



# 2006 Minerals Yearbook

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REPUBLIC OF KOREA

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# THE MINERAL INDUSTRY OF THE REPUBLIC OF KOREA

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The Republic of Korea is a newly industrialized country in East Asia. Its indigenous mineral resources are poor. The country's raw material requirements for its ferrous and nonferrous metals manufacturing industries were met mostly by imports. The country also imported all its requirements for coking coal, natural gas [in the form of liquefied natural gas (LNG)], crude petroleum, and uranium mainly for its iron and steel and utilities industries.

According to state-owned Korea Resources Corp. (KORES), which was under the supervision of the Ministry of Commerce, Industry and Energy (MCIE), the Republic of Korea has small reserves of antimony, copper, gold, iron ore, lead, molybdenum, silver, tin, tungsten, and zinc. The country's reserves of coal and offshore natural gas are also small. Reserves of industrial minerals, such as dolomite, kaolin, limestone, pyrophyllite, silica stone (quartzite), talc, and zeolite, however, are larger than those of other identified minerals in the Republic of Korea (Korea Resources Corp., 2003, p. 117).

Because of its limited indigenous mineral resources, the Republic of Korea relied 100% on imports to meet its requirements for bituminous coal, ores and concentrates of copper, and fluorite and phosphate rock. The Republic of Korea relied on imports for about 99% of its domestic consumption of iron ore and most nonferrous metallic minerals, such as lead and zinc (Korea Resources Corp., 2003, p. 77).

In 2006, the Republic of Korea was one of the world's leading importers of coking coal, ores and concentrates of ferrous and nonferrous metals, natural gas, and crude petroleum. The country was the leading producer of cadmium, the third ranked producer of slab zinc, and the fifth ranked producer of steel in the world (International Iron and Steel Institute, 2007a; World Bureau of Metal Statistics, 2007, p. 34, 129). The country was a major producer of cement, refined copper, pyrophyllite, talc, and zeolite in the Asia and the Pacific region and one of the region's significant consumers and importers of coal, natural gas, and crude petroleum; of ores and concentrates of copper, iron, lead, and zinc; and of nickel oxide sinter.

## Minerals in the National Economy

The mining and quarrying sector, which was the smallest sector of the Republic of Korea's economy, produced small quantities of anthracite coal and of ores and concentrates of ferrous and nonferrous metals and a considerable quantity of industrial minerals for domestic consumption by the manufacturing and construction industries. According to the Bank of Korea, the output of the mining and quarrying sector accounted for only 0.26% of the country's real gross domestic product (GDP) (in 2000 constant prices) in 2006. The output of the industrial minerals (nonmetal) sector accounted for about 70% of the country's total mineral production (Korea Resources Corp., 2003, p. 9; Bank of Korea, 2007, p. 184).

In 2006, the country's GDP in current prices was \$911.9 billion<sup>1</sup> [Korean Won (W) 847,876.4 billion], and real GDP in 2000 constant prices was \$816.6 billion (W759,234.4 billion). The economy as measured by the real GDP grew by 5% in 2006. This 5% growth was attributable mainly to an 8.4% growth in the manufacturing sector. The mining and quarrying sector grew by 2.7% in 2006 compared with a decline of 1.7% in 2005 (Bank of Korea, 2007, p. 184).

## Government Policies and Programs

The MCIE is the main Government agency that implements the country's mineral law and policies. The Korea Mining Act as amended by law No. 6656 of 2002 provides the basic guidelines for the mining industry to develop the national industry through the rational exploitation of the country's mineral resources. In June 1967, the Government established KORES to support the development of the domestic private sector mining industry, to conduct research, and to provide technical assistance in the development and acquisition of overseas mineral resources (Korea Resources Corp., 2003, p. 87, 95).

Because of the country's heavy reliance on imports of raw materials for its manufacturing sector and the lack of a materials stockpiling program to draw upon in a potential resource crisis, the MCIE, through KORES (for the development of overseas mineral resources) and the Korean National Oil Corporation (KNOC) (for the exploration and development of overseas oilfields), was actively promoting overseas exploration and development of mineral resources and seeking cooperative relations with resource-rich developing countries. As a long-term policy goal, the Government was seeking to secure a stable supply of the mineral resources (including mineral fuels) that are essential for stable economic growth. In recent years, KORES has moved toward direct equity participation in overseas mine development to achieve the following development-linked mineral import ratio for six strategic minerals by 2010: coal, 30%; copper and zinc, 20% each; iron ore and uranium, 10% each; and rare earths, 5% (Korea Resources Corp., 2003, p. 77; 2005, p. 9).

## Production

The Republic of Korea's mine production of ferrous and nonferrous metals included copper, gold, iron ore, lead, silver, and zinc. The mine production of industrial minerals included diatomite, feldspar, graphite, kaolin, limestone, mica, pyrophyllite, quartzite, salt, sand, talc, and zeolite. The annual mine production of ferrous and nonferrous metals was very small compared with the country's annual raw material requirements for its ferrous and nonferrous metal manufacturing

<sup>1</sup>Values have been converted from Korean Won (W) to U.S. dollars (US\$) at a rate of W929.8=US\$1.00 for 2006.

industries. The annual mine production of industrial minerals was mostly for domestic consumption. Some mine production of industrial minerals, such as pyrophyllite, talc, and zeolite, was exported. The country also produced anthracite coal and a small amount of natural gas from an offshore gasfield, but no crude petroleum.

