10% for any component and even lower for the project as a whole.

VI. FINANCES

A. Background

6.01 Implementation of the proposed project is expected to allow KNR and KMPA to meet anticipated increases in demand for transporting imported and locally mined coal and locally produced cement. The objective of the financial analysis is to define conditions under which transport of these two components will help improve KNR´s and KMPA´s overall financial situation. The analysis covers the following: (a) KNR´s overall financial situation; (b) cost coverage of coal and cement, rail tariffs; and (c) conditions under which Incheon and Ulsan ports´ new coal terminals will generate a profit for KMPA.

B. KNR´s Financial Situation

6.02 Despite KNR´s high technical efficiency, its financial performance has steadily deteriorated since 1979. This is because KNR´s gross operating revenue declined in real terms due to the stagnation of traffic resulting from the overall economic situation while operating costs remained virtually steady. The main financial problem of KNR is the very large losses incurred on ordinary passenger trains and to a lesser extent on commuters (in Korea commuters refer to season ticket holders rather than to urban trips). These losses amounted to W 66 billion (US$90 million) in 1981, compared with a total net deficit of W 62.9 billion meaning that KNR would have generated a net profit if it had been allowed to charge cost based tariffs on this

traffic. The same situation is expected to occur in 1982. The reason for such losses is the very low tariff applied to ordinary train passengers: 6.30 W/km in relation to total costs of 17.6 W/km in 1981. In comparison, ordinary bus fares were about 12 W/km. In the past, losses incurred on ordinary trains and commuter traffic were to a substantial extent offset by profits generated by express trains. However, this is no longer true due to the adverse effect of traffic stagnation on express trains' profits. As a result KNR has not been able to meet the rate of return covenant of Loan 1836-KO (Seventh Railway Project).

6.03 Another problem is KNR's heavy debt service, and in particular interest payments. As freight tariffs were historically well below cost and ordinary train tariffs remained at only one-third of costs, KNR could not, in the past, generate enough funds internally to finance the investments needed for modernization and expansion. In recent years, investments financed through loans were made to accommodate traffic expected to continue growing at the rates experienced in the late 1970s. Traffic, however, has stagnated and KNR is now committed to cover the related debt service while its revenue anticipation did not materialize. As a result, KNR's short-term (less than one year) payables as of December 31, 1982 exceeded liquid assets (cash plus receivables) by W 105 billion of which W 67 billion in loan maturities. The ratio of current assets to current liabilities by the same date reached 0.3 instead of the 1.5 objective provided for under Section 3.05 of the Loan Agreement 1836-KO (Seventh Railway Project).

6.04 In our ongoing dialogue with the Government, we have been discussing ways and means to improve KNR's financial situation. In particular, in November 1982, we suggested that the Government take action among the following remedial measures:

(a) selective tariff increases comprising measures proposed in paras. 6.04 and 6.05;

(b) compensation for losses on social services (ordinary passengers and commuters);

(c) adjustment of the original 1982-86 investment plan to fit the anticipated reduction in traffic demand; and

(d) easing of the debt service obligation of KNR through Government subsidies.

6.05 On December 15, 1982, Government increased rail tariffs by 4.5% for passengers and 6.6% for freight. This is on top of the 4.7% for passengers and 5% for freight applied in July 1982. In February 1983, the Government also submitted a 1983-86 financial plan for KNR based on guidelines from EPB's budget bureau dealing with the above four matters and KNR's proposal for reducing costs. Details of the guidelines and the cost reduction plan are given in the project file.

KNR's Financial Objectives 1983-88

6.06 The major objective of the plan is to gradually reduce subsidies against operating losses, with a view to discontinue them by 1986. The plan would lead to rates of return on average net fixed assets of 2% in 1983 growing to 5% in 1986 and 6% by 1988; the latter being the original objective Section 4.08 of of Loan 1836-KO (Seventh Railway Project) for 1983. These rates of return would be achieved by the following measures:

(a) selective annual increases in passenger and freight tariffs averaging 1% p.a. in real terms;

(b) progressive application of cost-based tariffs especially for coal and cement (paras. 6.09-6.12);

(c) reductions and postponements in the investment program amounting to 35% of the investments included in the original Fifth Five Year Plan (1982-86); these include reductions in motive power and rolling stocks and postponement of a major signalling investment on the Seoul-Busan line pending results of a feasibility study in this corridor; and

(d) improvement of KNR's efficiency by management actions such as: stringent control over increase in staff; discontinuation of certain uneconomic lines, stations and training; disposal of subsidiary activities; and technical innovations.

6.07 On the basis of the above measures and agreed reduced traffic forecasts, KNR's summarized financial statements over 1982-91 have been prepared as shown in Tables 6.1 to 6.4. While reaching the rates of return given above, KNR would only generate a net profit for 1986. Even in that year it would need cash subsidies to cover its debt service. KNR's working capital would improve from a negative W 93 billion at the end of 1982 to 0 by the end of 1986 and reach a positive W 95 billion by the end of 1988. This would also be the first year at the end of which KNR could reach the 1.5 ratio of current assets to current liabilities it was to achieve by December 31, 1983 under the provision of Section 4.05 of Loan Agreement 1836-KO.

6.08 Agreement between the Government and the Bank on a revision of the financial objectives of Loan 1836-KO along the above lines was reached at negotiations. The revised targets are reflected in the related covenants of the proposed Loan Agreement (para. 7.01). In addition assurances were obtained at negotiations that the Government would agree with the Bank before undertaking major new railway investments (para. 7.01).

C. Coal and Cement Rail Tariffs

6.09 Rail freight tariffs in general and those for coal and cement in particular were historically much below costs. Covenants of successive Bank

railway projects emphasized the need to increase freight tariffs in real terms. This has been done and the following table shows freight tariffs were increased by 42% in real terms between January 1976 and July 1982.

Consumer price index increase			Freight Tariff Increase		
Dates	%	Indices	Dates	%	Indices
Mid 1975		100			100
" 1980	29.5	221	Jan 80	20.0	230
			Aug 80	25.0	288
" 1981	23.3	273	June 81	22.0	352
Dec 1981	3.2	282	Dec 81	12.0	394
July 1982	3.2	292	July 82	4.8	413
			Dec 82	7.0	442

Source: IMF, International Financial Statistics for CPI, and KNR.

6.10 Coal tariffs which were lower than other tariffs were raised 55% in 1981. As a result of these increases, both coal and cement tariffs covered 110% of operating costs (including depreciation) and 95% of total costs (including debt service) as of December 31, 1981. In 1982 the Government increased freight tariffs by 4.7% as of July 1 and by an additional 6% (6% for anthracite coal) effective December 15. The following table shows end 1982 costs and revenues per ton kilometer for anthracite, bituminous coal and cement based on KNR's preliminary results for 1982.

	Won				
	Operating cost	Total cost	Tariff	Net operating revenue	Net revenue (loss)
Coal:anthracite	15.44	18.66	18.24	2.80	(0.42)
Coal:bituminous	15.44	18.66	18.34	2.90	(0.32)
Cement	16.05	19.37	18.15	2.10	(1.22)

6.11 Coal and cement tariffs as of December 31, 1982 covered operating costs but only 98% and 94% of full cost respectively. At negotiations it was agreed that the full cost coverage will be reached by July 1, 1984 for coal and by January 1, 1985 for cement and maintained thereafter (para. 7.01). Under present cost projections, coal tariffs as of December 31, 1982 would have to be increased by 14% (i.e. 4.5% every 6 months starting July 1, 1983) and cement tariffs by 24% (i.e. 5.5% every 6 months starting July 1, 1983). These increases include inflation projected at 5% per annum. They will most likely be lessened as a result of the decrease in KNR's operating cost which can be anticipated following the recent worldwide decrease in petroleum product prices.

6.12 KNR applies identical rates for transporting bagged and bulk cement although costs for transporting bagged cement are higher than for bulk (para. 3.08), because the turnaround time for box cars used for carrying bagged cement is longer than for bulk cement tank cars. In addition to preventing KNR from incurring losses on transport of bagged cement, the introduction of a new full cost covering rate for bagged cement would induce the cement industry to increase the more economic transport in bulk. The measure should consequently be applied as soon as KNR has the cement tank cars required to meet demand. Agreement that the measure will be implemented by January 1, 1985 was reached at negotiations (para. 7.01). The new tariff will cover full costs as its implementation will coincide with the agreed date for such coverage.

D. Coal Terminals in Ports

6.13 KMPA does not intend to operate the Incheon and Ulsan ports coal terminals itself but to lease them to third parties who will operate them on its behalf. While no final decision has been taken, it is likely that each terminal will be leased to a Terminal Operating Company (TOC). Each TOC would be established under terms and conditions similar to those agreed under the Second Ports Project (Loan 1401-KO) for the port of Busan. Agreement on this or on alternative arrangements for operating the terminals should be reached at negotiations (para. 7.01).

6.14 Detailed calculations available in the project file show that if KMPA had operated the Incheon and Ulsan terminals on its own, the terminals would have had to generate rates of return on average net fixed assets in use revalued annually of 5% and 8%, respectively, to meet their need for funds in 1986 (the first year of operation), and generate adequate profits thereafter. KMPA should charge annually the future operators (a) the above rates of return; (b) rental fees equivalent at least to the annual provision for depreciation of the terminals' assets, including annual additions, revalued annually and (c) administrative costs incurred by KMPA for supervising the activities of the TOC's. Detailed calculations of the fees to be paid by the Incheon and Ulsan TOC's (or alternative operating units) under

these conditions are given in Tables 6.6 (Incheon) and 6.8 (Ulsan). Agreement on the method of calculating these fees should be reached at negotiations. This agreement should necessarily cover the above-mentioned rates of return on average net fixed assets in use (para. 7.01).

6.15 Tables 6.7 (Incheon) and 6.9 (Ulsan) show projected income statements and sources and applications of funds for each of the terminals assuming that (a) each TOC (or alternative operator) would pay KMPA the fees calculated as above, and (b) KMPA would finance from these fees annual renewals or additional assets and service debts contracted for building/acquiring assets. The tables show that KMPA would earn a substantial net profit of Won 5 billion ($6.7 million equivalent) and W 8.2 billion ($11 million equivalent) in cash on the leasing of the Incheon terminal over 1982-86. The leasing of the smaller Ulsan coal terminal would still generate net profits of W 1.3 billion ($2.1 million equivalent) and W 0.6 billion (US$0.8 million equivalent) in cash over the same period. The financial viability of the two terminals is clearly demonstrated by these results.

VII. RECOMMENDATIONS

7.01 During loan negotiations, agreement was reached or assurances obtained on the following:

(a) Conditions of Effectiveness

(i) signing of subsidiary loan agreement between the Borrower and KNR (para. 4.16); and

(ii) signing of subsidiary loan agreement between the Borrower and KMPA (para. 4.16);

(b) Loan Conditions and Agreements

(i) installation of briquette factories in the coal terminal of the Bugog Terminal by the end of 1986 (para. 2.13);

(ii) obtain land rights for the widening of the Su-In Line and for installation of briquette factories and construction of cement silos (para. 2.16 and para. 4.04);

(iii) provide a timetable for completion of works for port coal and the Bugog terminals and for widening of the Su-In line (para. 4.05);

(iv) obtain cofinancing for the port component (para. 4.15);

(v) assure that the Project Coordination Committee meets at least four times a year and employ an assistant for the Project Administrator (para. 4.17 and para. 4.18);

(vi) legal autonomous powers for KMPA (para. 4.19);

(vii) assure that KMPA employs consultants to assist in the design of equipment and for training port staff in coal handling (para. 4.20);

(viii) assure specific financial targets, including rates of return on average net fixed assets in use, for KNR (paras. 6.06 and 6.08);

(ix) Government commitment to agree with the Bank prior to undertaking major new railway investments (para. 6.08);

(x) coal and cement transport tariffs should cover full cost by July 1, 1984 and January 1, 1985 respectively and be maintained at this level thereafter (para. 6.11);

(xi) introduction of separate rail tariffs for bagged and bulk cement transport and timing for implementation thereof (para. 6.12);

(xii) administrative procedures and method for calculating rental fees for operating the Incheon and Ulsan coal terminals (para. 6.13);

(xiii) financial rates of return objectives for Incheon and Ulsan coal terminals (para. 6.14).

With the above assurances and agreements, the proposed project is suitable for a Bank loan of US$122 million for a period of 15 years including 3 years of grace, for onlending to KNR and KMPA on the same terms and conditions; to carry out their respective shares of the project.

