

THE MINERAL INDUSTRY OF

TAIWAN

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Helped by a worldwide economic recovery, Taiwan's industrial growth rate increased from 6.0% in 1993 to 6.5% in 1994.² The country's economic transition had evolved from labor-intensive manufacturing industry to one based on high technology and capital-intensive enterprises. Although Taiwan's economic growth rate would not average 8% as it had in the 1980's, it was expected to continue at about 6% until the year 2000 as the country's economy matures.

Taiwan authorities had a consistent policy to provide a favorable environment for private investment, stimulate investment potential, and attract investment from foreign "high-tech" companies. The Government was making an effort to review and revise outmoded laws and regulations, simplify administrative procedures, and set up special agencies to help enterprises to upgrade technological investments.

Its population grew from 20.9 million in 1993 to 21.1 million in 1994, and the per capita gross national product (GNP) increased from \$10,852³ in 1993 to \$11,604 in 1994. The total labor force increased to 9.2 million, and the unemployment rate remained low at 1.6%. The output value of the mining sector was 0.33% of GNP, which is insignificant compared with other sectors. The consumer price index rose only 4.1% in 1994 from that of 1993.⁴

Taiwan authorities opened the financial securities sector to more foreign firms. Such market liberation would bring the local market into alignment with the policies of the General Agree on Tariffs and Trade (GATT). The Government reportedly believed that the growing competition would improve domestic financial management and upgrade the operational technology of local securities houses.

The Government developed a set of programs to address major problems in the areas of land, environment, labor, tariff rates, and financing to improve domestic investment conditions. The Government urged the local business community to "keep their roots in Taiwan" and to stop the exodus. The plan indicated that those who make large, substantial investments would be given the opportunity to arrange for favorable financing through the issuance of corporate convertible bonds. Imports of essential raw materials and equipment would be given preferential tariffs or quota rates. The Environment Protection Agency (EPA) would develop more flexible regulations for less-polluting industries, such as electronics.

The Ministry of Economic Affairs (MOEA) approved a

plan to develop Taiwan as an Asia-Pacific Regional operations center. MOEA believed that the Asian Pacific region would have the world's highest economic growth in the next two decades. The goal was to concentrate of activities in six areas: manufacturing, sea transportation, air transportation, finance, telecommunications, and training. Taiwan had signed investment guarantee agreements with Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. Negotiation for such an agreement with other southern Asian countries was proceeding.

Taiwan's EPA was established in August 1987 under the Executive Yuan to address environmental degradation that had become one of the most serious problems in Taiwan. According to Taiwan's Six-Year Development Plan, the country would invest \$37 billion in pollution control and environmental protection systems. Environmental regulations would be strengthened to protect the society. In 1992, Taiwan's Legislative Yuan passed the Air Pollution Control Act and strengthened noise pollution regulations to enforce a higher living standard in the country.

Industry production accounted for about 34% of the country's GNP. The Industrial Development Bureau (IDB) of the MOEA was the major Government agency dealing with industry affairs. IDB initiates specific industrial policies and development strategies. However, overall economic planning, coordination, and policy evaluation were handled by the Council for Economic Planning and Development.

During the past two decades, as natural gas and coal reserves had slowly depleted, the mining industry also declined. Total mining output was less than 1% of total industrial production. The major mining activities in Taiwan were coal, dolomite, limestone, marble, natural gas, and salt. Coal, natural gas, and salt were mined in the western part of the country. Marble and limestone quarries were operated in the eastern part of the country. Employment in the mining and quarrying industry had steadily decreased since the early 1980's to 17,300 in 1993. The production of major mineral commodities is listed in table 1.

Due to a shortage of labor, Taiwan's industry shifted from labor-intensive products to technology- and capital-intensive goods. In 1994, the imports on metals and minerals accounted for more than 36.1% of the total imports. It reflected the demand for quality consumer goods and capital- and technology-intensive machines and equipment.

The demand for mineral products had continuously increased over the years while local supplies kept dwindling. The bulk of domestic supply could meet only about 25% of the country's needs. Coal, oil, and natural gas were the country's most valuable mine products. Carbonate minerals, such as dolomite, limestone, and marble, comprised the most important nonfuel mining sector. In addition to the aggregates, clays, feldspar, salt, and talc made up the remaining mine production. In the metals production sector, the country produced iron and steel and processed aluminum, copper, lead, nickel, tin, and zinc from imported raw materials. Major nonfuel and fuel producers are listed in table 2.

