



2010 Minerals Yearbook

REPUBLIC OF KOREA

THE MINERAL INDUSTRY OF THE REPUBLIC OF KOREA

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The Republic of Korea, which is a northeast Asian country that is located between China and Japan and which shares a border with North Korea, had limited mineral and energy resources to support the country's consumption for its robust manufacturing sector. In 2010, the Republic of Korea's real gross domestic product (GDP) growth rate was 6.2%, the inflation rate was 2.9%, and the unemployment rate was 3.7%. The Government debt was 30.9% of the GDP, and the public deficit was about 1.4% of the GDP (Bank of Korea, 2011a, p. 7; Global Finance, 2011). The Republic of Korea has some deposits of coal, graphite, lead, molybdenum, and tungsten; however, the mining and quarrying sector was not a significant contributor to the country's economy. The significant manufacturing industries were automobiles, chemicals, electronics, shipbuilding, steel, and telecommunications.

Minerals in the National Economy

In 2010, the total output value of the mining and quarrying and manufacturing sectors combined increased by about 15% (at 2005 prices) compared with that of the previous year. The output value of the mining and quarrying sector, which accounted for 0.6% of the two sectors' combined total, decreased by about 8%, and the output value of the manufacturing sector, which accounted for about 99.4% of the total, increased by about 15% (Bank of Korea, 2011b, p. 144). Producers of processed mineral products were largely reliant on external resources for much of their mineral requirements.

Government Policies and Programs

The Government continued to sponsor and encourage the growth of family-owned industrial conglomerates, which were helping to transform the country into one of the world's major economies and a leading exporter of cars and electronic goods. The leading companies in the Republic of Korea were Hyundai Heavy Industries (capital goods), Hyundai Motor (consumer goods), LG Corp. (electronics, chemicals, and telecommunications), Pohang Iron and Steel Co. Ltd. (POSCO) (steelmaking and materials), and Samsung Electronics (semiconductors). In the third quarter of 2009, the country's economy began to recover from the global economic downturn that began in late 2008, and growth exceeded 6% in 2010, in large part owing to export growth, low interest rates, and an expansionary Government fiscal policy. In March 2010, after a North Korean submarine sunk the navy ship Cheonan, the Republic of Korea stopped all trade with North Korea except at the Kaesong Industrial Complex, and in November, there was a serious cross-border clash between the two states (Bank of Korea, 2011a, p. 13–22; BBC News, 2011; Global Finance, 2011; U.S. Department of State, 2011).

Production

The Republic of Korea was a leading global producer of cadmium, slab zinc, and steel; it was also a major regional producer of cement, refined copper, pyrophyllite, talc, and zeolites. The country was one of the region's significant consumers and importers of coal, natural gas, and crude oil; of ores and concentrates of copper, iron, lead, and zinc; and of nickel oxide sinter. In 2010, production of cadmium metal increased by 67% compared with that of the previous year; production of bismuth metal increased by 66%; steel, by 21%; pig iron by 14%; and iron ore, by 13%. Among the industrial materials, production of mica increased by 35%, and that of kaolin increased by 16%. Production of mined zinc decreased by 81%; mined lead, by 43%; and mined gold, by 14%. Among the industrial materials, mine output of salt decreased by 42%; graphite, by 21%; and feldspar, by 20% (table 1).

Structure of the Mineral Industry

The Government—through the Ministry of Commerce, Industry and Energy (MCIE)—owned and supervised the country's coal mining, natural gas, petrochemical, and petroleum refining companies. The rest of the mining, quarrying, and mineral processing companies were privately owned and operated (table 2).

Mineral Trade

In 2010, the country's exports were valued at about \$466.4 billion, which was an increase of 28% from their value of \$363.5 billion in 2009; imports were valued at about \$425.2 billion, which was an increase of 32% from their value of \$323.1 billion in 2009. The Republic of Korea was the United States' seventh ranked trading partner, and there were significant flows of manufactured goods, services, and technology between the two countries. In December 2010, the United States Government announced the resolution of outstanding issues in the Korea-U.S. Free Trade Agreement (KORUS FTA), which would eliminate tariffs on more than 95% of consumer and industrial goods within 5 years. The KORUS FTA was the largest FTA that the Republic of Korea had ever signed, and it was the United States' first FTA with an Asian economy. The FTA was expected to generate billions of dollars in increased trade and investment between the Republic of Korea and the United States and to help economic growth and job creation in both countries.