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Railway Investments

A. Electrification of the Jecheon Yeongju Section of the Jung Ang Line (64 km)

1. Presently KNR has 428 km of lines (935.5 km of track) electrified, including 98 km of line (316.5 km of track) in the Seoul metropolitan area. The Taebaeg line is electrified from Jecheon to Baegsan (106.7 km), the Jeongdong line from Cheolam to Bugpyeong (62.6 km) and the Jung Ang line form Cheongryangri (Seoul area) to Jecheon (160.1 km). The system used is 25 KV AC, with technology from Europe and Japan.

2. Past electrification programs were justified mainly by the added capacity generated, and to a lesser extent by reduced operating costs. In Korea, as in other countries, locomotive maintenance is cheaper with electrics than with diesels. On the other hand, energy cost savings were minimal in Korea because most of the electricity was produced by oil-fired power units. In recent years, however, nuclear power generation has accounted for a greater percentage of the total and coal fired stations are now being built. This shift in electric generation sources, combined with the increased cost of oil and diesel fuel, results in significant energy cost savings for electric traction compared with diesel traction.

3. The 64 km portion of the Jung Ang line to be electrified under the project has several sections where capacity is becoming a problem. For the level of traffic expected in 1986, line capacity will have to be increased. The mountainous terrain makes it very expensive to double the track, and electrification would provide the needed capacity at lower costs, while also reducing operating costs, and increasing the utilization of the existing electric locomotive fleet.

B. Signalling: CTC on the Taebaeg Line

4. The Taebaeg line has presently a very dense freight and passenger traffic, showing a constant increase over the years. This trend is expected to continue in the future. Signalling is provided by an interlocking system and the main lines in the stations are equipped with track circuits. There are no intermediate signals between stations.

5. To provide the added capacity needed in some sections of the line, Centralized Traffic Control (CTC) is to be installed on 126.8 km of track, between Jecheon and Cheolam. /1 In addition to the increased capacity resulting from a better scheduling of train crossings and from a reduction of time lost during meets, CTC allows trains to be dispatched in sequence, without waiting for completely liberated track. Manpower in stations is also reduced with this improved signalling technique.

C. Su-In Line

6. In the past, the port of Incheon was linked by a narrow gauge rail line to Suweon, about 50 km south-east, on the Seoul-Busan main line. Incheon was also linked to Seoul by a standard gauge line, which was later doubled. Since Seoul is linked to Busan by a standard gauge double track, rail capacity was adequate in this northwestern part of the country and the narrow gauge line Suweon-Incheon (the Su-In line) became redundant. Rails were lifted in the port area and presently only four daily passenger trains are operated between Suweon and Songdo (10 km from Incheon), the end of the line.

7. Over the years, however, traffic built up and urbanization of both Seoul and Incheon increased enormously. In addition to a sizeable freight traffic, the Incheon-Seoul line is saturated with commuter trains which often run at full capacity. The line east of Seoul (the single track Jung Ang line) also carries a very high traffic and is close to saturation. To increase track capacity in the Incheon - Seoul - Jecheon corridor, already electrified and equipped with CTC, double tracking would be needed, at a very high cost.

8. In order to cope with the increased traffic projected for the port of Incheon, and to transport imported coal as a substitute for oil to the cement plants in the Jecheon area, another solution had to be found. First, the whole coal import pattern was examined in order to see whether other ports could relieve Incheon. The result of this study showed that, although Ulsan should contribute, Incheon was the most economical port of entry for

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/1 Cheolam is actually on the Yeongdong line, 4.3 km south of the junction with the Taebaeg line at Baegsan. Cheolam is the main coal forwarding station and the end of the electrified line.

about two thirds of the imported coal due for the Jecheon area cement plants. For the volumes at hand and the transport distance involved, rail is clearly the most economical transport mode.

9. In addition, the Bugog area is being developed and a freight terminal with a capacity of 10 million tons per year is being built. Bugog is located south of Seoul, on the Seoul-Busan main line, and is only 8 km north of Suweon. Bugog is scheduled to be an important destination for both domestic and imported anthracite coal and for some imported bituminous coal for industry. Therefore, a study was made of the feasibility of broadening the Su-In line to standard gauge, reconnecting it to Incheon port where a new coal terminal is being built, and using it for coal traffic to the Jecheon area via Cheonan and Jochiweon. Although this route is longer, the transportation scheme would be attractive because the utilization of the coal cars would be improved. Domestic coal cars coming from the Taebaeg region would be unloaded in the Seoul area (including Bugog) and about 15% of them would travel empty to nearby Incheon, be loaded with imported coal and transport it to the cement plants near the Taebaeg mines. The economic evaluation showed that this scheme was feasible and the Government decided to include the broadening of the Su-In line in its 1982-1986 Five-Year Investment Plan.

10. The new standard gauge Su-In line would follow the existing narrow gauge alignment for most of the distance, except for local realignments justified by the need to provide easier curves for standard gauge rolling stock. A preliminary engineering study completed in December 1981 estimated the cost of this project at W 88.4 billion, including the cost of land and buildings, and the connection to the Incheon coal terminal. Final engineering is presently under way and will be available before negotiations.

D. Specialized Freight Cars

11. As mentioned in paragraphs 3.08 and 5.09, operational and economic reasons indicate that more cement should be transported in bulk in tank cars rather than in bags in box cars. Presently, KNR operates a fleet of 520 cement tank cars, of which 254 are owned by the cement producers. About 38% of the cement transported by KNR is in bulk.

12. Cement tank cars are in great shortage, and all plant managers contacted by the mission complained about this situation. Utilization of the tank cars is extremely good with a turnaround time of only three days, compared with five for box cars which have more time-consuming loading and unloading operations. KNR has therefore decided to progressively increase the percentage of bulk cement transport to 40% in 1982, 43% in 1983, 45% in

1984, 49% in 1985 and 52% in 1986. A total of 320 cars will therefore be purchased under the project at an estimated unit cost of $68,500.

13. For coal, the situation is somewhat similar. Part of it is transported in specialized hopper cars, which provide for speedy unloading when the customers have adequate receiving facilities (elevated tracks and conveyor belt evacuation systems). The rest of the coal is transported in ordinary gondolas, for which the unloading operation is more time-consuming, whether done with mechanical shovels or manually. KNR is progressively increasing its fleet of specialized hopper cars, in line with the provision of more unloading facilities by its customers. A total of 261 coal cars will be purchased under the project, at an estimated unit cost of $66,700.

14. Coal can also be transported in special gondolas equipped with pneumatic cylinders for unloading. Air is provided by the train braking system. With these "side-dumpers", there is no need for elevated tracks at the receiving end so that they can be used almost anywhere. This type of cars has never been used in Korea, but 50 will be purchased under the project, on a trial basis. If they prove successful, more side-dumpers would be purchased toward the end of the project period, instead of hopper cars.

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Port Investments

A. Incheon Port Coal Terminal

1. Incheon, Korea's second largest port after Busan, is situated west of Seoul on the Yellow Sea. This location experiences very high tidal variations, thus the port is divided into a tidal basin with two locks, south harbour and an outer harbour. Most of the berthing facilities are located within the tidal basin which contains 5,420 m of quay capable of berthing 30 ships of sizes ranging between 2,000 to 50,000 DWT. It also contains some wharves with floating ramps for small vessels. The south harbour contains a 300 m wharf which is currently utilized for coal handling from lighters. The outer harbour is mainly used for small vessels. Transit sheds, storage warehouses and open storage areas are adequate. Power, water supply, and waste disposal systems are adequate and so are telecommunications.

2. The tide is semi-diurnal with an average range between mean high and low water of 5.70 meters and a spring tidal range of about 8 meters. The approach consists of two navigable paths, the east channel and the west channel. Both channels can allow ships to pass, with the west channel more favorable for ships as large as 100,000 DWT, during the high water cycle of the tides. Tidal currents in the approach channel reach 2.0 m/sec and a significant wave height of 1.3 m.

3. The proposed project with its jetty outside the tidal basin consists of: (Map 16954)

(i) construction, started in 1980, of a 240 m coal jetty and mooring dolphins with an alongside depth of 16.0 m below MLW capable of accommodating a 100,000 DWT bulk carrier. Also construction of a 14 m wide, 519 m long trestle, connecting the jetty to the land, capable of carrying two conveyor belts and a 6.0 m roadway;

(ii) reclamation of the area required for stockpile yard and other services;

(iii) construction of a seawall and retaining wall around the reclaimed stockpile and service area;

(iv) construction of the required auxiliary buildings, and extension of the railway tracks to the stockpile area, the required shunting yard, and pavements;

(v) procurement of coal handling equipment.

B. Ulsan Port Coal Terminal

4. Ulsan port is situated at the estuary of the Taehwa River within the Bay of Ulsan at the southeastern extremity of the Korean peninsula. It is only 37 km north of Korea's main port of Busan. This port serves primarily the petrochemical industry in the area with 16 berths totalling 2,348 m. Two of the berths can handle 40,000 DWT ships, the rest handle ships of 1,000 to 20,000 DWT. Transit sheds, storage warehouses, and open storage areas are adequate. Power, water supply, waste disposal, and telecommunication systems are adequate.

5. The tide is semi-diurnal with an average range between mean high and low water of 0.3 m and a spring range of 0.5 m. The approach channel has a depth of 12 meters allowing passage of vessels up to 40,000 DWT.

6. The proposed project consists of: (Map 16955)

(i) construction, started in 1980 of a 270 m coal pier, extending from the eastern extremity of pier no. 1 north of the port with an alongside depth of 12.0 m below MLW capable of accommodating a 40,000 DWT bulk carrier;

(ii) preparation of the area required for stockpile and the rest of the facilities required for the terminal;

(iii) construction of the required auxiliary buildings and pavements and extension of the rail tracks to the stockpile area with the required shunting yard;

(iv) procurement of coal handling equipment.

C. Project Equipment

7. The base cost estimates of the project equipments are presented in Attachments 1 and 2 to this annex. These costs are in March 1983 prices.

8. The schedule of execution of the project is presented in Attachment 3 to this Annex.

INCHEON PORT TERMINAL EQUIPMENT
(March 1983 prices)

	Unit	Capacity	Quantity	Unit price US$ '000	Local	Foreign	Total	Local	Foreign	Total
					-----Won million-----			------US$ 000--------		
Ship unloader	ton/hr	1,250	2	4,600	548	6,306	6,854	736	8,464	9,200
Stacker	ton/hr	3,000	2	2,120	253	2,906	3,159	339	3,901	4,240
	ton/hr	1,000	1	1,250	74	857	931	100	1,150	1,250
Reclaimer	ton/hr	1,200	2	1,750	209	2,399	2,608	280	3,220	3,500
Conveyors	ton/hr	3,000-1,000	4,835 m	1.4/m	404	4,639	5,043	542	6,227	6,769
Truck loadiig hopper	ton/hr	160	8	350	167	1,919	2,086	224	2,576	2,800
Train loading hopper	ton/hr	400	2	700	83	960	1,043	112	1,288	1,400
Sampler	one	-	2	60	7	82	89	10	110	120
Weighing scale	ton/hr	100-3,000	1	150	9	103	112	12	138	150
Truck scale	MT	50	4	50	12	137	149	16	184	200
Train scale	MT	120	1	210	12	144	156	17	193	210
Base Subtotal					1,778	20,452	22,230	2,388	27,451	29,839
Anti-pollution facilities	Lump Sum				90	1,028	1,118	120	1,380	1,500
Electric equipment	Lump Sum				93	1,069	1,162	125	1,435	1,560
Maintenance tools and others	Lump Sum				33	384	417	45	515	560
Spare parts 10% of base subtotal	Lump Sum				178	2,045	2,223	239	2,745	2,984
Subtotal					394	4,526	4,920	529	6,075	6,604
Total					2,172	24,978	27,150	2,917	33,526	36,443
Price contingencies					334	3,831	4,165	448	5,142	5,590
GRAND TOTAL					2,506	28,809	31,315	3,365	38,668	42,033

Source: KMPA and Bank Staff.

Date: February 1983.

ULSAN PORT TERMINAL EQUIPMENT
(March 1983 prices)

	Unit	Capacity	Quantity	Unit price US$ '000	Local	Foreign	Total	Local	Foreign	Total
					-----Won million-----			------US$ 000--------		
Ship unloader	ton/hr	750	2	2,210	264	3,029	3,293	354	4,066	4,420
Stacker/reclaimer	ton/hr	1,800/1,500	2	1,330	159	1,823	1,982	213	2,447	2,660
Conveyor	ton/hr	1,800	2,290 m	1.4/m	191	2,197	2,388	256	2,950	3,206
Truck loading hopper	ton/hr	160	6	350	126	1,439	1,565	168	1,932	2,100
Train loading hopper	ton/hr	400	1	700	42	480	522	56	644	700
Sampler	one	-	2	60	7	82	89	10	110	120
Weighing scale	ton/hr	100-1,800	2	70	8	96	104	11	129	140
Truck scale	MT	50	6	50	18	206	224	24	276	300
Base Subtotal					815	9,352	10,167	1,092	12,554	13,646
Anti-pollution facilities	Lump Sum				57	658	715	77	883	960
Electric equipment	Lump Sum				85	973	1,058	114	1,306	1,420
Maintenance tools and others	Lump Sum				33	384	417	45	515	560
Spare parts 10% of base subtotal	Lump Sum				82	935	1,017	109	1,256	1,365
Subtotal					257	2,950	3,207	345	3,960	4,305
Total					1,072	12,302	13,374	1,437	16,514	17,951
Price contingencies					161	1,839	2,000	215	2,469	2,684
GRAND TOTAL					1,233	14,141	15,374	1,652	18,983	20,635

Source: KMPA and Bank Staff.