The Republic of Korea manufactured large quantities of iron and steel and refined petroleum products using imported raw materials for domestic consumption and export. The country also produced significant quantities of cadmium and zinc and a considerable amount of nonferrous metals, including bismuth, copper, gold, lead, and nickel, all using mostly imported raw materials. The country's metal production of cadmium, crude steel, and refined zinc all increased in 2006; it ranked first, fifth, and third, respectively, in the world in output of these commodities.

Cement production, for which mostly domestic raw materials (such as limestone) were used, increased by 5% to about 54 million metric tons (Mt) in 2006 from that of 2005 owing mainly to stronger domestic demand by the construction industry. Refined petroleum products production increased by 3% to 947.4 million barrels (Mbbbl) in 2006 owing mainly to increased exports (table 1).

## Trade

In 2006, the Republic of Korea's total exports increased by 14.5% to \$325.7 billion owing mainly to a 14.4% increase in exports of heavy industry products to \$236.2 billion, a 14.5% increase in exports of chemicals to \$28.3 billion, and a 13.3% increase in exports of petroleum products to \$20.6 billion. The country's total imports increased by 18.4% to \$309.4 billion owing mainly to a 23.0% increase in imports of crude materials and fuels to \$174 billion, of which fuel, which included coal, natural gas, and crude petroleum, increased by 28.4% to \$85.3 billion, and metallic and industrial minerals, by 39.3% to \$13 billion (Bank of Korea, 2007, p. 126-127).

In minerals trade, the Republic of Korea was a net importer of mineral commodities owing to its large imports of coal, natural gas, and crude petroleum; iron ore and ores and concentrates of copper, lead, and zinc; and ferrous and nonferrous metal products. In 2006, imports of fuels totaled \$85.3 billion, of which \$55.9 billion was crude petroleum. Imports of iron and steel products totaled \$17.7 billion, and nonferrous metals, \$12.3 billion. Imports of minerals, which included iron ore and ores and concentrates of copper, lead, zinc, and other minerals, totaled \$13 billion. Exports of crude materials and fuels totaled \$25.1 billion, of which \$20.6 billion was refined petroleum products. Exports of iron and steel products totaled \$27.2 billion (Bank of Korea, 2007, p. 126-127).

## Structure of the Mineral Industry

The Republic of Korea's mining and quarrying sector consisted of small mining industries of coal and ferrous and nonferrous metals and a relatively larger industry of industrial minerals. The mineral-processing sector, which consisted of the cement, ferrous and nonferrous metals, and refined petroleum

products industries, was much larger than the mining and quarrying sector (table 2). The mining and quarrying sector employed about 11,000 workers, of which about 6,600 were coal miners; about 4,400, industrial minerals miners; and about 140, metallic minerals miners. Most of the mining, quarrying, and ferrous- and nonferrous-metal-processing companies were owned and operated by private companies incorporated in the Republic of Korea. The larger coal mining, natural gas, petrochemical, and petroleum refining companies, however, were state-owned and under the supervision of MCIE (Korea Resources Corp., 2003).

LS-Nikko Copper Inc. (formerly LG-Nikko Copper Inc.) had a copper refining capacity of 510,000 metric tons per year (t/yr) in Onsan and an additional refining capacity of 60,000 t/yr in Changhang. LS-Nikko Copper also had a refined-silver production capacity of 370,000 kilograms per year (kg/yr) in Onsan (Korea Nonferrous Metal Association, 2006).

Construction of the country's first molybdenum smelter with a capacity of 6,000 t/yr started in 2006. The smelter, which was a joint venture of KORES and KTC Korea Co., was scheduled to begin production in 2007 (Mineweb.com, 2007).

## Commodity Review

### *Metal*

**Aluminum.**—The Republic of Korea relied on imports to meet all its requirements for primary aluminum. In 2006, imports of primary aluminum decreased by 2.1% to 1,204,350 metric tons (t), of which 940,188 t was primary aluminum ingot, and 264,162 t, primary aluminum alloys. The major suppliers of primary aluminum ingots and alloys were China (34.8%), Russia (28.4%), Australia (19.0%), the United Arab Emirates (4.2%), and Canada (3.6%). The country's imports of aluminum and aluminum alloy scrap increased by 26.6% to 377,178 t in 2006 (World Bureau of Metal Statistics, 2007, p. 25).

In 2006, domestic demand for primary aluminum in the Republic of Korea decreased by 4.0% to 1.15 Mt. The major consumers were the manufacturers of coil, plate, and aluminum sheet; aluminum extrusion; aluminum foil; aluminum metal powders; and aluminum wheels for automobiles and other casting products (Joo Ho Kim, Vice Chief, Korea Nonferrous Metal Association, written commun., June 8, 2006; World Bureau of Metal Statistics, 2007, p. 25).