U.S. exports to the Republic of Korea in 2010 totaled \$38.8 billion and included \$2.7 billion in semiconductors, \$1.2 billion in petroleum products (other than fuel oil), \$1.1 billion in steelmaking materials, \$543 million in nonferrous metals, \$462 million in precious metals, \$326 million in aluminum

and alumina, and \$199 million in copper. U.S. imports from the Republic of Korea in 2010 totaled \$48.9 billion and included \$6.6 billion in passenger cars, \$3.4 billion in computer accessories, \$2.9 billion in petroleum products (other than fuel oil), \$753 million in semifinished iron and steel mill products, and \$698 million in iron and steel manufactured products (Bank of Korea, 2011b, p. 120–121; U.S. Census Bureau, 2011a, b; U.S. Department of State, 2011).

Commodity Review

Metals

Copper.—In 2010, the country's consumption of copper ore and concentrate was slightly more than 1.8 million metric tons (Mt) and included domestic consumption of 1.8 Mt and exports of 3,864 metric tons (t). The domestic mine production of copper was only 9 t, and imports of copper ore and concentrate totaled about 1.7 Mt and were valued at about \$4.5 billion. The country relied on imports to meet the raw material requirements for its copper smelters, which were located in Changhang and Onsan (Korea Institute of Geoscience and Mineral Resources, 2010, p. 9).

Gold.—Mine production of gold decreased by 14% to 235 kilograms (kg) from 274 kg. The country produced 54,540 kg of refined gold, of which 2,776 kg was produced from domestic raw materials (which included scrap). Imports of refined gold totaled 40,683 kg, which was valued at about \$1.55 billion; domestic consumption of refined gold was 44,058 kg. Exports of refined gold totaled 77,804 kg, which was valued at about \$2.91 billion. The major end users of refined gold were the manufacturers of coins, dental products, electrical communication parts, jewelry, and materials for semiconductors (Korea Institute of Geoscience and Mineral Resources, 2010, p. 9).

Iron and Steel.—In 2010, mine production of iron ore, in gross weight, was about 513,000 t, and the country relied heavily on imports to meet its iron ore requirement. Imports of iron ore totaled 56.3 Mt and were valued at about \$6.65 billion. The country's crude steelmaking capacity in 2010 increased by 18.6% to 76.1 Mt from that of 2009 owing to the start of full operations at Hyundai Steel's two blast furnaces. Crude steel production in 2010 increased by 21% to 58.9 Mt. Total imports of iron and steel products increased by 24.2% to 27.4 Mt, and the imports from China and Japan totaled 19.7 Mt, or 78% of total imports. Consumption by the country's construction industry, which was one of the major steel consumers, decreased in 2010 because of decreased private housing construction. Steel consumption by the manufacturing sector increased because of increased motor vehicle production and increased new shipbuilding orders. In October, POSCO resumed operation of a blast furnace in Pohang after the furnace was refurbished. The annual production capacity of the furnace was increased to 5.3 Mt, which made the Pohang blast furnace the largest capacity furnace in the country and the fourth largest in the world (Korea Times, The, 2010; South East Asia Iron and Steel Institute, 2011, p. 31–32).

Manganese.—The Republic of Korea did not produce any refined manganese in 2010. The country imported 904,347 t of

refined manganese valued at \$311.4 million; domestic demand for refined manganese was 904,346 t. It exported 1 t of refined manganese valued at \$35,000 (Korea Institute of Geoscience and Mineral Resources, 2010, p. 9).

Nickel.—La Société Minière du Sud Pacifique (SMSP) of New Caledonia (51%) and POSCO (49%) jointly established the Nickel Mining Co. (NMC) in New Caledonia and Société du Nickel de Nouvelle Calédonie et Corée (SNNC) in the Republic of Korea. All raw materials were to come from New Caledonia, and the joint venture would make POSCO 60% self-sufficient in nickel. The joint venture's smelting capacity in 2010 was 30,000 t, and POSCO was planning to build a new \$448 million nickel refining plant at Gwangyang to increase the annual production capacity to 54,000 t. POSCO was also building plants in China, Turkey, and Vietnam to further secure its nickel supply (Kosich, 2011).