Taiwan's cement industry would face a shortage in 1997 when the mining rights on its east coast expire. Domestic cement production would be cut as much as 40% in 1997. Cement companies were looking for investment opportunities in other countries to construct greenfield plants to ensure the stable supply of cement for the country's needs. MOEA approved Chia Hsin Cement Corp.'s plan to invest \$120 million to build a new cement plant in the Philippines. Construction of the new plant started in the second half of 1994.

Since the shutdown of the island's only copper smelter-refinery in 1991, Taiwan relied on imports for refined copper. Because of rising labor costs, difficulties in land acquisition, and stiffening environmental protection regulations, domestic secondary copper recovery companies were exploring opportunities to move their less profitable scrap plant to neighboring countries. Demand for copper cable from the telecommunications sector was expected to slow down as that sector was planning to replace metallic cable with fibre optics.

After spending 3 years exploring for gold in Chinkuashih, Taipei County, the Government concluded that the Chinkuashih deposit contained about 5.8 million metric tons (Mmt) of ore with an estimated of 7.5 metric tons (mt) of gold within a depth of 100 meters (m).

China Steel Corp. (CSC), the only pig iron producer in Taiwan, received a total of \$422 million in loans from Kreditanstalt fur Wiederaufbau of Germany (\$340 million) and West Merchant Bank of the United Kingdom (\$82 million) for its fourth-phase expansion project. The 8-year noncollateral loans were set at a fixed rate of 5.38% for the United Kingdom loan and less than 7% for the German loan. CSC estimated that the expansion project would require a total investment of \$2.13 billion. Hitachi Zosen Corp. of Japan was awarded the contract to provide a sintering plant to CSC. The sintering plant would have a daily steel production capacity of 12,000 mt and be equipped with a trough-type circular chilling machine with a built-in chamber to reduce air leakage, save energy and labor, and protect the environment.⁵

CSC placed an order with Mannesman Demag Sack of Germany to supply a hot wide strip mill with an annual

capacity of 3 Mmt. The order included a two-stand roughing train; a seven-stand, 4-high finishing train; two coiling facilities; and inspection lines. The mill could produce carbon and special steel slabs down to a thickness of 1.2 millimeters (mm) and the width between 90 centimeters (cm) and 188 cm.⁶

MOEA postponed selling 1.75 billion CSC shares to private investors in Taiwan as part of the privatization of state-owned enterprises. The Government held about 67% of CSC shares and had made an effort to reduce its stake to 43%. Until the Government's share drops below 50%, CSC's budget and significant policy changes must be approved by the Legislative Yuan. CSC sold annually about 80% of its products in the domestic market. Privatization would allow CSC to have more freedom to cut costs and to diversify its investments into other sectors such as electronics.

In May 1994, CSC signed a joint-venture agreement with MEMC Electronic Materials, Inc., a subsidiary of Huls AG of Germany. The joint venture planned to construct an electronic materials plant in the Science Industrial Park in Hsinchu to produce silicon wafers in September 1994. The new plant was scheduled to begin production of 15.25- and 20.32-cm (6- and 8-inch) wafers in 1997. Its annual output was expected to be about 38,710 square meters (60 million square inches) of silicon wafer. This will reduce Taiwan's dependence on imports silicon wafers and increase its competitiveness in integrated circuit sector.

In 1992, because of the Government's objection, CSC suspended plans to form a joint venture with Malaysia's Lion Group to build a steel plant in Malaysia. However, the Lion Group had since continued to seek technological expertise from CSC. In 1994, CSC signed a draft agreement with the Lion Group to help the Malaysian Group to build a new plant. Under the terms of agreement, CSC would provide technological services including planning, construction, and trial operation of the steel mill, as well as various personnel training.⁷

The Iron Ore Co. of Canada signed a contract to supply CSC with 300,000 metric tons per year (mt/a) of blast furnace pellets for 3 years. The first shipment was expected to be in 1995.⁸