**Copper.**—Mined production of copper was very small and insignificant compared with the country's 2006 requirements for copper ore and concentrate of about 1.46 Mt (in gross weight), which contained about 437,400 t of copper. The Republic of Korea was the third ranked consumer and fourth ranked producer of refined copper in the Asia and the Pacific region in 2006. The country relied on imports of copper ore and concentrate to meet the raw material requirements for its copper smelters, which were located in Changhang and Onsan. In 2006, imports of copper ore and concentrates increased by 4.6% to 1,458,115 t, which was valued at about \$3.3 billion (Ministry of Commerce, Industry and Energy, 2007, p. 292).

In 2006, the Republic of Korea's copper smelters produced about 484,000 t of blister and anode copper (International

Copper Study Group, 2007, p. 13). To meet raw material requirements for the Changhang and the Onsan copper smelters and refineries, the country also imported 87,112 t of blister and anode copper and 205,342 t of copper and copper alloy scrap. The Republic of Korea produced about 575,492 t of refined copper. To meet the domestic refined copper requirements, the country also imported about 380,254 t of refined copper, 414 t of master alloys, and 3,743 t of copper alloy ingots (World Bureau of Metal Statistics, 2007, p. 71).

In June 2006, LS-Nikko Copper reportedly started Phase one expansion works at its Onsan refinery and would increase its copper refining capacity by 50,000 t/yr by the end of 2008. LS-Nikko Copper shut down its Changhang smelter in September but kept its refinery operating (Platts.com, 2006b).

In 2006, domestic demand for copper cathode decreased by 4.7% to 827,869 t from 868,454 t in 2005. Exports of copper cathode, however, increased sharply by 65.4% to 144,246 t from 87,208 t in 2005, and imports of copper cathode decreased by 11.2% to 380,254 t from 428,049 t in 2005. In the domestic market, most copper cathode was consumed by the manufacturers of brass, cable, plates, sheet, strip, tube, and wire (Korea Nonferrous Metal Association, 2006, p. 1; World Bureau of Metal Statistics, 2007, p. 71).

**Gold.**—Mine production of gold increased by 4.1% to 277 kilograms (kg) from 266 kg (Lee, Kyung-Han, Principal Researcher, Mineral Economics Team, Korean Institute of Geoscience and Mineral Resources, written commun., July 11, 2007). The country produced 43,505 kg of refined gold, of which 1,582 kg was produced from domestic raw materials (which included scrap). Imports of refined gold totaled 42,916 kg, which was valued at \$814.9 million; domestic demand for refined gold was 41,683 kg. Exports of refined gold totaled 45,469 kg, which was valued at \$825.9 million. The major end users of refined gold were the manufacturers of coins, dental products, electrical communication parts, jewelry, and materials for semiconductors (Ministry of Commerce, Industry and Energy, 2007, p. 9).

**Iron and Steel.**—In 2006, mine production of iron ore, in gross weight, increased by 6.6% to about 227,000 t. Domestic iron ore was produced from the Sinyemi Mine. The Yeon-Chon Mines reportedly had been closed in 2003. The Republic of Korea relied 99.5% on imports to meet its iron ore requirement in 2006. Imports of iron ore totaled 43.9 Mt and were valued at about \$2.38 billion. Imports of iron ore were mainly from Australia (62.6%), Brazil (27.5%), India (3.8%), and South Africa (3.1%). Other suppliers of iron ore were Chile, Peru, and the United States. The average import price of iron ore rose by 22.1% to \$54.16 per metric ton from \$44.37 per metric ton in 2005 (Ministry of Commerce, Industry and Energy, 2007, p. 9; Tex Report, The, 2007d).

In 2006, the iron and steel industry consumed 43.41 Mt of iron ore. Pig iron production increased slightly to 27.5 Mt from 27.3 Mt in 2005. Crude steel production increased by 1.3% and reached a new record-high level of 48.43 Mt in 2006, of which 30.16 Mt (62.3%) was produced by Pohang Iron and Steel Co. Ltd. (POSCO); 8.86 Mt (18.3%), by Hyundai INI Steel Co.; 2.87 Mt (5.9%), by Dongkuk Steel Mill Co. Ltd.; 1.11 Mt (2.3%), by Korea Iron and Steel Co. Ltd.; and the

remaining 5.43 Mt (11.2%), by more than seven other smaller steel companies led by SeAH Besteel Corp. and Yamato Korea Steel Corp. (Ministry of Commerce, Industry and Energy, 2007, p. 278; Tex Report, The, 2007c).

In 2006, the Republic of Korea was the world's fifth ranked steel-producing country (not counting the European Union as a country). The country's crude steel output accounted for about 3.9% of the world's total. The Republic of Korea's two leading steelmakers—POSCO and Hyundai INI Steel Co. Ltd.—were the world's 4th and 31st ranked steel-producing companies, respectively, in 2006 (International Iron and Steel Institute, 2007a, b).

According to the Korea Iron and Steel Association, the country's steel consumption was estimated to be about 48.9 Mt in 2006. This amount was expected to increase by 2.7% to about 50.2 Mt in 2007 from that of 2006 because of the growing demand for steel in the manufacturing sector, which was driven by a boom in the automobile and shipbuilding industries (Yonhap News, 2006b).