Date: February 1983

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Studies

Seoul Metropolitan Region (Gyeonggi-do) Integrated Transport Study

1. This study is part of a set of three aimed at preparing future multimodal Transport Projects. The two other are the Seoul Pusan Transport Corridor Study started in March 1983 and the South Eastern Coast Industrial Belt study due to start in 1984. The first of these studies will be financed from Loan 1836-KO (Seventh Railway Project). The second will likely be part of the forthcoming Highway Sector Project and financed from the relevant Bank loan.

2. The Gyeonggi-do study, estimated to cost US$1.6 million, was to be funded entirely under the Seventh Railway Project (Loan 1836-KO); but at the request of government US$.6 million of this amount will be funded under the present Coal and Cement Project to allow all urban studies, including the feasibility of Secondary Cities transport improvements, to be started earlier under funding from the Seventh Railway Project. The Seoul Region Transport Study has objectives to (a) assess multimodal transport requirements (rail, roads, ports, airports) in the area; and (b) conduct feasibility studies of selected capacity increase investments.

ANNEX 4

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Selected Documents and Data Available in the Project File

- Long-range cement supply and demand outlook and proposal to improve cement distribution system - Korea Industrial Development Research Institute - October 1979
- Coal/Cement distribution study, final report - Regional Development Research Institute and Korea Advanced Institute of Science and Technology - July 1981
- Feasibility study report for Incheon and Ulsan port coal terminals - Korea Maritime and Port Administration - April 1982
- Detailed engineering for Incheon coal terminal
- Detailed engineering for Ulsan coal terminal.
- KNR's Investment Plan 1982-86 (April 1982 version)
- KNR's Financial Plan December 1982
- EPB's Guidelines for Revised KNR Financial Plan (January 1983)
- KNR's Revised Investment and Financial Plan (February 11, 1983)
- Tables showing projections of coal and cement rail transport costs and of tariff increases needed for reaching the full cost recovery level by agreed dates
- Tables supporting Calculation of Rate of Return on Average Net Fixed Assets in use for the Incheon and Ulsan ports coal terminals

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Growth Trend of Domestic Freight Traffic (1961-81)
(Units: 1,000 tons; million tons-km)

	1961		1966		1962-66	1971		1967-71	1976		1972-76	1981		1977-81
	Traffic volume	% share	traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share	% increase
Tonnage														
Railways	15,373	47.9	24,064	46.9	9.4	31,955	25.1	5.9	43,629	17.8	6.7	48,761	12.1	2.2
Highways														
Commercial	N.A.	-	N.A.	-	-	73,934	58.0	-	93,751	38.1	4.9	104,256	25.9	2.1
Private & gov't.	N.A.	-	N.A.	-	-	10,320	8.1	-	94,439	38.5	55.7	226,547	56.4	19.1
Subtotal	15,299	47.6	24,528	47.8	9.9	84,254	66.1	28.0	188,190	76.6	17.5	330,803	82.3	(11.9)
Maritime	1,442	4.5	2,686	5.3	13.2	11,263	8.8	34.2	13,829	5.6	5.3	22,206	5.5	9.9
Aviation	-	-	-	-	-	7	-	49.1	5	-	(5.7)	18	-	28.5
Total	32,114	100.0	51,279	100.0	9.8	127,479	100.0	18.0	245,653	100.0	5.2	401,788	100.0	10.3
Tons-km														
Railways	3,486	88.3	5,450	81.6	9.4	7,841	48.9	7.6	9,728	44.6	4.7	10,815	37.5	2.2
Highways														
Commercial	N.A.	-	N.A.	-	-	3,302	20.6	-	4,374	20.1	6.0	4,868	16.9	2.2
Private & gov't.	N.A.	-	N.A.	-	-	237	1.5	-	2,172	9.9	55.0	5,217	18.1	19.2
Subtotal	323	8.2	558	8.4	11.8	3,539	22.1	44.9	6,546	30.0	13.0	10,085	35.0	(9.1)
Maritime	141	3.6	672	10.0	45.2	4,653	29.0	50.2	5,533	25.4	4.1	7,927	27.5	7.5
Aviation	-	-	-	-	-	2	-	-	2	-	(2.5)	7	-	26.5
Total	3,950	100.0	6,680	100.0	11.1	16,026	100.0	18.8	21,809	100.0	4.4	24,834	100.0	5.8

Sources: (1) Fifth Five-Year Economic and Social Development Plan, Transportation Sector Plan - (1982-86), December 1981, Transportation Sector Sector Planning Task Force, MOT, Korea, pp. 2-3.
(2) Statistical Yearbook of Transportation - 1981, MOT, Korea, pp. 111, 113, 155, 157.
(3) Statistical Yearbook of Transportation - 1973, MOT, Korea, pp. 76-77, 101.
(4) Statistical Yearbook of Transportation - 1982, MOT, Korea, pp. 10-11, 159, 161.

September 1982

Table 1.1

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Growth Trend of Domestic Passenger Traffic (1961-81)
(Units: 1,000 Passengers; million pass-km)

	1961		1966		1962-66	1971		1967-71	1976		1972-76	1981		1977-81
	Traffic volume	% share	traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share	% increase	Traffic volume	% share	% increase
Passenger														
Railways														
Rail intercity	88,291	13.0	138,299	8.3	9.4	128,159	4.1	(1.5)	144,859	2.7	2.5	268,329	2.9	13.1
Seoul suburban	N.A.	-	N.A.	-	-	N.A.	-	-	103,840	2.0	-	172,800	1.9	10.7
Subtotal	88,291	13.0	138,299	8.3	9.4	128,159	4.1	(1.5)	248,699	4.7	14.2	441,129	4.8	12.2
Subway	-	-	-	-	-	-	-	-	33,914	0.6	-	88,326	1.0	21.1
Highways														
Intercity	N.A.	-	272,313	16.4	-	339,886	10.7	4.5	651,624	12.2	13.5	910,657	9.9	7.0
Urban	N.A.	-	1,239,245	74.9	-	2,684,343	85.0	16.5	4,399,359	82.4	10.5	7,772,473	84.2	12.0
Subtotal	586,864	86.4	1,511,558	91.3	20.8	3,024,229	95.7	14.9	5,050,983	94.6	10.8	8,683,130	94.1	11.4
Maritime	3,743	0.6	5,909	0.4	9.6	6,371	0.2	1.5	5,994	0.1	(1.2)	9,230	0.1	9.0
Aviation	62	-	192	-	34.1	1,105	-	44.8	795	-	(5.6)	1,555	-	14.4
Total	678,960	100.0	1,655,958	100.0	19.5	3,159,864	100.0	13.8	5,340,385	100.0	11.1	9,223,370	100.0	11.5
Pass-km														
Railways														
Rail intercity	5,372	53.0	8,665	42.5	10.0	8,750	27.1	0.8	12,441	21.2	7.3	16,523	18.1	5.8
Seoul suburban	N.A.	-	N.A.	-	-	N.A.	-	-	1,864	3.2	-	5,005	5.5	21.7
Subtotal	5,372	53.0	8,665	42.5	10.0	8,750	27.1	0.8	14,305	24.4	10.3	21,528	23.6	8.5
Subway	-	-	-	-	-	-	-	-	388	0.7	-	1,258	1.4	26.5
Highways														
Intercity	N.A.	-	N.A.	-	-	11,937	37.0	-	25,030	42.7	16.0	35,559	39.0	7.3
Urban	N.A.	-	N.A.	-	-	10,980	34.1	-	18,369	31.3	10.7	31,756	34.9	11.6
Subtotal	4,618	45.5	11,464	56.2	19.9	22,917	71.1	14.9	43,399	74.0	13.6	67,315	73.9	9.2
Maritime	136	1.3	196	1.0	7.8	256	0.8	5.5	249	0.4	(0.6)	480	0.5	14.0
Aviation	18	0.2	55	0.3	43.7	314	1.0	41.7	276	0.5	(2.5)	557	0.6	15.1
Total	10,144	100.0	20,380	100.0	15.0	32,237	100.0	9.6	58,617	100.0	12.7	91,138	100.0	9.2

Sources: (1) Fifth Five-Year Economic and Social Development Plan, Transportation Sector Plan - (1982-86), December 1981, Transportation Sector Sector Planning Task Force, MOT, Korea, pp. 2-3.
(2) Statistical Yearbook of Transportation - 1981, MOT, Korea, pp. 16-17, pp. 60-63, pp. 110-113.
(3) Statistical Yearbook of Transportation - 1973, MOT, Korea, pp. 76-77.
(4) Statistical Yearbook of Transportation - 1982, MOT, Korea, pp. 8-9.

January 1983

Table 2.5

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

The Briquette Industry by Size and Location and Domestic Coal Consumption in 1981

Location and size of plants	No. of plants	Coal used million tons	Coal used %
Seoul			
Large	16	6.79	
Medium	1	0.03	
Subtotal	17	6.82	40.8
Incheon			
Large	3	0.51	
Medium	2	0.17	
Subtotal	5	0.68	4.1
Busan			
Large	6	1.58	9.4
Daegu			
Large	6	1.29	7.7
Daejeon			
Large	2	0.45	2.7
Gwangju			
Large	2	0.56	3.3
Subtotal	38	11.38	68.0
Rest of Country			
Large	10	1.74	10.4
Medium	138	3.42	20.5
Small	96	0.18	1.1
Total	282	16.72	100.0

Note: Large plants use over 100,000 tons p.a., medium between 5,000 and 100,000 tons, p.a., and small plants less than 5,000 tons p.a.

Source: KIER.

February 1983

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Composition and Cost Estimates (March 1983 prices)

	1983			1984			1985			1986			1983-86			Total 1983-86		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Fireign	Total
	(Won million)															(US$'000)		
Railway Investments																		
Electrification, 64km	0	0	0	3388	1230	4618	4754	6945	11699	3737	871	4608	11879	9046	20925	15945	12142	28087
Signaling, 126.8 km	0	0	0	1237	1661	2898	2370	10172	12542	1558	0	1558	5165	11833	16998	6933	15883	22816
Gauge widening, 53.2km	2142	817	2959	26747	10197	36944	24356	9285	33641	8411	3206	11617	61656	23505	85161	82760	31550	114310
Cement tank cars, 320	249	2204	2453	419	3085	3504	704	4407	5111	853	4407	5260	2225	14103	16328	2987	18930	21917
Special coal cars, 261	734	6495	7229	0	0	0	0	0	0	930	4806	5736	1664	11301	12965	2234	15169	17403
Maintenance equipment	0	0	0	793	4188	4981	117	636	753	0	0	0	910	4824	5734	1221	6475	7696
Subtotal-railways	3125	9516	12641	32584	20361	52945	32301	31445	63746	15489	13290	28779	83499	74612	158111	112080	100149	212229
Intermodal terminals Investments																		
Bugog	9956	4577	14533	23533	12028	35561	6154	2531	8685	0	0	0	39643	19136	58779	53212	25686	78898
Seongbug	0	0	0	1250	99	1349	1097	252	1349	706	643	1349	3053	994	4047	4098	1334	5432
Subtotal-terminals	9956	4577	14533	24783	12127	36910	7251	2783	10034	706	643	1349	42696	20130	62826	57310	27020	84330
Port Coal Terminals																		
Incheon- Civil works	4545	4545	9090	9819	9819	19638	5905	5905	11810	0	0	0	20269	20269	40538	27207	27207	54414
- Equipment	0	0	0	0	11239	11239	0	11239	11239	2172	2500	4672	2172	24978	27150	2917	33526	36443
Subtotal-Incheon	4545	4545	9090	9819	21058	30877	5905	17144	23049	2172	2500	4672	22441	45247	67688	30124	60733	90857
Ulsan - Civil Works	1740	1740	3480	1507	1507	3014	0	0	0	0	0	0	3247	3247	6494	4358	4358	8716
- Equipment	0	0	0	0	4921	4921	1072	7381	8453	0	0	0	1072	12302	13374	1437	16514	17951
Subtotal-Ulsan	1740	1740	3480	1507	6428	7935	1072	7381	8453	0	0	0	4319	15549	19868	5795	20872	26667
Subtotal-ports	6285	6285	12570	11326	27486	38812	6977	24525	31502	2172	2500	4672	26760	60796	87556	35919	81605	117524
Study																		
Gyeonggi-do	0	447	447	0	0	0	0	0	0	0	0	0	0	447	447	0	600	600
Subtotal-study	0	447	447	0	0	0	0	0	0	0	0	0	0	447	447	0	600	600
Technical Assistance																		
Port procurement	73	67	140	0	51	51	0	25	25	0	27	27	73	170	243	98	228	326
Port training	0	43	43	0	0	0	0	0	0	0	0	0	0	43	43	0	58	58
Subtotal-T.A.	73	110	183	0	51	51	0	25	25	0	27	27	73	213	286	98	286	384
Total	19439	20935	40374	68693	60025	128718	46529	58778	105307	18367	16460	34827	153028	156198	309226	205407	209660	415067
Physical Contingencies	498	229	727	1470	751	2221	719	995	1714	300	76	376	2987	2051	5038	4009	2752	6761
Baseline Cost Estimate	19937	21164	41101	70163	60776	130939	47248	59773	107021	18667	16536	35203	156015	158249	314264	209416	212412	421828
Price Contingencies																		
% per year	8.0	8.0		7.5	7.5		7.0	7.0		6.0	6.0							
% compounded	2.0	2.0		10.1	10.1		18.2	18.2		26.0	26.0							
Amount	399	423	822	7086	6138	13224	8599	10879	19478	4853	4299	9152	20937	21739	42676	28103	29180	57283
GRAND TOTAL	20336	21587	41923	77249	66914	144163	55847	70652	126499	23520	20835	44355	176952	179988	356940	237519	241592	479111

Source: KNR, KMPA and Bank Staff.
Date: March 1983.