Tungsten.—In 2010, Woulfe Mining Corp. of Canada announced an underground drilling program for the Sangdong tungsten project in the Republic of Korea, where Woulfe's program aimed to quantify a potential zone of 3 to 5 Mt of high-grade tungsten resources. The Sangdong tungsten-molybdenum mine is located on the east coast 187 kilometer (km) from Seoul, and historically was among the larger tungsten mines in the world. Woulfe also fully (100%) owned the Chongyang tungsten mine, which is located south of Seoul but which ceased production in 1977. The Chongyang Mine was previously evaluated for gold by Indochina Goldfields in 1995, when the bulk tonnage open pit of tungsten-molybdenum and some silver-zinc mineralization was recognized. Woulfe had three mining licenses for the Chongyang Mine area and planned to evaluate the deposit by conducting 1,500 meters of diamond core drilling (Woulfe Mining Corp., 2010a, b).

Zinc.—ZincOx Resources plc of the United Kingdom helped the Korea Recycling Plant (KRP) treat electric arc furnace dust (EAFD) to produce zinc oxides. EAFD contains between 18% and 25% zinc, or about four times more than the ore. According to ZincOx, the purchase of the KRP site (at the Cheonbuk Industrial Complex, which is located approximately 10 km west of Pohang) was completed in July 2010, and a provisional \$50 million loan was signed with Korea Zinc in December. The KRP's total designed capacity was to treat 400,000 metric tons per year (t/yr) of EAFD, which would be supplied by all Korea's steel recycling companies. The EAFD contained about 23% zinc and 28% iron. The KRP would be developed in two equal phases, and each phase would produce about 46,000 t/yr of zinc (oxide concentrate) and about 100,000 t/yr of iron. The projected cost for phase 1 was \$110 million, and the scheduled development period was 15 months. The cost for phase 2 was \$146 million and this phase would include the construction of a washing plant to upgrade the zinc product (ZincOx Resources plc, 2010, p. 6).

Industrial Minerals

Lithium.—According to the Ministry of Land, Transport and Maritime Affairs, POSCO signed an agreement with the Government in early 2010 to begin extracting lithium

from seawater. The Government and POSCO would invest a combined \$26 million to build a lithium extracting plant, which was expected to be commissioned by 2014. Lithium was used in batteries for electric cars, mobile phones, and other electronic devices. The agreement was aimed at securing a stable source of lithium (Yonhap News Agency, 2010).

Rare Earths.—Rare earth materials were used in high-technology products ranging from electronic cars to liquid-crystal display (LCD) televisions to new energy technologies. In 2010, KORES discovered veins containing rare earths while it was redeveloping an old iron ore mine; the company planned to conduct an exploration program to determine the quantity of rare earths in the mineral deposit. The Public Procurement Services (PPS) had a long-term plan to build stockpiles of minor metals and rare earths (Reuters, 2010; Guardian, The, 2011).

Mineral Fuels

Natural Gas and Petroleum.—The Republic of Korea imported 33.8 Mt (44.44 billion cubic meters) of liquefied natural gas (LNG) in 2010. State-owned Korea Gas Corp. (KOGAS), which was the world's leading corporate buyer of LNG, had an agreement with Royal Dutch Shell plc (Shell) of the Netherlands and Total S.A. oil company of French (Total) for a long-term supply of LNG to secure 17% of the Republic of Korea's annual gas consumption. KOGAS would import 5.64 Mt of LNG valued at \$84 billion each year from 2013 through 2035. The agreement would replace a number of contracts with such countries as Brunei, Indonesia, and Malaysia that were scheduled to expire between 2013 and 2015 and that covered a total annual LNG volume of 4.7 Mt. KOGAS would also invest \$1.5 billion in Samsung Heavy Industries' floating LNG facility, which would be the largest such facility in the world (Petroleum Economist, 2011a). KOGAS signed a 15-month LNG supply agreement with Repsol YPF, S.A. of Spain to import LNG at the rate of 1.9 billion cubic meters per year. This was Repsol's first LNG sales to an Asian market (Petroleum Economist, 2011b).