For 4 consecutive years, the Republic of Korea's steel imports had exceeded its steel exports owing mainly to a steady increase in domestic demand for low-priced steel, especially steel from China. In 2005, the country's steel imports totaled 18.9 Mt and exports totaled 16.3 Mt. Between 2000 and 2005, the country's steel imports had grown rapidly from 11.5 Mt in 2000 to 17.7 Mt in 2004 and to 18.9 Mt in 2005, while steel exports grew less rapidly from 13.8 Mt in 2000 to 15.1 Mt in 2004 and to 16.3 Mt in 2005. In terms of value, however, steel exports were valued at \$14.6 billion and steel imports amounted to only \$13.3 billion in 2005. According to the Korea Iron and Steel Association, the country's steel imports from China increased sharply by more than 445% to 10 Mt in 2006 compared with only 1.8 Mt in 2003. For the first 10 months of 2006, imports of high-end cold-rolled steel plate and galvanized sheets from China rose by 44.7% and imports of hot-rolled steel plates from China for the automobile, shipbuilding, and construction industries increased by 118.3% compared with the same period in 2005 (Chosun Ilbo, The, 2006; Metals Place, 2006).

To meet the increasing domestic demand for steel, Hyundai INI Steel announced in April 2006 that it planned to construct two 3.5-million-metric-ton-per-year (Mt/yr) furnaces at Dangjin (Tangjin) in South Chungcheong Province. The company planned to start construction of the first furnace in early 2007 and was scheduled to finish construction by the fourth quarter of 2009. Dongkuk Steel Mill Co. Ltd., which completed the construction of an exclusive berth (the company's privately owned berth) at Pohang New Port in North Kyongsang Province, was to build a 1.5-Mt/yr plant for the production of steel used in shipbuilding by 2012 (Southeast Asia Iron and Steel Institute, 2006a, b).

**Molybdenum.**—In October 2006, Vancouver-based Oriental Minerals Inc. acquired the Sangdong molybdenum-tungsten mine, which had been one of the world's leading tungsten producing mines between 1947 and 1992 but was closed in 1992 owing to low metal prices. The Sangdong molybdenum and tungsten mine is located about 170 kilometers (km) east-southeast of Seoul in Youngwol County, Kangwong Province. According to the acquisition agreement, Oriental Minerals agreed to pay \$2.4 million in cash and \$800,000 in company



stock to the Se Woo Mining Co. Ltd., which is a private company based in Seoul. Following the initial payment of \$2.4 million, Oriental Minerals must spend an additional \$800,000 during each of the next 3 years. Oriental Minerals will earn an initial 51% interest in all properties, an additional 19% interest by completing a prefeasibility study within 5 years, and a final 30% if the company starts a feasibility study during the fifth year and completes it within 18 months. In addition to the Sangdong Mine, which Oriental Minerals acquired in October 2006, other mineral properties under the acquisition agreement included the Chongyang molybdenum-tungsten mine (which was closed in 1977), the Muguk gold-silver mine (which was the country's leading gold producing mine), and the Gasado gold-silver property on Gasado Island (which is located 5 km off the southwest coast of the Korean Peninsula). According to an estimate by KORES, the Sangdong Mine still had reserves of about 85,730 t (189 million pounds) of tungsten trioxide ( $\text{WO}_3$ ) from 15.6 Mt of ore at a grade of 0.5%  $\text{WO}_3$  in the main ore body and 1.4 Mt of ore at a grade of 0.55%  $\text{WO}_3$  in the east ore body. A molybdenum deposit beneath the existing tungsten mine was estimated to contain a resource of 16 Mt at a grade of 0.4%  $\text{MoS}_2$  which contains about 63,550 t (140 million pounds) of molybdenum (Northern Miner, The, 2006; Oriental Minerals Inc., 2006).

In November, 2006, Oriental Minerals began its first hole drilling at SD-01 to a depth of 750 meters (m) from the surface at the Sandong molybdenum-tungsten mine. Samples from the hole were to be sent to ALS Chemex Laboratory in Brisbane, Australia, for analysis (Oriental Minerals Inc., 2006).

**Nickel.**—The Republic of Korea relied 100% on imports to meet its nickel requirements. In 2006, the country imported 135,408 t of ferronickel (in gross weight), 37,220 t of nickel oxide sinter (in gross weight), 35,787 t of refined nickel, and 1,108 t of nickel powder and flakes. The major suppliers of ferronickel were Japan (61.4%), Indonesia and Colombia (13.6% each), and the Dominican Republic (6.7%). The majority of nickel oxide sinter was exported to Japan (56.0%), Canada (17.8%), Australia (17.7%), and Russia (5.6%). The major suppliers of refined nickel were Russia (41.7%), Australia (32.2%), and Canada (10.1%). Canada, which was the principal supplier of nickel powder and flakes, accounted for 74.1% of the total commodity imports (International Nickel Study Group, 2007, p. 43-44).

Korea Nickel Corp. was the sole nickel refining company in the Republic of Korea. The company's nickel refinery in Onsan was estimated to produce only 25,400 t in 2006. The Onsan nickel refinery produced 97% purity nickel for consumption by the domestic stainless steel manufacturers but mainly by POSCO. Demand for nickel ingot in the domestic market decreased by an estimated 26% to 86,000 t. Nickel ingot exports increased sharply by 105% to 14,210 t in 2006. Taiwan alone accounted for 12,669 t in 2006 (International Nickel Study Group, 2007, p. 44).