Table 4.1

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

List of Goods
(March 1983 US$'000)

	Unit price	1983	1984	1985	1986	Total	Loan
KNR							
Railways							
Electrification, Taebaeg Line							
Overhead line	LS	-	-	3,404	-	3,404	
Substations	LS	-	-	3,598	-	3,598	
Feeder line	LS	-	-	101	-	101	
Communications	LS	-	-	44	-	44	
Signaling	LS	-	-	1,946	-	1,946	
Subtotal electrification		-	-	9,093	-	9,093	9,093
Signaling, Jung Ang Line							
Control panel (1)	1,324	-	-	1,324	-	1,324	
Main transceiver (1)	1,426	-	-	1,426	-	1,426	
Train no. describer (1)	1,070	-	-	1,070	-	1,070	
Time recorder (2)	95	-	-	190	-	190	
Train recorder (1)	832	-	-	832	-	832	
Station transceiver (26)	178	-	-	4,632	-	4,632	
Repeater (5)	95	-	-	475	-	475	
Block device (68)	24	-	1,615	-	-	1,615	
Training and T.A.	LS	-	-	519	-	519	
Subtotal signaling		-	1,615	10,458	-	12,083	12,083
Broadening, Su In Line							
Rails, 50 kg/m (9,700 tons)	0.615	-	-	5,969	-	5,969	
Timber ties (160,900)	0.044	-	-	7,080	-	7,080	
Signaling		-	-	530	-	530	
Subtotal broadening		-	-	13,579	-	13,579	13,579
Freight Cars							
Cement tank cars (320)	59	2,957	4,140	5,914	5,914	18,925	
Coal cars (261)	58	8,715	-	-	6,449	15,164	
Subtotal freight cars		11,672	4,140	5,914	12,363	34,089	34,089
Maintenance Equipment	LS	-	5,416	804	-	6,220	6,220
Total Railways		11,672	11,171	39,858	12,363	75,064	75,064

	Unit/a price	1983	1984	1985	1986	Total	Loan
Bugog Terminal							
Rails, 50 kg/m (4,200 tons)	0.623	1,369	1,244	-	-	2,613	
Timber ties (100,000)	0.044	1,308	3,051	-	-	4,359	
Transtainer craners (2)	609	1,219	-	-	-	1,219	
Total Bugog Terminal		2,678	4,295	-	-	8,191	8,191
Total KNR		15,568	15,466	39,858	12,363	83,255	83,255
Physical Contingencies		195	296	978	262	1,731	1,731
Baseline estimate		15,763	15,762	40,836	12,625	84,986	84,986
Price Contingencies		2%	10%	18.2%	26%		
		315	1,576	7,432	3,282	12,605	12,605
Total		16,078	17,338	48,268	15,907	97,591	97,591
KMPA							
Ports							
Incheon							
Ship unloader (2)	4,232	-	3,809	3,809	846	8,464	
Stacker, 3,000 t/hr (2)	1,950.5	-	1,755	1,756	390	3,901	
Stacker, 1,000 t/hr (1)	1,150	-	518	517	115	1,150	
Reclaimer, 1,200 t/hr (2)	1,610	-	1,449	1,449	322	3,220	
Conveyors (4,835 m)	-	-	2,802	2,802	623	6,227	
Truck loading hopper (8)	322	-	1,158	1,159	258	2,576	
Train loading hopper (2)	644	-	579	580	129	1,288	
Sampler (2)	55	-	50	49	11	110	
Weighing scale (1)	138	-	62	62	14	138	
Truck scale (4)	46	-	83	83	18	184	
Train scale (1)	193	-	87	87	19	193	
Spare parts	LS	-	1,235	1,235	275	2,745	
Antipollution	LS	-	621	621	138	1,380	
Electric equipment	LS	-	645	646	144	1,435	
Maintenance tools and others	LS	-	232	231	52	515	
Subtotal Incheon		-	15,086	15,086	3,354	33,526	15,556
Ulsan							
Ship unloader (2)	2,033	-	1,645	2,421	-	4,066	
Stacker/reclaimer, 1,800/1,500 (2)	1,223.5	-	979	1,468	-	2,447	
Conveyors (2,290 m)	-	-	1,180	1,770	-	2,950	
Truck loading hopper (6)	322	-	773	1,159	-	1,932	
Train loading hopper (1)	644	-	258	386	-	644	
Sampler (2)	55	-	44	66	-	110	
Weighing scale (2)	64.5	-	52	77	-	129	
Truck scale (6)	6	-	110	166	-	276	
Spare parts	LS	-	502	754	-	1,256	
Antipollution	LS	-	353	530	-	883	
Electric equipment	LS	-	522	784	-	1,306	
Maintenance tools and others	LS	-	206	309	-	515	
Subtotal Ulsan		-	6,624	9,890	-	16,514	7,663
Total Ports		-	21,710	24,976	3,354	50,040	23,219

/a The foreign costs for Ports equipment is calculated as 92% of total price.

	Unit price	1983	1984	1985	1986	Total	Loan
Technical Assistance							
Port procurement		90	68	34	36	228	
Port training		58	-	-	-	58	
Total Technical Assistance		148	68	34	36	286	286
Total KMPA		148	21,778	25,010	36	46,972	23,505
Study (MOC)							
Gyeonggi-do (balance)		600	-	-	-	600	600
Total All Categories		16,826	39,116	73,278	15,943	145,163	121,696
Front-end fee (0.25% of above)							304
GRAND TOTAL							122,000

Source: KNR, KMPA, and Bank Staff.

Date: February 1983

Table 4.3

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Cumulative Disbursement Schedule /a

IBRD fiscal year and quarter	Estimated cumulative disbursement		Cumulative disbursement country profile
	US$ million	%	
1983/84			
September 30, 1983	1.2	1.0	-
December 31, 1983	2.4	2.0	0.8
March 31, 1984	5.5	4.5	-
June 30, 1984	8.6	7.0	5.5
1984/85			
September 30, 1984	12.1	9.9	-
December 31, 1984	17.7	14.5	14.0
March 31, 1985	24.3	19.9	-
June 30, 1985	30.9	25.3	26.1
1985/86			
September 30, 1985	43.5	35.7	-
December 31, 1985	54.5	44.6	40.4
March 31, 1986	64.3	52.7	-
June 30, 1986	74.6	61.1	55.1
1986/87			
September 30, 1986	88.4	72.5	-
December 31, 1986	98.2	80.5	68.2
March 31, 1987	106.1	87.0	-
June 30, 1987	114.1	93.5	78.9
1987/88			
September 30, 1987	118.6	97.2	
December 31, 1987	122.0	100.0	87.0
March 31, 1988			
June 30, 1988			93.0
December 31, 1988			97.1
June 30, 1989			100.0

/a Assumptions: Board date in third quarter FY1983. Proposed closing date: December 31, 1987.

Source: KNR, KMPA, and Bank Staff.

Date: March 1983

Table 5.1

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Forecast of Coal Imports Through Incheon, Ulsan, Mogpo and Bugpyeong Ports and Rail/Road Allocation, 1986-91

	1981	1986			1991		
		Total	Rail	Road	Total	Rail	Road
Incheon							
Anthracite	2,532	1,570	793	777	1,570	793	777
Bituminous	203	1,538	1,183	355	3,024	1,999	1,025
Total	2,735	3,108	1,976	1,132	4,594	2,792	1,802
Ulsan							
Anthracite	244	175	87	88	175	87	88
Bituminous	339	1,040	388	652	3,027	455	2,572
Total	583	1,215	475	740	3,202	542	2,660
Mogpo							
Anthracite	108	300	150	150	300	150	150
Bituminous	-	278	100	178	926	115	811
Total	108	578	250	328	1,226	265	961
Bugpyeong							
Anthracite	-	-	-	-	-	-	-
Bituminous	813	2,089	-	2,089	2,190	-	2,190
Total	813	2,089	-	2,089 (12 km)	2,190	-	2,190 (12 km)
Other Ports							
Anthracite	963	1,110		1,110	1,110	-	1,110
Grand Total							
Anthracite	3,847	3,155	1,030	2,125	3,155	1,030	2,125
Bituminous	1,355	4,945	1,671	3,274	9,167	2,569	6,598
Total	5,202	8,100	2,701	5,399	12,322	3,599	8,723

Note: This table does not include bituminous and steam coal which will be imported by the steel mill and the coal-fired power plants since these are located on the seashore and have their own ports. For anthracite the table only covers needs for briquettes. Small amounts will continue to be imported for the existing power plants at Busan and Masan. In addition, coastal shipping from Mukho of about 1.7 million tons p.a. of domestic anthracite will continue to Ulsan, Mogpo and other ports.

Source: MOER and Bank Staff.
Date: February 1983.

Table 5.2

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Forecast Coal Imports Through Incheon and Coal Traffic on the Su-In Line, 1986-91
('000 tons)

	1986			1991		
		Su-In line			Su-In line	
	Total	To Bugog (75 km)	To areas (150-200 km)	Total	To Bugog (75 km)	To areas (150-200 km)
Anthracite						
Seoul City	780	260	-	780	260	-
Gyeonggi	517	260	-	517	260	-
Gangwon	45	-	45	45	-	45
Chungnam	134	-	134	134	-	134
Chungbug	94	-	94	94	-	94
Subtotal	1,570	520	273	1,570	520	273
Bituminous						
To cement plants	830	-	830	975	-	975
For industrial boilers	708			2,049		
Gyeonggi (50%)	(354)	155	-	(1,025)	451	-
Incheon (22%)	(156)	-	-	(451)	-	-
Gangwon	-	-	-	-	-	-
Ghungnam (28%)	(198)	-	198	(573)	-	573
Chungbug	-	-	-	-	-	-
Subtotal	1,538	155	1,028	3,024	451	1,548
Total	3,108	675	1,301	4,594	971	1,821
Total Coal Traffic on the Su-In Line		1,976			2,792	

Assumptions: Anthracite distribution is based on 1981 briquette consumption; assuming that briquette consumption will decrease by about 30% in Seoul and in Gyeonggi Province, and remain at its 1981 level in other areas. Modal allocation assumes for 1986: 1/3 of Seoul City and 40% of Gyeonggi served by Bugog and using the Su-In Line. For 1991, 50% of Gyeonggi served from Bugog.

Bituminous distribution is based on the number of industrial boilers in 1981 suitable for conversion to coal. The hypothesis is that 40-50% of boilers will be converted to coal by 1991.

Source: Bank Staff.
Date: February 1983.