Yieh Loong Group (YLG) decided to invest \$4.15 billion during the next 5 years to build an integrated steel mill. According to the plan, the mill initially would have two blast furnaces with an annual output capacity of 7.5 Mmt of crude steel and 2.3 Mmt of hot coil in Chiku, Tainan County. The first-phase construction was expected to be completed in 1999. A new company, Lien Ting, had been established to be in charge of this project. YLG would finance \$1.37 billion of the project with the remaining funds from local and foreign bank loans.⁹

Yieh United Steel Co. Ltd. appointed Mannesmann Demag Huttentechnik of Germany as the consortium to supply technology and equipment for its second-phase expansion.

The second phase was comprised of an engineering design, a 90-mt electric arc furnace, a 100-mt MRP-L converter, a 100-mt VOD plant, 100-mt ladle furnace, fume cleaning plant, and steel mill vehicles. After completion of the second phase, Yieh United Steel Co. Ltd. would increase its production capacity from 400,000 mt/a to 800,000 mt/a. Commissioning of the new plant was expected to be in the second quarter 1995.¹⁰

Walsin-Lihwa of Taiwan and Carpenter Technology Corp. of the United States formed a joint venture, Walsin CarTech Specialty Steel Corp., to build a specialty steelmaking plant in southern Taiwan. The plant was expected to produce 200,000 mt/a of carbon and stainless steel billet, bar, and rod for both regional and the world markets. Carpenter Technology Corp. invested \$47.5 million to secure a 19% share of the plant and had the option to extend its share to 35% by 1996. The plant began operation in late 1994 to produce stainless steels with product sizes between 5.5 mm and 14 mm for wire rod and between 14 mm and 35 mm for bars in coil.¹¹

Taiwan Nickel Refining Corp., the only nickel smelter in Taiwan, had an annual output capacity 14,000 mt of nickel. In 1994, Taiwan's iron and steel industry consumed about 25,000 mt/a of nickel. Taiwan imported more than 20,000 mt of unwrought nickel in 1994 to meet the country's demand.

Taiwan's coal production dropped to 285,099 mt in 1994. This decline was attributed to Government policies designed to close unsafe operations, high production costs, and reduced domestic coal resources. Since 1985, MOEA implemented a policy to close mines that failed to meet safety and profitability standards. The number of operating mines in Taiwan has steadily decreased from 108 pits in 1985 to 56 pits at yearend 1993.

In 1994, Taiwan imported 26.7 Mmt of coal, mainly from Australia, Indonesia, South Africa, China, and the United States, in descending order. Taipower and CSC were the two largest consumers of coal in Taiwan, accounting for more than 50% in 1994.

Indonesia was a sole source for supplying liquefied natural gas (LNG) to Taiwan. In 1994, Taiwan imported 2.2 Mmt of LNG from Indonesia. Chinese Petroleum Corp. (CPC), which was responsible for LNG imports, wanted to diversify its sources of supply. CPC signed a contract with Petronas of Malaysia to supply 2.2 Mmt of LNG yearly beginning in 1995. The MOEA and the Ministry of Finance agreed to reduce a 5% tariff on LNG in order to encourage an increase in imports. The Government planned to increase LNG consumption in the energy sector from 5% presently to 11% by 2000 and to 16% by 2010.

The MOEA gave the green light to CPC to indirectly purchase crude oil from China. The total crude oil purchased from China would not exceed 20% of the country's total annual consumption. The Government required that all crude oil shipped from China to Taiwan be transported via a third

country.

CPC announced the discovery of an offshore natural gas deposit at about 100 kilometers (km) west of Kaohsiung. The deposit is located 4,000 m under the sea with an estimated of 7.3 billion cubic meters of natural gas.

Taiwan has a very weak mineral resource base, and output is limited to mostly carbonate minerals, small amounts of other industrial minerals, and negligible amounts of fossil fuels, the overall value of which is significant only to the local economy. Reserves of major minerals are listed in table 3.