In April 2006, POSCO and Société Minière du Sud Pacific S.A. (SMSP) of New Caledonia signed an agreement to establish nickel mining and refining joint ventures to provide a long-term stable source of raw materials for POSCO. Under

the agreement, POSCO would invest \$325 million for the construction of a nickel refinery in the Gwangyangman Free Economic Zone in the Republic of Korea. The refinery was scheduled to start production by the end of 2008. SMSP would provide mining rights for a joint-venture nickel mine to be established in New Caledonia. POSCO would own a 49% equity interest in each of the joint ventures and SMSP would hold a 51% stake. The nickel refinery was expected to produce 30,000 t/yr of nickel exclusively for POSCO, with the ore feed for the refinery to be supplied by the joint-venture nickel mine in New Caledonia for 30 years. POSCO reportedly consumed about 84,000 t of nickel in 2005 (Platts.com, 2006a).

In October 2006, a Republic of Korean consortium led by state-owned KORES agreed to invest about \$1.1 billion in a nickel mine development project in Ambatovy, Madagascar. The Korean consortium, which was made up of KORES, Daewoo International Corp., Keangnam Enterprises Ltd., and STX Corp., would own a 27.5% stake in the nickel project. Other partners in the nickel project would include Dynatec Corp. of Canada, Sumitomo Corp. of Japan, and SNC-Lavalin Inc., which would hold 40%, 27.5%, and 5% interest, respectively, in the project. The mine, which was estimated to contain about 125 Mt of nickel ore, was scheduled to start production of about 60,000 t/yr of nickel metal beginning in 2010. The Korean consortium would have the right to purchase 50% of the total production (Reuters, 2006).

**Zinc.**—The Republic of Korea relied on imports for almost all the raw material requirements for its zinc-refining industry. In 2006, imports of zinc ore and concentrate, in gross weight, increased by 1.9% to 1,307,811 t, which contained about 654,000 t of zinc metal and was valued at \$1.55 billion. The major suppliers were Australia (30.7%), Peru (20.4%), the United States (14.9%), India (12.5%), and Bolivia (8.5%). Consumption of zinc ore and concentrate was 1.25 Mt, which was the same level as that of 2005 (Ministry of Commerce, Industry and Energy, 2007, p. 9; World Bureau of Metal Statistics, 2007, p. 143).

In 2006, production of zinc slab decreased by about 2.7% to 662,500 t, of which about 63% was produced by Korea Zinc Co. Ltd. at Onsan, and 37%, by Young Poong Corp. at Sukpo. A worldwide shortage of raw materials that limited the supply of zinc ore and concentrate in 2006 had resulted in a sharply higher price of imported ore and concentrates. The average import price in 2006 was 167.5% higher than that of 2005. Korea Zinc remained one of the world's leading producers of slab zinc in 2006. The company produced about 435,000 t of slab zinc from its plants in Korea. According to Korean Zinc, the company planned to produce about 435,000 t of refined zinc in 2007 but was concerned about the appreciation of Korean Won, which could weaken its export competitiveness (Korea Zinc Co. Ltd., 2007).

Domestic demand for primary zinc (including unwrought zinc and zinc alloys, zinc bars, zinc rods, and other primary zinc products) was estimated to have increased by 6.4% to 450,000 t in 2006. Exports of primary zinc dropped by 15.9% to 315,083 t and imports of primary zinc decreased by 16.1% to 91,890 t (Korea Nonferrous Metal Association, 2006).

## *Industrial Minerals*

**Cement.**—The Republic of Korea was the world's fifth ranked cement producer after China, India, the United States, and Japan. According to the country's National Statistical Office, the national production of portland cement increased by 5% to about 54.0 Mt from 51.4 Mt in 2005 (Korea Development Bank, 2007, p.185).

According to the Korean Cement Industrial Association (KCIA), the Republic of Korea's cement industry comprised 11 companies that operated 51 kilns at 13 kiln plants and 27 grinding plants. The industry's total number of employees was about 6,640 in 2005. The total clinker production by all members decreased by about 1% to 42.7 Mt from 43.1 Mt (revised) in 2005, and the total cement production by all KCIA members increased by 4.2% to 49.2 Mt from 47.2 Mt in 2005. In 2006, the country did not import any clinker but imported 3.2 Mt of cement. Exports of clinker increased by 13.3% to 2.21 Mt from 1.95 Mt in 2005, and exports of cement in 2006 were at about the same level as that of 2005, which was about 4 Mt. Domestic consumption of cement increased by 4.5% to 48.4 Mt in 2006 (Korea Cement Industrial Association, 2007).

Tong Yang Cement Corp., which was the country's third ranked cement producer, produced about 11 Mt in 2006. The company reportedly had overcome the difficulties brought on by the 2006 appreciation of the Korean Won and higher oil prices but continued to face the difficulties brought on by the domestic construction industry's slowdown during the past 2 years. To remain competitive under these difficult situations, the company was to improve productivity and to reduce costs (Tong Yang Cement Corp., 2007).