Table 5.3

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Economic Evaluation of Incheon Coal Terminal and Su-In Line
(All figures in 1982 billion won)

Year	Incheon Port					Su-In Line			
	Capital costs	Operating costs	Cargo handling cost savings/a	Ship cost savings In port/b	Ship cost savings Voyage/c	Capital costs	Transport cost savings/d	Total Benefits	Total costs
1	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0
2	7.9	0.0	0.0	0.0	0.0	2.8	0.0	0.0	10.7
3	27.8	0.0	0.0	0.0	0.0	35.5	0.0	0.0	63.3
4	21.0	0.0	0.0	0.0	0.0	33.0	0.0	0.0	54.0
5	4.5	0.0	0.0	0.0	0.0	11.4	0.0	0.0	15.9
6	0.0	3.5	11.0	7.8	17.0	0.0	8.5	44.3	3.5
7	0.0	3.5	12.0	8.5	18.5	0.0	9.4	48.6	3.5
8	0.0	3.5	13.0	9.2	20.0	0.0	10.3	52.5	3.5
9	0.0	3.5	14.0	9.9	21.5	0.0	11.2	56.6	3.5
10-25	0.0	3.5	15.0	10.6	23.0	0.0	12.2	60.8	3.5

ERR = 22%.
Sensitivity with bituminous coal traffic to industrial users other than cement plants down 50%, ERR = 18%.
Sensitivity with costs up 20% ERR = 19%.
Traffic is given in Tables 5.1 and 5.2.

/a At 3,258 W/ton.
/b Without project unloading 2,500 t/day, ship costs US$10,325/day (US$1 = W 720) for a 25,000 DWT ship; with project unloading 20,000 t/day, ship costs US$18,000/day for a 100,000 DWT ship.
/c Savings estimated at $7 per ton; this is a conservative estimate based on the above ship sizes.
/d Rail costs 15 W/tkm, road cost 60 W/tkm.

Source: Consultants, KMPA, KNR and Bank Staff.

Date: February 1983

Table 5.4

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Economic Evaluation of Ulsan Coal Terminal
(All figures in 1982 billion won)

Year	Capital costs	Operating costs	Cargo handling cost savings/a	Ship in port cost savings/b	Total Benefits	Total costs
1	7.2	0.0	0.0	0.0	0.0	7.2
2	3.0	0.0	0.0	0.0	0.0	3.0
3	6.0	0.0	0.0	0.0	0.0	6.0
4	8.1	0.0	0.0	0.0	0.0	8.1
5	0.0	2.1	2.8	4.3	7.1	2.1
6	0.0	2.1	3.6	5.5	9.1	2.1
7	0.0	2.1	4.4	6.7	11.1	2.1
8	0.0	2.1	5.2	8.0	13.2	2.1
9	0.0	2.1	6.1	9.3	15.4	2.1
10-25	0.0	2.1	7.0	10.6	17.6	2.1

ERR = 28%

Sensitivity with bituminous coal traffic to industrial users other than cement plants down 50%, ERR = 18%.

Sensitivity with costs up 20%, ERR = 25%.

Traffic is given in Table 5.1.

/a At 2,130 w/ton.

/b Without project unloading at 2,000 tons/day, with project 10,800 tons/day; ship cost US$11,000/day (US$1 = W 720). Ship size of 25-30,000 DWT is the same with and without the project.

Source: Consultants, KMPA and Bank Staff.

Date: February 1983.

Table 5.5

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Rail Traffic Forecast - Taebaeg Line
(Traffic in the East-West Direction Only)

	Actual		Forecast	
	1979	1981	1986	1991
Jecheon-Ssangyong				
Freight (million tons p.a.)				
Coal domestic	6.5	7.0	7.9	7.8
Cement Ssangyong	2.6	2.6	3.9	5.7
Cement from East Coast	.9	.9	1.3	2.0
Ore	.7	.7	.9	1.2
Others	.3	.3	.4	.5
Total	11.0	11.5	14.4	17.2
Passengers (million)	1.2	1.3	1.6	2.0
Ssangyong-Yeongwol				
Freight (million tons p.a.)				
Coal domestic	6.5	7.0	7.9	7.8
Cement East Coast	.9	.9	1.3	2.0
Ore	.2	.2	.3	.4
Others	.1	.1	.1	.2
Total	7.7	8.2	9.6	10.4
Passengers (million)	1.2	1.3	1.6	2.0
Yeongwol-Jeungsan				
Freight (million tons p.a.)				
Coal domestic	6.7	7.3	8.2	8.1
Cement East Coast	.9	.9	1.3	2.0
Ore	.2	.2	.3	.4
Others	.1	.1	.1	.2
Total	7.8	8.5	9.9	10.7
Passengers (million)	1.3	1.4	1.6	2.0
Jeungsan-Baegsan				
Freight (million tons p.a.)				
Coal domestic	5.4	5.6	6.3	6.2
Cement East Coast	.9	.9	1.3	2.0
Total	6.3	6.5	7.6	8.0
Passengers (million)	.9	1.0	1.1	1.2

Source KNR and Bank Staff.

Date: February 1983.

Table 5.6

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Economic Evaluation of Taebaeg Line Signaling and Coal Cars
(All figures in 1982 billion won)

Year	Capital costs		Benefits		Total Benefits	Total costs
	Signal-ling	Coal cars	Coal cost savings/a	Cement transport cost savings/b		
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	7.2	0.0	0.0	0.0	7.2
3	2.8	0.0	0.0	0.0	0.0	2.8
4	12.4	0.0	0.0	0.0	0.0	12.4
5	1.4	5.8	5.8	2.1	7.9	7.2
6	0.0	0.0	5.5	2.2	7.7	0.0
7	0.0	0.0	5.2	2.4	7.6	0.0
8	0.0	0.0	5.0	2.5	7.5	0.0
9	0.0	0.0	4.7	2.5	7.2	0.0
10	0.0	0.0	4.4	5.6	10.0	0.0
11	0.0	0.0	4.1	5.6	9.7	0.0
12	0.0	0.0	3.8	5.6	9.4	0.0
13	0.0	0.0	3.5	5.6	9.1	0.0
14	0.0	0.0	3.2	5.6	8.8	0.0
15-25	0.0	0.0	2.9	5.6	8.5	0.0
Switching values at 10% Disc. Rate						
Percentage change:	249	298	-114	-116	ERR = 25%	

/a Assumes 0.9 mt of anthracite need to be imported at extra cost of US$9 per ton decreasing by 50% in 10 years.

/b Assumes diversion of 0.5 to 0.7 mt from east coast, saving 4,156 w/ton and, starting in 1991, diversion of 1.5 mt from Jecheon area saving 1,815 w/ton.

Source: KNR and Bank Staff.

Date: February 1983.

Table 5.7

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Rail Traffic Forecast - Jung-Ang Line

	Actual		Forecast	
	1979	1981	1986	1991
Jecheon-Dodam (Dodam-Jecheon direction only) 17.4 km				
Freight (million tons p.a.)				
Coal domestic	2.1	2.4	2.5	2.1
Coal bituminous	-	-	0.3	0.4
Cement	3.1	2.0	5.2	6.2
Oil	1.0	0.6	1.1	1.6
Others	1.1	0.9	1.5	1.9
Total	7.3	5.9	10.6	12.2
Passengers (million)	1.8	1.8	3.1	3.9
Dodam-Yeongju (Yeongju-Dodam direction only) 46.7 km				
Freight (million tons p.a.)				
Coal domestic	2.1	2.6	2.5	2.1
Coal bituminous	-	-	0.6	0.8
Oil	1.5	0.8	1.3	1.8
Others	1.5	2.5	2.0	2.6
Total	5.1	5.9	6.4	7.3
Passengers (million)	1.8	1.9	3.1	3.9
Yeongcheon-Yeongju (Yeongcheon-Yeongju direction only)				
Freight (million tons p.a.)				
Coal domestic	1.9	1.9	2.1	1.9
Cement	1.2	1.2	1.7	2.4
Ore	1.7	2.2	2.1	2.4
Others	0.9	0.6	1.2	8.3
Total	5.7	5.9	7.1	8.3
Passengers (million)	1.9	2.0	2.9	3.5

Source: KNR and Bank Staff.

Date: February 1983.

Table 5.8

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Economic Evaluation of Jung-Ang Line Electrification
(All figures in 1982 billion won)

	Capital		Benefits				
Year	Capital & maintenance costs /a	Avoided loco costs/b	Energy cost savings/c	Labor cost savings	Loco maintenance cost savings/d	Total benefits	Total costs
1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4.3	0.0	0.0	0.0	0.0	0.0	4.3
4	11.4	0.0	0.0	0.0	0.0	0.0	11.4
5	4.3	-11.1	0.9	0.4	1.1	2.4	-6.8
6-7	0.1	0.0	0.9	0.4	1.1	2.4	0.1
8-9	0.1	0.0	1.0	0.4	1.2	2.6	0.1
10	0.1	0.0	1.0	0.4	1.3	2.7	0.1
11-25	0.1	0.0	1.0	0.4	1.4	2.8	0.1
Switching values at 10% Disc.Rate							
Percentage change:	59	-121	-145	-352	-110	ERR = 22%	

/a Maintenance cost 1.31 million W/km.

/b 8 locos at W 1,385 million each.

/c Diesel costs 2,010 W/MGTkm; electricity costs 1,255 W/MGTkm (MGT = Million Gross Tons).

/d Unit cost electric locos W 40.2 million p.a., diesel locos W 71.5 million p.a.

Source: KNR and Bank Staff.

Date: February 1983

Table 5.9

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Economic Evaluation of Cement Tank Cars
(All figures in 1982 billion won)

Year	Cost of tank cars/a	Cost of box cars/b	Net benefits
1	0.0	0.0	0.0
2	2.5	1.7	-0.8
3	6.8	4.6	-2.2
4	8.4	6.3	-2.1
5	8.6	5.7	-2.9
6-25	0.0	11.2	11.2

ERR is 68%.

/a Includes the construction of cement silos necessary to accommodate traffic carried by the proposed 320 tank cars, i.e., 1.95 million tons p.a. Estimated cost of silos is W 9.9 billion spread over 3 years.

/b Includes savings in bagging costs W 3,668/ton and loading of box cars with cement bags W 2,050/ton.

Source: KNR and Bank Staff.

Date: February 1983

Table 5.10

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Summary of Costs and Benefits
(All figures in 1982 billion won)

Year	Total incremental benefits	Total incremental costs/a	Net incremental benefits
1	0.0	40.5	-40.5
2	1.7	37.1	-35.4
3	4.6	123.0	-118.4
4	6.3	104.5	-98.2
5	23.1	28.3	-5.2
6	74.7	5.7	69.0
7	80.7	5.7	75.0
8	87.0	5.7	81.3
9	93.0	5.7	87.3
10	102.3	5.7	96.6
11	102.1	5.7	96.4
12	101.8	5.7	96.1
13	101.5	5.7	95.8
14	101.2	5.7	95.5
15-25	100.9	5.7	97.2

ERR = 19%

/a Includes the cost of Bugog and Seongbug terminals, and of track maintenance equipment, but no further benefits than those included in the various project elements analyzed separately.

Source: Tables 5.1 to 5.9.

Date: February 1983

Table 6.1

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Korean National Railroad (KNR)