Outlook

With Hyundai Steel's and POSCO's upgrade of their blast furnaces, the domestic iron and steel market has increased its capacity, and the country's requirement for iron ore and scrap is also expected to increase. Besides the Chongyang and the Sangdong tungsten-molybdenum drilling programs, Woulfe's current projects include the Muguk gold-silver mine (formerly the largest-producing gold mine in the Republic of Korea) and a number of other properties with significant known mineralization and regional potential. Woulfe holds a diversified portfolio of mining licenses for base metals, gold, molybdenum, tungsten, uranium, and vanadium in the Republic of Korea. The Republic of Korea's LNG consumption is expected to increase gradually by 2 Mt each year to reach an annual volume of 34 Mt in 2024. The Republic of Korea is a significant consumer of rare earths, and is expected to aggressively seek a more cost-efficient way to meet its need for rare earths for its industrial

consumption. The economic challenges of the Republic of Korea include a rapidly aging population, an inflexible labor market, and overdependence on the manufacturing sector to drive economic growth (2point6billion.com, 2010; Korea Times, The, 2010; Reuters, 2010; Woulfe Mining Corp., 2010a, b; Petroleum Economist, 2011; U.S. Department of State, 2011).

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TABLE 1
REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2006	2007	2008	2009	2010	
METALS						
Bismuth, metal	236	267	210	300	498	
Cadmium, smelter	3,320	2,846	3,090	2,500	4,166	
Copper:						
Mine output, Cu content	3	6	4	14	9	
Metal:						
Smelter, primary and secondary	484,000	515,000	544,000	499,200 ^r	541,200	
Refined, primary and secondary	575,500	581,467	537,925	531,701 ^r	564,600	
Gold:						
Mine output, Au content	kilograms	277	162	175	274	235
Metal, refined	do.	43,505	47,078	37,989	51,186	54,540
Iron and steel:						
Iron ore and concentrate:						
Gross weight	thousand metric tons	227	291	366	455	513
Fe content	do.	155	163	205	274 ^r	308
Metal:						
Pig iron	do.	27,548	29,437	31,043	27,475	31,228
Ferrous alloys:						
Ferromanganese		169,202	209,321	251,125	--	--
Ferrosilicomanganese		94,119	105,607	76,184	--	--
Total		263,321	314,928	327,309	--	--
Steel, crude	thousand metric tons	48,455	51,517	53,493 ^r	48,572	58,912
Lead:						
Mine output, Pb content		17	12	449	2,064	1,168
Metal, smelter		163,379	195,022	244,137	216,918 ^r	197,900
Nickel						
Ferro-nickel		--	--	2,506	21,609 ^r	20,000 ^e
Metal		28,085	28,675	28,653	NA ^r	NA
Silver:						
Mine output, Ag content	kilograms	1,521	1,400	--	--	--
Metal	do.	1,377,659	1,393,935	1,461,886	1,740,078	NA
Zinc:						
Mine output, Zn content		16	4,067	3,672	3,672 ^r	710
Metal, primary		662,521	670,000	738,000	751,179 ^r	717,100
INDUSTRIAL MINERALS						
Cement, hydraulic	thousand metric tons	53,971	52,182	51,653	50,127	47,236
Clays, kaolin	do.	2,399	688	955	659	764
Diatomaceous earth		3,460	2,360	2,540	2,440	2,200
Feldspar		427,378	398,513	344,257	622,700	496,511
Graphite, all types		68	52	73	48	34
Lime, slaked lime ^e		3,700,000	3,900,000	4,000,000	NA ^r	NA
Mica, all grades		30,356	42,385	49,474	27,078	36,486
Nitrogen, N content of ammonia		90,000	--	--	--	--
Salt		285,568	249,515	384,304	382,270	222,509
Soda ash, manufactured ^e		310,000	310,000	310,000	310,000	310,000
Stone, sand and gravel:						
Limestone	thousand metric tons	79,404	82,655	83,469	77,923	79,625
Quartzite	do.	2,921	3,511	3,325	3,536	3,603
Sand, including glass sand	do.	1,437	22,227	1,757	455	535
Sulfur, byproduct: ^e						
Metallurgy	do.	660	670	660	600	600
Petroleum	do.	950	1,000	900	900	900
Total	do.	1,610	1,670	1,560	1,500	1,500
Talc and related materials:						
Pyrophyllite		677,465	798,054	892,625	617,411	673,936
Talc		64,118	9,557	6,438	5,996	5,729
Zeolites		160,056	157,408	217,691	235,226	242,190