**Graphite.**—According to KORES, the 50-50 joint venture between KORES and a North Korean firm officially opened the Jeongchon graphite mine in North Korea in late April 2006. KORES reportedly had spent about \$10.2 million to develop the mine in Jeongchon, South Hwanghae Province. The mine, which was estimated to contain 6.25 Mt of graphite, was capable of producing 3,000 t/yr of graphite, of which 1,830 t/yr would be exported to the Republic of Korea for the next 15 years. Under the joint-development agreement signed in March 2003, the Republic of Korea had transferred mining materials and other equipment to the mine in early 2004, and the mine development started shortly afterwards (Yonhap News, 2006a).

## *Mineral Fuels*

**Coal.**—Anthracite coal production held steady at the 2.8 Mt level in 2006. The ongoing coal industry's restructuring program was carried out under the Coal Mining Industry Act of 1988, which subsidized a portion of the expenses for mine closures. The Government also continued to support the relatively more-efficient coal mines with funds to modernize their facilities and revamp their development methods. Anthracite coal production was mostly consumed domestically as the main fuel in homes in the country's remote rural area.

To meet the country's overall coal requirements for general consumption and for industrial use in the cement, iron and steel, and electric power industries, the Republic of Korea imported

5.1 Mt of anthracite coal mainly from China (49.5%), Australia (25.5%), Vietnam (12.4%), and Canada (8.0%); 15.6 Mt of coking coal mainly from Australia (60.0%), China (11.5%), Russia (4.6%), and the United States (2.0%); and 59.0 Mt of thermal (steam) coal, of which about 55.3 Mt was bituminous coal, mainly from Indonesia (35.0%), Australia (31.1%), China (24.4%), Russia (6.9%), and Canada (1.8%). In 2006, coal imports increased by 3.8% to 79.7 Mt from 76.8 Mt in 2005 (Tex Report, The, 2007b).

In 2006, demand for coal (anthracite and bituminous) by the country's electric power industry increased by 4.6% to 52.6 Mt from 50.3 Mt in 2005. Of the coal consumed by the electric power industry, 50.3 Mt was bituminous coal, and 2.3 Mt, anthracite. Demand for anthracite coal by the electric power industry decreased by 1.7% to 2.32 Mt from 2.36 Mt in 2005. Demand for bituminous coal by the electric power industry increased by 4.8% to 50.25 Mt from 47.94 Mt in 2005 (Tex Report, The, 2007a). Other major consumers of coal were the iron and steel industry, which consumed between 20 Mt/yr and 22 Mt/yr, and the cement industry, which consumed between 10 Mt/yr and 11 Mt/yr.

**Natural Gas and Petroleum.**—In November 2004, KNOC began producing a small amount of offshore natural gas from the Donghae-1 field. In 2006, the daily production of natural gas was about 1.43 million cubic meters (50 million cubic feet), which was equivalent to about 2% of total domestic consumption. The Donghae-1 gasfield has total natural gas reserves of 708 million cubic meters (25 billion cubic feet). KNOC announced in 2005 that it had discovered new gas reserves estimated to contain about 1.13 billion cubic meters of natural gas in a gasfield located about 63 km offshore Ulsan on the east coast of the Korean Peninsula. According to KNOC, the new discovery could support production of 800,000 t of LNG (Korean National Oil Corp., 2007a).

In 2006, the Republic of Korea was the world's second ranked importer of LNG. The country relied on imports of LNG to meet 98% of its natural gas requirements. The country's consumption of LNG increased by 7.2% to 22.85 Mt in 2006, of which 14.03 Mt was for city gas companies to distribute to residential use and other uses, including industrial use, and 8.82 Mt was for power generation (Korea Gas Corp., 2007).

The Republic of Korea's imports of LNG in 2006 were estimated to be between 22 Mt and 23 Mt mostly under long-term contract. In 2005 (the latest year for which data were available), the country imported about 22.3 Mt of LNG mainly from Qatar (28%), Indonesia (25%), Malaysia (21%), and Oman (19%), and the remaining 7% from Algeria, Australia, Brunei, Nigeria, Russia, Spain, and the United Arab Emirates (Korea Gas Corp., 2007).

KOGAS and OAO Gazprom had signed a 5-year cooperation agreement in May 2003 for deliveries of Russian natural gas to the Republic of Korea. In October 2006, OAO Gazprom reportedly delivered its first consignment of LNG to the Republic of Korea. The delivery was made to the Pyeongtaek terminal, which was owned and operated by Korea Gas Corp. (KOGAS) (EN.RIAN.RU, 2006).

To secure additional supply of LNG at lower prices, state-owned KOGAS signed three 20-year sales and purchase

contracts worth nearly \$20 billion with Malaysia LNG Tiga (1.5 Mt/yr), Russian Sakhalin Energy (1.5 Mt/yr), and Yemen LNG (1.3 Mt/yr). Under the contracts, the companies would begin supplying the LNG in 2008. KOGAS reportedly also was negotiating with potential sellers for the purchase of an additional 3 Mt/yr to 5 Mt/yr of LNG (Petroleum Economist, 2006).