Summarized Forecasted Financial Statements
(Won billion)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Traffic										
Passengers (million pass-km)	21,343	22,464	23,443	24,478	25,705	26,862	28,071	29,334	30,654	32,033
Freight (million ton-km)	10,383	10,833	11,601	12,415	12,953	13,600	14,281	14,995	15,744	16,532
Total (million traffic units)	31,726	33,297	35,044	36,893	38,658	40,462	42,352	44,334	46,398	48,565
Income Statement										
Gross operating revenue	404.6	471.0	546.2	614.4	684.8	709.6	862.8	967.2	1,084.2	1,217.0
Working costs	357.5	379.3	410.7	445.6	479.7	515.6	569.4	628.6	704.7	791.0
Depreciation	46.2	51.0	56.7	63.1	70.4	75.0	81.0	88.0	94.0	100.0
Net Operating Revenue /a	0.9	40.7	78.8	105.7	134.7	179.0	212.4	250.6	285.5	326.0
Net nonoperating revenue	3.0	3.0	3.1	3.2	3.3	3.5	4.0	4.5	5.0	5.5
Interest charges	80.6	92.0	104.1	117.0	125.5	136.9	156.7	164.8	179.1	191.4
Net Profit (Loss)	(76.7)	(54.3)	(22.2)	(8.1)	12.5	45.6	59.7	90.3	111.4	140.1
Ratios (%)										
Working	88.0	81.0	75.0	73.0	68.0	67.0	66.0	65.0	65.0	65.0
Operating	100.0	91.0	86.0	83.0	80.0	77.0	75.0	74.0	74.0	73.0
Sources and Applications of Funds										
Sources										
Cash generated by KNR	55.1	100.7	145.1	179.5	216.8	267.0	308.4	355.6	399.4	447.5
Government contributions	18.0	27.5	40.0	70.0	60.0	60.0	65.0	70.0	75.0	80.0
Subsidies against operating losses	34.8	35.4	65.0	65.0	50.0	-	-	-	-	-
Borrowing	178.0	184.2	134.7	233.2	185.3	218.0	273.0	228.0	205.0	200.0
Total Sources	285.9	347.8	384.8	547.7	512.1	545.0	646.4	653.6	679.4	727.5
Applications										
Investments	176.1	208.5	231.2	257.8	275.9	300.0	325.0	350.0	375.0	400.0
Debt services	121.5	134.8	146.6	217.9	227.1	199.1	272.6	237.2	259.0	280.6
Total Applications	297.6	343.3	377.8	475.7	503.0	499.1	597.6	587.2	634.0	680.6
Annual variations in working capital	(11.7)	4.5	7.0	72.0	9.1	45.9	48.8	66.4	45.4	46.9
Ratios										
Debt service coverage										
Balance Sheet										
Assets										
Working capital	(92.6)	(88.1)	(81.1)	(9.1)	0.0	45.9	94.7	161.1	206.5	253.4
Net fixed assets	2,105.4	2,318.6	2,553.3	2,814.1	3,097.5	3,390.4	3,721.3	4,077.3	4,455.4	4,864.4
Other assets	70.1	70.1	70.1	70.1	70.1	75.0	77.0	80.0	85.0	90.0
Total Assets	2,082.9	2,300.6	2,542.3	2,875.1	3,167.6	3,511.3	3,893.0	4,318.4	4,746.9	5,207.8
Liabilities										
Long-term debt	844.4	988.8	1,084.5	1,220.3	1,308.0	1,463.8	1,620.9	1,776.5	1,901.6	2,012.4
Equity equivalent	1,238.5	1,311.8	1,457.8	1,654.8	1,859.6	2,047.5	2,272.1	2,541.9	2,845.3	3,195.4
Total Liabilities	2,082.9	2,300.6	2,542.3	2,875.1	3,167.6	3,511.3	3,893.0	4,318.4	4,746.9	5,207.8
Ratios										
Average net fixed assets in use	1,861.0	2,068.0	2,271.0	2,501.0	2,756.0	3,035.0	3,341.0	3,674.0	4,032.0	4,415.0
Rate of return on average net fixed assets in use (%)	-	2.0	3.5	4.2	4.9	5.9	6.4	6.8	7.1	7.4
Debt to equity	41/59	43/57	43/57	42/58	41/59	42/58	42/58	41/59	40/80	39/61

/a Compensation for losses on ordinary trains and commuters not included in the net operating revenue.

Source: KNR and Bank Staff.

Date: February 1983.

Table 6.2

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Korean National Railroad (KNR)

Gross Operating Revenue, 1982-91

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Traffic										
Passenger (million pass-km)	21,343	22,464	23,443	24,478	25,705	26,862	28,071	29,334	30,654	32,033
Freight (million ton-km)	10,383	10,833	11,601	12,415	12,953	13,600	14,281	14,995	15,744	16,532
Total Traffic Units	31,726	33,297	35,044	36,893	38,658	40,462	42,352	44,334	46,398	48,565
Passengers										
Based on July 1982 tariff										
Per pass-km (Won) /b	10.49	10.84	11.04	11.21	11.32	11.55	11.78	12.01	12.25	12.50
Total	224.1	243.4	258.8	274.5	291.1	310.2	330.7	352.3	375.5	400.4
Tariff increases - % per year /d	-	10.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
% compounded	-	7.1/a	16.6	23.6	31.0	38.9	47.2	56.0	65.3	75.3
Total revenue including tariff increase	224.1	260.9	301.8	339.3	381.3	430.9	486.8	549.6	620.7	701.9
Freight and Baggage										
Based on July 1982 tariff										
Per ton-km (Won) /c	16.33	16.43	16.43	16.39	16.35	16.45	16.45	16.45	16.45	16.45
Total	169.6	178.0	190.6	203.5	211.8	223.7	234.9	246.7	259.0	272.0
Tariff increases - % per year /d	-	13.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
% compounded	-	9.8/a	20.0	27.0	35.0	43.1	51.7	60.8	70.4	80.7
Total revenue including tariff increase	169.6	195.4	228.7	258.4	285.9	320.1	356.3	396.7	441.3	491.5
Other	13.6	14.7	15.7	16.7	17.6	18.6	19.7	20.9	22.2	23.6
Total Operating Revenue	404.6	471.0	546.2	614.4	684.8	769.6	862.8	967.2	1,084.2	1,217.0

/a Including December 15, 1982 tariff increase +6% increase as of July 1, 1983.
/b Revenue per pass-km (quoted in July 1982 tariffs):
1982-86: based in KNR's detailed projection.
1986-88: increased by 2% p.a. to reflect anticipated tariff increases and planned reduction in ordinory train service.
/c Revenue per ton-km (quoted in July 1982 tariffs):
1982-88: assumed to remain constant to reflect increasing low tariff bulk transport.
/d Annual tariff increases for passengers and freight = 6% (5% for inflation) + 1% in real terms.

Source: KNR and Bank Staff.

Date: February 1983.

Table 6.3

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Korean National Railroad (KNR)

Calculation of Working Costs, 1982-86

	1982	1983	1984	1985	1986
Staff					
Traffic units	31,726	33,297	35,044	36,893	38,658
Traffic units per employee ('000) (+ 3% p.a. over 1983)	753	790	814	838	863
Number of staff	42,137	42,148	43,052	44,025	44,795
1981 staff cost per employee (W'000)	4,135	4,135	4,135	4,135	4,135
Increases - % p.a.	9.9	6.0	7.0	7.0	7.0
compounded	9.9	16.5	24.6	33.4	42.7
Annual cost of staff (Won '000)	4,544	4,817	5,152	5,516	5,901
Total staff costs (Won billion)	191.5	203.0	221.8	242.8	264.3
Fuel and Electricity					
Increase 15% in 1986 over 1982 instead of 11.9% in KNR's original plan (Won billion)	82.2	85.8	88.8	92.3	94.6
Maintenance (increase over 1986 in proportion to increase in traffic units)	55.8	60.8	67.9	75.6	83.2
Total Direct Costs (Won billion)	329.5	349.6	378.5	410.7	442.1
General expense (8.5% of staff + fuel + maintenance) (Won billion)	28.0	29.7	32.2	34.9	37.6
Total Working Costs (Won billion)	357.5	379.3	410.7	445.6	479.7

Source: KNR and Bank Staff.

Date: February 1983.

Table 6.4

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Korean National Railroad (KNR)

Sources and Applications of Funds, 1982-91
(Won billion)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1987-91
Sources											
Gross operating revenue	404.6	471.0	546.2	614.4	684.8	769.6	862.8	967.2	1,084.2	1,217.0	4,900.8
Working expenses	357.5	379.3	410.7	445.6	479.7	515.6	569.4	628.6	704.7	791.0	3,209.3
Cash generated from operations	47.1	91.7	135.5	168.8	205.1	254.0	293.4	338.6	379.5	426.0	1,691.5
Borrowing											
Local	144.0	160.0	100.0	150.0	100.0	150.0	200.0	150.0	120.0	110.0	730.0
Foreign	34.0	24.2	34.7	83.2	85.3	68.0	73.0	78.0	85.0	90.0	394.0
Total	178.0	184.2	134.7	233.2	185.3	218.0	273.0	228.0	205.0	200.0	1,124.0
Subsidies											
Against investments	18.0	27.5	40.0	70.0	60.0	60.0	65.0	70.0	75.0	80.0	350.0
Against operating losses	34.8	35.4	65.0	65.0	50.0	-	-	-	-	-	250.2
Total	52.8	62.9	105.0	135.0	110.0	60.0	65.0	70.0	75.0	80.0	600.2
Provision for severance pay	3.0	3.0	3.5	3.5	4.0	4.5	5.0	5.5	6.0	7.0	28.0
Other nonoperating revenue	3.0	3.0	3.1	3.2	3.3	3.5	4.0	4.5	5.0	5.5	22.5
Sale of assets	2.0	3.0	3.0	4.0	4.4	5.0	6.0	7.0	8.9	9.0	35.9
Total Sources	285.9	347.8	384.8	547.7	512.1	545.0	626.4	653.6	679.4	727.5	3,251.9
Applications											
Investments	176.1	208.5	231.2	257.8	275.9	300.0	325.0	350.0	375.0	400.0	1,750.0
Debt service											
Interest	80.6	92.0	104.1	117.0	125.5	136.9	156.7	164.8	179.1	191.4	828.9
Repayment of principal	40.9	42.8	42.5	100.9	101.6	62.2	115.9	72.4	79.9	89.2	419.6
Total	121.5	134.8	146.6	217.9	227.1	199.1	272.6	237.2	259.0	280.6	1,248.5
Total Applications	297.6	343.3	377.8	475.7	503.0	499.1	597.6	587.2	634.0	680.6	2,998.5
Annual variation in working capital	(11.7)	4.5	7.0	72.0	9.1	45.9	48.8	66.4	45.4	46.9	253.4
Working capital brought forward	(80.9)	(92.6)	(88.1)	(81.7)	(1.9)	-	45.9	94.7	161.1	206.5	
Working Capital at End of Year	(92.6)	(88.1)	(81.1)	(9.1)	-	45.9	94.7	161.1	206.5	253.4	

Source: KNR and Bank Staff.

Date: February 1983.

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Korean National Railroad (KNR)

Investment Financing
(Won billion)

	1982	1983	1984	1985	1986	1982-86	%	1987	1988	1989	1990	1991	1987-91
Investments													
Local	140.9	180.6	189.8	167.2	181.3	859.8	75	225.0	244.0	263.0	281.0	300.0	1,313.0
Foreign	35.2	27.9	41.4	90.6	94.6	289.7	25	75.0	81.0	87.0	94.0	100.0	437.0
Total	176.1	208.5	231.2	217.8	275.9	1,149.5		300.0	325.0	350.0	375.0	400.0	1,750.0
Financing													
Government subsidies	18.0	27.5	40.0	70.0	60.0	215.5	20/a	60.0	65.0	70.0	75.0	80.0	350.0
Borrowing - Local	144.0	160.0	100.0	150.0	100.0	654.0		150.0	200.0	150.0	120.0	110.0	730.0
Foreign	34.0	24.2	34.7	83.2	85.3	261.4	90/b	68.0	73.0	78.0	85.0	90.0	394.0
Subtotals - Local	162.0	187.5	140.0	220.0	160.0	869.5		210.0	265.0	220.0	195.0	190.0	1,080.0
Foreign	34.0	24.2	34.7	83.2	85.3	261.4		68.0	73.0	78.0	85.0	90.0	394.0
Total Internal	196.0	211.7	174.7	303.2	245.3	1,130.9		278.0	338.0	298.0	280.0	280.0	1,474.0
KNR	(19.9)	(3.2)	56.5	(45.4)	30.6	18.6		22.0	(13.0)	52.0	95.0	120.0	276.0

/a Of local.
/b Of foreign.
/c KNR financing.