See footnotes at end of table.

TABLE 1—Continued
 REPUBLIC OF KOREA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2006	2007	2008	2009	2010	
MINERAL FUELS AND RELATED MATERIALS						
Carbon black	484,302	497,191	484,000 ^e	500,000 ^e	500,000 ^e	
Coal, anthracite	thousand metric tons	2,824	2,886	2,773	2,519	2,500 ^e
Fuel briquets, anthracite briquets ^e	do.	2,327 ²	2,400	2,320	2,000	2,000
Petroleum, refinery products ³	thousand 42-gallon barrels	717,493	770,523	747,827	750,000	750,000 ^e

^eEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ^fRevised. do. Ditto. -- Zero.

¹Table includes data available through October 24, 2011.

²Reported figure.

³Includes bunker oil C-type, diesel oil, gasoline, kerosene, liquefied petroleum gas, and naphtha.

Sources: Ministry of Commerce, Industry and Energy, Korea Institute of Geoscience and Mineral Resources, 2010 supply and demand balance by mineral, p. 9; U.S. Geological Survey Minerals Questionnaire 2006–10; World Bureau of Metal Statistics, December 2010; Bank of Korea Monthly Statistical Bulletin, table—41, Exports by principal commodity, and table 42, Imports by principal commodity, May 2010, p. 132–135.

TABLE 2
REPUBLIC OF KOREA: STRUCTURE OF THE MINERAL INDUSTRY IN 2010

(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 refinery	100
Cadmium	do.	do.	do.	2,000
Do.	do.	Young Poong Corp.	Sukpo refinery	805
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. (KNOC)	Ulleung Basin	NA
Gold:				
In concentrate	kilograms	Hangum Co. Ltd.	Haenam, Jeonnam Province; Muguk Mine	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	kilograms	Korea Zinc Co. Ltd.	do.	55,000
Iron ore		NA	Mines at Sinyemi, Gangwon-do Province	300
Lead, metal, primary		Korea Zinc Co. Ltd.	Kangwon	200
Magnesium		Pohang Iron and Steel Co. Ltd. (POSCO)	Magnesium refinery plant, Gangneung City, Gangwon-do Province	10
Do.		do.	Magnesium metal sheet plant, Suncheon City, Jeonnam Province	3
Molybdenum	metric tons	Korea Resources Corp. (KORES)	Mine at Uljin; smelter at Yeosu, Jeonnam Province	6,000
Nickel:				
Metal		Korea Nickel Corp.	Onsan nickel refinery plant	48
Ferronickel		Pohang Iron and Steel Co. Ltd. (POSCO)	Gwangyang ferronickel plant	30
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
Pyrophyllite		NA	Wan-Do, Sungsan, Hwasan, Okmesan, Dae-Do, and Chin-Do Mines in Haenam	446
Do.		NA	Nilyang, Yangsan, Kimhae, Pusan, and Kyong-Nam Mines in Dong-Nae	446
Silver:				
In concentrate	kilograms	Hangum Co. Ltd.	Haenam, Jeonnam 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. (POSCO)	Kwangyang (Gwangyang) Works	15,000
Do.		do.	Pohang Works	13,000
Do.		Hyundai Steel Co. Ltd.	Inchon 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
Do.		Korea Zinc Co. Ltd.	Onsan	430
Do.		Young Poong Corp.	Sukpo	280
Zinc		Korea Zinc Co. Ltd.	Onsan refinery	445
Do.		Young Poong Corp.	Sukpo refinery	303

Do., do., Ditto NA Not available.