The Republic of Korea produced no crude petroleum and imported all crude petroleum requirements for its oil refining industry. In 2006, the country's imports of crude petroleum averaged about of 2.93 million barrels per day (Mbbbl/d), of which about 2.2 Mbbbl/d was consumed by the country and the remaining was refined and reexported as refined petroleum products mostly to neighboring countries in East Asia. Dependence on crude petroleum from the Middle East region continued to be very high. In 2006, the Middle Eastern region accounted for about 64% of the total crude petroleum imports, and Saudi Arabia alone accounted for 29% of total crude petroleum imports (U.S. Energy Information Administration, 2007).

Demand for crude petroleum in 2006 averaged 2.20 Mbbbl/d compared with 2.17 Mbbbl/d in 2005. In 2006, the Republic of Korea was the fourth ranked petroleum importer in the world and the seventh ranked petroleum consumer, but its energy self-sufficiency rating was very low. Because of its total dependence on oil imports, the country had developed a strategic petroleum reserve managed by KNOC. According to MCIE, the country will increase its emergency oil stockpile. KNOC planned to expand its storage capacity from 116 Mbbbl to 146 Mbbbl by 2009 and to fill the emergency oil stockpile to 141 Mbbbl by 2010 (U.S. Energy Information Administration, 2007).

## Outlook

During the next 2 to 3 years, production in the Republic of Korea's mining sector is expected to hold steady; in the mineral processing sector, however, the ferrous and nonferrous metals manufacturing industries are expected to expand. The country is expected to aggressively continue its direct equity participation in the joint-venture exploration and development of mineral resources, which include coal, copper, lead, zinc, and other nonferrous minerals as well as overseas oil and gas, especially in the Eurasian, Latin American, and Southeast Asian countries. The country is expected to continue to cooperate with North Korea in the joint development of copper, lead, magnesite, and zinc mines.

The country's economy as measured by the GDP is projected to grow at a slightly slower pace of 4.5% in 2007. The country's rate of inflation is forecasted to be between 2.5% and 3% during the next 2 years (International Monetary Fund, 2006).

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TABLE 1  
REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES<sup>1</sup>

(Metric tons unless otherwise specified)

Commodity	2002	2003	2004	2005	2006
<b>METALS</b>					
Bismuth, metal	69	120	156	231	236
Cadmium, smelter	1,825	2,175	2,362	2,582	3,320
Copper:					
Mine output, Cu content	--	--	7	16	13
Metal:					
Smelter, primary and secondary	430,000	460,000	442,500 <sup>r</sup>	486,500 <sup>r</sup>	484,000
Refined, primary and secondary	500,300 <sup>r</sup>	510,000 <sup>r</sup>	496,000 <sup>r</sup>	519,300 <sup>r</sup>	575,500
Gold:					
Mine output, Au content kilograms	310	166	233	266	277
Metal, refined do.	26,181	40,262	32,449	42,485	43,505
Iron and steel:					
Iron ore and concentrate:					
Gross weight thousand metric tons	157 <sup>r</sup>	174 <sup>r</sup>	226 <sup>r</sup>	213 <sup>r</sup>	227
Fe content do.	88 <sup>r</sup>	97 <sup>r</sup>	127 <sup>r</sup>	119 <sup>r</sup>	155
Metal:					
Pig iron do.	26,570	27,314	27,556	27,309	27,548
Ferroalloys:					
Ferromanganese	137,000	141,000	165,525	124,000	169,202
Ferrosilicomanganese	94,000	90,942	82,917	74,000	94,119
Total	231,000	231,942	248,442	198,000	263,321
Steel, crude thousand metric tons	45,390	46,310	47,521	47,820 <sup>r</sup>	48,437
Lead:					
Mine output, Pb content	28	--	40	50 <sup>r</sup>	17
Metal, smelter	179,863	169,297	173,609	180,784	163,379
Nickel	30,337	31,340	27,200	26,300	25,400 <sup>c</sup>
Silver:					
Mine output, Ag content kilograms	6,811	11,704	5,059	3,515	1,521
Metal do.	973,140	947,781	1,172,632	1,218,849	1,377,659
Zinc:					
Mine output, Zn content	99	--	14	77 <sup>r</sup>	16
Metal, primary	605,990	644,218	668,666	644,828	662,521
<b>INDUSTRIAL MINERALS</b>					
Barite	78	140	50	--	--
Cement, hydraulic thousand metric tons	56,823 <sup>r</sup>	60,725 <sup>r</sup>	56,955	51,391	53,971
Clays, kaolin do.	2,831	3,009	2,780	2,767	2,399
Diatomaceous earth	20,666	15,636	2,441	2,193	3,460
Feldspar	415,580	477,012	541,788	508,644	427,378
Graphite, all types	94	58	247	39	68
Lime, slaked lime	216,536	220,000 <sup>c</sup>	210,000 <sup>c</sup>	200,000 <sup>r,c</sup>	220,000
Mica, all grades	29,870	33,651	59,238	36,623	30,356
Nitrogen, N content of ammonia	152,600	118,900	163,400	165,000	90,000
Salt	800,000 <sup>c</sup>	800,000 <sup>c</sup>	340,828	378,887	285,568
Soda ash, manufactured <sup>c</sup>	310,000	310,000	310,000	310,000	310,000
Stone, sand and gravel:					
Limestone thousand metric tons	86,008	90,626	85,549	79,168	79,404
Quartzite do.	3,041	2,966	2,842	2,868	2,921
Sand, including glass sand do.	891	480	554	461	1,437
Sulfur, byproduct: <sup>c</sup>					
Metallurgy do.	737	797	796	800	850
Petroleum do.	687	757	879	900	950
Total do.	1,424	1,554	1,675	1,700	1,800

See footnotes at end of table.