Table 6.5

Table 6.6

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Incheon Coal Port Terminal

Calculation of Rent to be paid by TOC
(Won million)

	1983	1984	1985	1986	Total	1988	1988	1989	1990	1991
Costs and Revaluation										
Civil Works										
Basic cost (March 1983)	9,090	19,638	11,810		40,538					
Physical contingencies (%)	455	982	590		2,027					
Base line cost estimate	9,545	20,620	12,400		42,565					
Price contingencies (compounded)										
- %	2.0	10.1	18.2	26.0						
- amount	191	2,083	2,257		4,531					
Total Civil Works	9,736	22,703	14,657		47,096					
Annual Revalued Values (6% p.a.)					47,096	49,922	52,917	56,092	59,458	63,025
Annual renewals and additions (1/2 of annual depreciation)						832	882	935	991	1,050
Cumulated renewals and additions						832	1,714	2,649	3,640	4,690
Basis for depreciation					47,096	50,754	54,631	58,741	62,798	67,715
Annual depreciation (over 30 years)					1,570	1,692	1,821	1,958	2,093	2,257
Cumulated depreciation					1,570	3,262	5,083	7,041	9,134	11,391
Net value in use					45,526	47,492	49,548	51,700	53,664	56,324
Annual average net fixed assets in use					45,526	46,509	48,520	50,624	52,682	54,994
Equipment										
Basic cost		11,239	11,239	4,672	27,150					
Price contingencies (compounded)										
- %		10.1	18.2	26.0						
- amount		1,135	2,045	1,215	4,395					
Total Equipment Cost		12,374	13,284	5,887	31,545					
Annual Revalued Values (6% p.a.)					31,545	33,438	35,444	37,571	39,825	42,214
Annual renewals and additions (1/2 of annual depreciation)					-	1,155	1,181	1,252	1,328	1,407
Cumulated renewals and additions						1,155	2,336	3,588	4,916	6,323
Basis for depreciation					31,545	34,593	37,780	41,159	44,741	48,537
Annual depreciation (over 15 years)					2,103	2,306	2,519	2,744	2,985	3,326
Cumulated depreciation					2,103	4,409	6,928	9,672	12,655	15,891
Net value in use					29,942	30,184	30,852	31,487	32,086	32,646
Annual average net fixed assets in use					29,942	30,063	30,518	31,170	31,787	32,366
Charges to TOC										
Administration										
1% of gross investment value of civil works					411	508	546	587	628	657
Plus 1.5% gross value of equipment					473	519	567	617	671	728
Total Administration					884	1,027	1,116	1,204	1,299	1,305
Depreciation										
Civil works					1,170	1,692	1,821	1,958	2,093	2,257
Equipment					2,103	2,306	2,519	2,744	2,983	3,230
Total Depreciation					3,673	3,998	4,340	4,702	5,076	5,493
Return on Average net investments in use										
Average net fixed assets in use					75,468	76,572	79,038	81,794	84,469	87,360
5%					3,773	3,829	3,952	4,090	4,223	4,368
Grand Total Charge to TOC					8,330	8,854	9,405	9,996	10,598	11,166

Table 6.7

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Incheon Coal Port Terminal

Projection of Income Statement and
Sources and Application of Funds 1986-91
(Won million)

	1986	1987	1988	1989	1990	1991	Total 1986-91
Income Statement							
Gross Operating Revenue							
TOC charges	8,330	8,854	9,405	9,996	10,598	11,166	
Operating Cost							
Administration	884	1,027	1,113	1,204	1,299	1,305	
Depreciation	3,673	3,998	4,340	4,702	5,076	5,493	
Total Operating Cost	4,557	5,025	5,453	5,906	6,375	6,798	
Net Operating revenue	3,773	3,829	3,952	4,090	4,223	4,368	
Interest charges	3,432	3,785	3,470	3,150	2,839	2,523	
Net Profit	341	44	482	940	1,384	1,845	
Sources and Applications of Funds							
Sources							
Cash generated from operations	7,446	7,827	8,292	8,792	9,299	9,861	51,517
Application							
Investments: Civil Works	-	832	882	935	991	1,050	4,690
Equipment	-	1,155	1,181	1,252	1,328	1,407	6,323
Total	-	1,987	2,063	2,187	2,319	2,457	11,013
Debt Service							
Interest	3,432	3,785	3,470	3,150	2,839	2,523	19,199
Repayment	-	2,629	2,629	2,629	2,629	2,629	13,145
Total	3,432	6,414	6,099	5,779	5,468	5,152	32,344
Total Applications	3,432	8,401	8,162	7,966	7,787	7,609	43,357
Annual cash earnings	4,014	(574)	130	826	1,512	2,252	8,160
Brought forward from previous year	-	4,014	3,440	3,570	4,396	5,908	
Cumulated cash earnings	4,014	3,440	3,570	4,396	5,908	8,160	

Table 6.8

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

Ulsan Coal Terminal

Calculation of Rent to be paid by TOC
(Won million)

	1983	1984	1985	1986	Total	1988	1988	1989	1990	1991
Costs and Revaluation										
Civil Works										
Basic cost (March 1983)	3,480	3,014			6,494					
Physical contingencies	174	151			325					
Base line cost estimate	3,654	3,165			6,819					
Price contingencies (compounded)										
- %	2.0	10.1	18.2	26.0						
- amount	73	320			393					
Total Civil Works	3,727	3,485			7,212					
Annual Revalued Values (% p.a.)					7,212	7,645	8,103	8,590	9,105	9,651
Annual renewals and additions (1/2 of annual depreciation)					-	127	135	143	152	161
Cumulated renewals and additions					-	127	262	405	557	718
Basis for depreciation					7,212	7,772	8,365	8,995	9,662	10,369
Annual depreciation (over 30 years)					240	259	279	300	322	346
Cumulated depreciation					240	499	778	1,078	1,400	1,746
Net value and use					6,972	7,273	7,587	7,917	8,262	8,623
Annual average net fixed assets in use					6,972	7,123	7,430	7,752	8,090	8,443
Equipment										
Basic cost		4,921	8,453		13 374					
Price contingencies (compounded)										
- %		10.1	18.2							
- amount		497	1,538		2,035					
Total Equipment Cost		5,418	9,991		15,409					
Annual Revalued Values (% p.a.)					15,409	16,333	!7,313	18,353	19,453	20,621
Annual renewals and additions (1/2 of annual depreciation)					-	544	577	612	648	687
Cumulated renewals and additions					-	544	1,121	1,733	2,381	3,068
Basis for depreciation					15,409	16,877	18,434	20,086	21,834	23,689
Annual depreciation (over 15 years)					1,027	1,125	1,229	1,339	1,456	1,579
Cumulated depreciation					1,027	2,152	3,381	4,720	6,176	7,755
Net value and use					14,382	14,725	15,053	15,366	15,658	15,934
Annual average net fixed assets in use					14,382	14,554	14,889	15,210	15,512	15,796
Charges to TOC										
Administration										
1% of gross investment value of civil works					72	78	84	90	97	104
Plus 1.5% gross value of equipment					234	253	277	301	328	355
Total Administration					306	331	361	391	425	459
Depreciation										
Civil works					240	259	279	300	322	346
Equipment					1,027	1,125	1,229	1,339	1,456	1,579
Total Depreciation					1,267	1,384	1,508	1,639	1,778	1,925
Return Average net investments in use										
Average net fixed assets in use					21,354	21,677	22,319	22,962	23,602	24,239
8%					1,708	1,734	1,786	1,837	1,888	1,939
Grand Total Charge to TOC					3,281	3,449	3,655	3,867	4,091	4,323

Table 6.9

KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

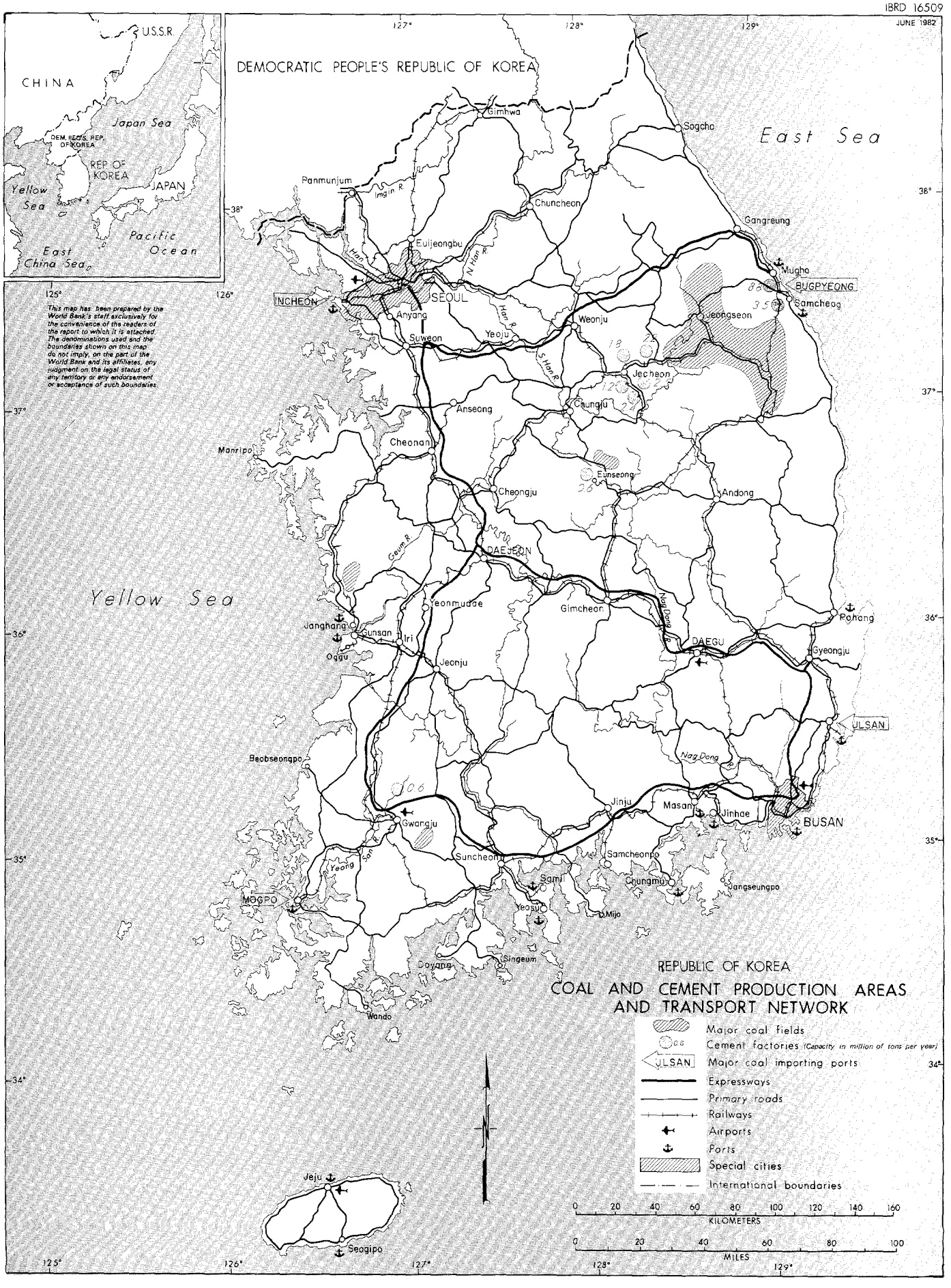
Ulsan Coal Terminal

Projection of Income Statement and Sources and Application of Funds 1986-91
(Won million)

	1986	1987	1988	1989	1990	1991	Total 1986-91
Income Statement							
Gross Operating Revenue							
TOC charges	3,281	3,449	3,655	3,867	4,091	4,323	
Operating Cost							
Administration	306	331	361	391	425	459	
Depreciation	1,267	1,384	1,508	1,639	1,778	1,925	
Total Operating Cost	1,573	1,715	1,869	2,030	2,203	2,384	
Net Operating revenue	1,708	1,734	1,786	1,837	1,888	1,939	
Interest charges	1,849	1,849	1,695	1,541	1,387	1,233	
Net Profit	(141)	(115)	91	296	501	706	
Sources and Applications of Funds							
Sources							
Cash generated from operations	2,975	3,118	3,294	3,476	3,666	3,864	20,393
Application							
Investments: Civil Works	-	127	135	143	152	161	718
Equipment	-	544	577	612	648	687	3,068
Total	-	671	712	755	800	848	3,786
Debt Service							
Interest	1,849	1,849	1,695	1,541	1,387	1,233	9,554
Repayment	-	1,284	1,284	1,284	1,284	1,284	6,420
Total	1,849	3,133	2,979	2,825	2,671	2,517	15,974
Total Applications	1,849	3,804	3,691	3,580	3,471	3,365	19,760
Annual cash earnings	1,126	(686)	(397)	(104)	195	499	633
Brought forward from previous year	-	1,126	440	43	(61)	134	
Cumulated cash earnings	1,126	440	43	(61)	134	633	

IBRD 16509

JUNE 1982



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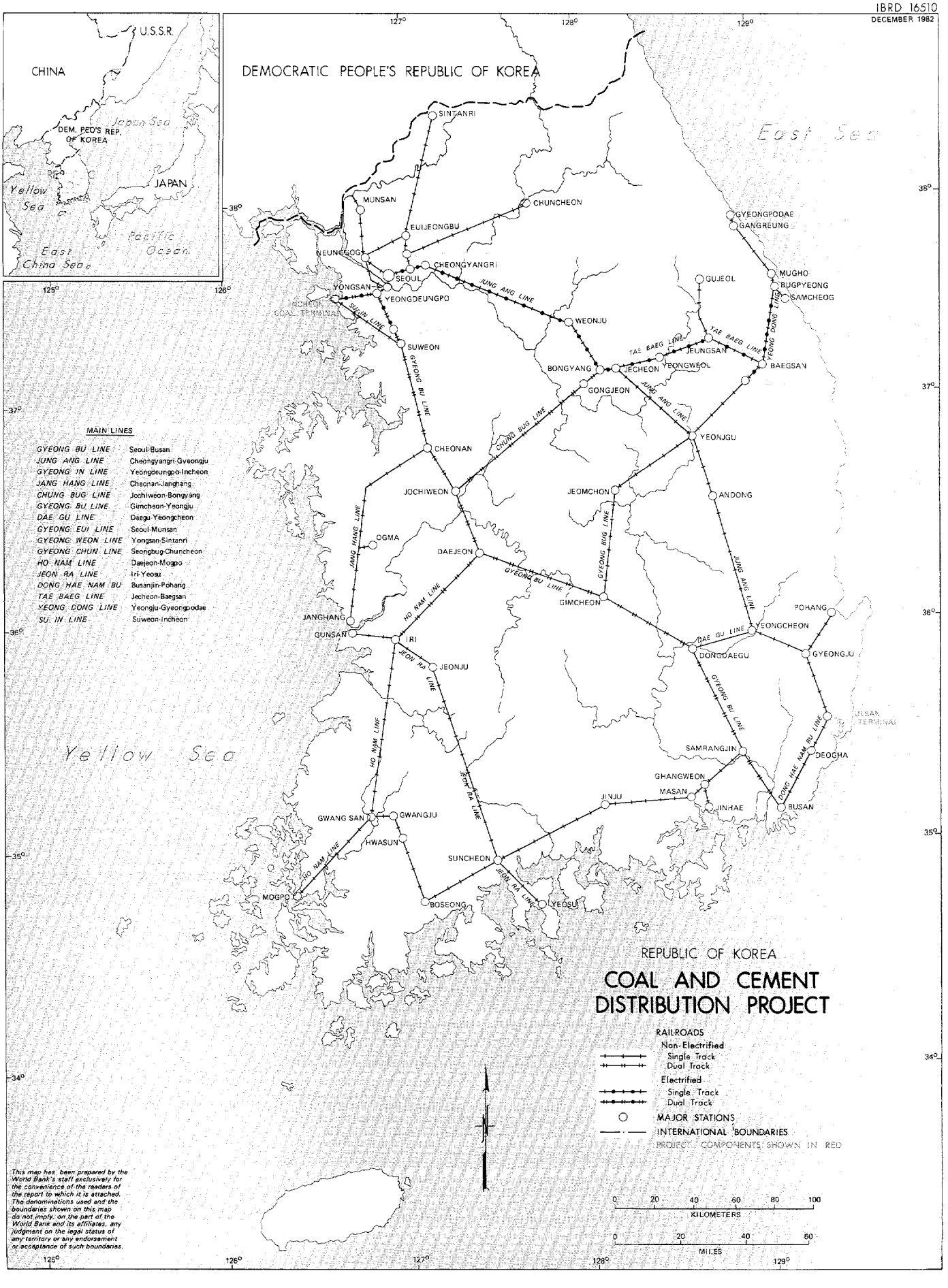
DECEMBER 1982



MAIN LINES

GYEONG BU LINE	Seoul-Busan
JUNG ANG LINE	Cheongyangri-Gyeongju
GYEONG IN LINE	Yeongdeungpo-Incheon
JANG HANG LINE	Cheonan-Janghang
CHUNG BUG LINE	Jochiweon-Bongyang
GYEONG BU LINE	Gimcheon-Yeongju
DAE GU LINE	Daegu-Yeongcheon
GYEONG EUI LINE	Seoul-Munsan
GYEONG WEON LINE	Yongsan-Sintanri
GYEONG CHUN LINE	Seongbug-Chuncheon
HO NAM LINE	Daejeon-Mogpo
JEON RA LINE	Iri-Yeosu
DONG HAE NAM BU	Busanjin-Pohang
TAE BAEG LINE	Jecheon-Baegsan
YEONG DONG LINE	Yeongju-Gyeongpodae
SU IN LINE	Suweon-Incheon

REPUBLIC OF KOREA

COAL AND CEMENT DISTRIBUTION PROJECT

RAILROADS
- Non-Electrified
  - Single Track
  - Dual Track
- Electrified
  - Single Track
  - Dual Track

MAJOR STATIONS

INTERNATIONAL BOUNDARIES

PROJECT COMPONENTS SHOWN IN RED

0 20 40 60 80 100 KILOMETERS

0 20 40 60 MILES

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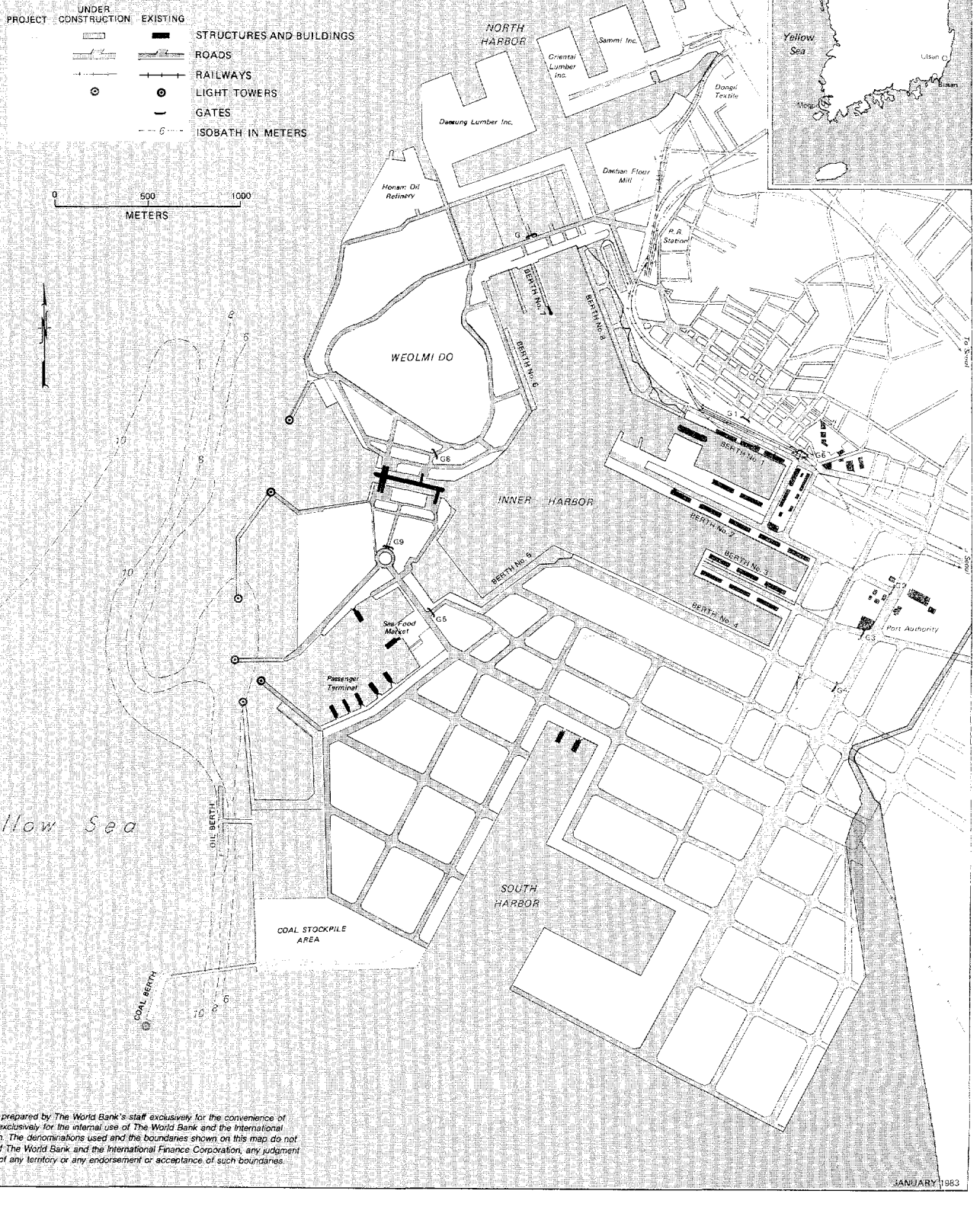
IBRD 16954

REPUBLIC OF KOREA

COAL AND CEMENT DISTRIBUTION PROJECT
INCHEON PORT



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JANUARY 1983

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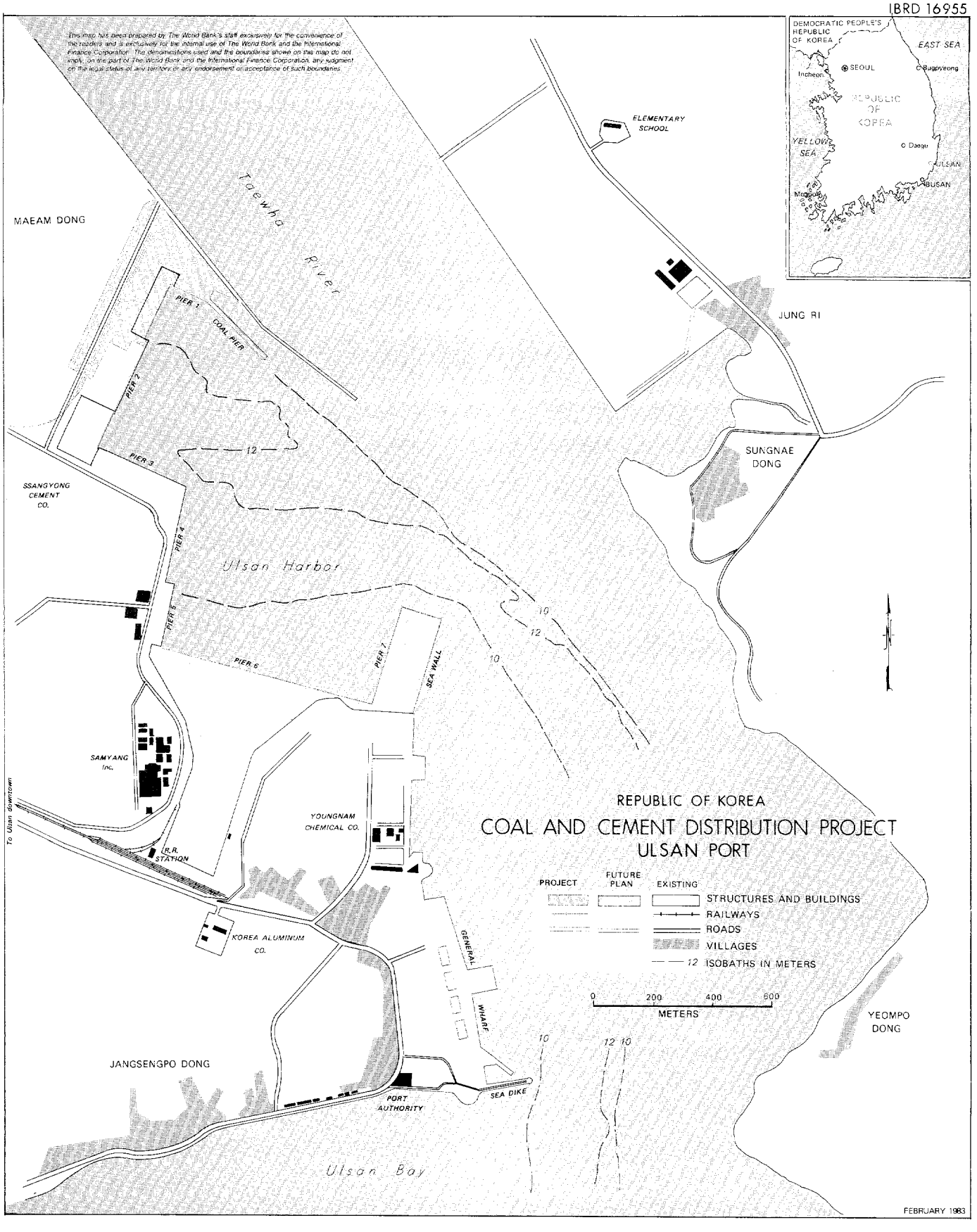
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DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA
EAST SEA
Incheon
SEOUL
Chuncheon
Pohang
REPUBLIC OF KOREA
YELLOW SEA
Daegu
ULSAN
BUSAN
Mokpo
ELEMENTARY SCHOOL
MAEAM DONG
Taewha River
JUNG RI
PIER 1
COAL PIER
PIER 2
PIER 3
12
SUNGNAE DONG
SSANGYONG CEMENT CO.
PIER 4
Ulsan Harbor
PIER 5
PIER 6
PIER 7
SEA WALL
10
12
10
SAMYANG Inc.
To Ulsan downtown
YOUNGNAM CHEMICAL CO.
R.R. STATION
KOREA ALUMINUM CO.
GENERAL
WHARF
JANGSENGPO DONG
PORT AUTHORITY
SEA DIKE
Ulsan Bay
10
12
10
YEOMPO DONG
REPUBLIC OF KOREA
COAL AND CEMENT DISTRIBUTION PROJECT
ULSAN PORT
PROJECT
FUTURE PLAN
EXISTING
STRUCTURES AND BUILDINGS
RAILWAYS
ROADS
VILLAGES
12 ISOBATHS IN METERS
0 200 400 600
METERS
FEBRUARY 1983