TABLE 1--Continued  
 REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES<sup>1</sup>

(Metric tons unless otherwise specified)

Commodity	2002	2003	2004	2005	2006	
<b>INDUSTRIAL MINERALS--Continued</b>						
Talc and related materials:						
Pyrophyllite	889,961	912,285	827,895	885,559	677,465	
Talc	37,863	47,911	79,313	83,471	64,118	
Zeolite	149,335	132,760	142,401	173,435	160,056	
<b>MINERAL FUELS AND RELATED MATERIALS</b>						
Carbon black	459,985	464,941	473,788	471,716	484,302	
Coal, anthracite	thousand metric tons	3,318	3,297	3,191	2,832	2,824
Fuel briquets, anthracite briquets	do.	1,200	1,191	1,385	2,010 <sup>f</sup>	2,327
Petroleum, refinery products	thousand 42-gallon barrels	940,000	796,000	886,415	919,627 <sup>f</sup>	947,433

<sup>e</sup>Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. <sup>f</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through August 30, 2007.

Sources: Ministry of Commerce, Industry and Energy, Korea Institute of Geoscience and Mineral Resources, Current status of minerals supply and demand, 2006; U.S. Geological Survey Minerals Questionnaire 2002-06. International Copper Study Group, Copper Bulletin, May 2007. Korea Development Bank, KDB Monthly, Table 13, Production of major manufacturers, May 2007, p. 248-52.

TABLE 2  
REPUBLIC OF KOREA: STRUCTURE OF THE MINERAL INDUSTRY IN 2006

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bismuth, metal	metric tons	Korea Zinc Co. Ltd.	Onsan	100
Cadmium	do.	do.	do.	2,000
Cement		Ssangyong Cement Industrial Co. Ltd.	Plants at Tonghae, Kwang Yang, Munhyung, Pukpyong, and Yeongwol	15,040
Do.		Sung Shin Cement Manufacturing Co. Ltd.	Tanyang plant	13,700
Do.		Tong Yang Major Corp.	Plants at Pukpyong and Samchok	11,580
Do.		Lafarge Halla Cement Corp.	Plants at Kwang Yang and Okkye	9,500
Do.		Hyundai Cement Co. Ltd.	Plants at Tanyang and Yongwol	8,600
Do.		Hanil Cement Manufacturing Co.	Plants at Chungbuk and Tanyang	7,200
Do.		Asia Cement Manufacturing Co. Ltd.	Plants at Daegu and Jaechon	4,600
Coal		Korea Coal Corp.	Mines at Changsung, Dogae, and Hwasoon	2,000
Copper, metal, primary		Korea Zinc Co. Ltd.	Onsan	20
Do.		LS-Nikko Copper Inc.	Changhang	60
Do.		do.	Onsan	510
Gas, natural		Korea National Oil Corp.	Ulleung Basin	NA
Gold:				
In concentrate	kilograms	Hangum Co. Ltd.	Haenam, Cholla Province	1,600
Refined	do.	Korea Zinc Co. Ltd.	Onsan	50,000
Do.	do.	LS-Nikko Copper Inc.	do.	60,000
Graphite		Kaerion Graphite Ltd.	Kangwon	NA
Do.		Wolmyong Mining Co.	do.	NA
Indium, metal	do.	Korea Zinc Co. Ltd.	do.	55,000
Lead, metal, primary		do.	do.	200
Nickel, metal		Korea Nickel Corp.	do.	48
Petroleum, refinery products	thousand 42-gallon barrels per day	SK Corp.	Ulsan	817
Do.	do.	LG-Caltex Corp.	Yocheon (Yosu)	650
Do.	do.	Hyundai Oil Refinery Co.	Daesan and Incheon	589
Do.	do.	S-Oil Corp.	Onsan	520
Silver:				
In concentrate	kilograms	Hangum Co. Ltd.	Haenam, Cholla Province	3,700
Refined	metric tons	Korea Zinc Co. Ltd.	Onsan	1,000
Do.	do.	LS-Nikko Copper Inc.	do.	370
Steel, crude		Pohang Iron and Steel Co. Ltd.	Kwangyang (Gwangyang) Works	15,000
Do.		do.	Pohang Works	13,000
Do.		Hyundai INI Steel Co.	Incheon Plant	4,800
Do.		do.	Pohang Plant	3,200
Do.		Dongkuk Steel Mill Co. Ltd.	Inchon Works	1,450
Do.		do.	Pohang Works	3,600
Do.		Korea Iron and Steel Co. Ltd.	Masan and Changwon Works	1,200
Talc		IL Shin Industrial Co. Ltd.	Choong Ju, Chungcheongbuk Province	160
Zinc, metal, primary		Korea Zinc Co. Ltd.	Onsan	430
Do.		Young Poong Corp.	Sukpo	280

NA Not available.