For the last several years, Taiwan's electricity generation capacity ran at a reserve margin of about 5%, much lower than its normal reserve margin of 20% to 25%. At the same time, demand of electricity has grown about 6% a year. In 1994, Taiwan's total power generation capacity was 20,980 megawatts (MW). The Government planned to expand power generation capacity to 34,000 MW in the year 2000. However, it faced strong public opposition for construction of powerplants, especially nuclear powerplants. Plans by Taipower to expand nuclear power generation capacity in the island were on hold since the early 1980's. Taipower had attempted many times to revive its fourth nuclear powerplant to be built at Kungliao, a remote town in the northeast coast of the island. In 1994, the Legislative Yuan finally approved a budget of \$4.2 billion for the construction of a fourth nuclear powerplant, but Taipower faced another hurdle of public opposition over construction of the plant.

The railroad system comprised 4,600 km of common carrier lines and 3,525 km of industrial carrier lines of 1.075-m-gauge and 1,075 km of 1.067-m-gauge. Common carrier lines were owned by the Government and operated by the Railway Administration under the Ministry of Communications. Industrial carrier lines were owned and operated by Government enterprises. Taiwan had a total of 20,041 km of highway, including 17,095 km of bituminous or concrete pavement, 2,371 km of crushed stone or gravel, and 575 km of graded earth.

Taiwan had four international harbors—Keelung, Kaoshiung, Hualien, and Taitung. Suao harbor on the northeastern coast was used as a supplementary port to Keelung. There are two international airports—Chiang Kai-shek International Airport in Taoyuan and Hsiaokang International Airport in Kaoshiung. In addition, there were a number of domestic airports on the east and west coasts of the island.

Because Taiwan lacks a strong and varied minerals resource base, the domestic mining sector will never contribute significantly to the output of downstream manufacturing. Rising wages and a strong international currency exchange rate have affected export competitiveness and have forced domestic businesses to establish operations in lower-cost neighboring countries, such as China, Indonesia, Malaysia, Thailand, and Vietnam. The future for Taiwan-based industry would seem to lie in high-technology-

intensive manufacturing.

¹Text prepared June 1995.

²Industry of Free China, Council for Economic Planning and Development, Executive Yuan, V. 83, No. 3, 1995, p. 72.

³Where necessary, values have been converted from New Taiwan dollars (NT\$) to U.S. dollars at the rate of NT\$26.4=US\$1.0 in 1994.

⁴Work cited in footnote 2.

⁵Journal of Commerce (New York). July 20, 1994, p. 4B.

⁶Steel Times International (London). Sept. 1994, p. 6.

⁷———. May 1994, p. 2.

⁸Metal Bulletin (London). Nov. 14, 1994, p. 29.

⁹American Metal Market (New York). Jun. 15, 1994, p. 5.

¹⁰Steel Times International (London). Sept. 1994, p. 8.

¹¹Metal Bulletin Monthly (London). Nov. 1994, p. 57.

Major Sources of Information

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15 Foochow Street
Taipei, Taiwan

Taiwan Provincial Bureau of Mines
2 Chenkiang Street
Taipei, Taiwan

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Quarrying Annual.

TABLE 1
TAIWAN: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1990	1991	1992	1993	1994
METALS					
Copper: Metal, refined	16,100	--	--	--	--
Gold, primary kilograms	72	--	3 r/	--	--
Iron and steel: Metal:					
Pig iron thousand tons	5,470	5,560	5,290	6,120	5,940
Ferroalloys:					
Ferromanganese	43,600	40,100	37,800	13,600	7,000 e/
Ferrosilicomanganese	20,600	12,800	3,990	--	--
Ferrosilicon	15,500	6,250	2,610	689	500 e/
Steel, crude thousand tons	9,750	11,000	10,700	12,000	11,500
Nickel, refined e/	10,400	11,200	10,000	9,000	10,000
Silver, primary kilograms	3,930	--	--	--	--
INDUSTRIAL MINERALS					
Cement, hydraulic thousand tons	18,500	19,400	21,500	24,000	23,700
Clays:					
Fire clay	99,400	79,500	55,000	35,100	24,400
Kaolin	105,000	93,000	100,000 e/	100,000 e/	100,000 e/
Feldspar	7,320	1,340	2,220	1,720 r/	778
Gypsum: Precipitated	1,740	3,720	1,670	3,180	3,000 e/
Lime	554,000	614,000	670,000	650,000	650,000 e/
Mica	4,950	8,600	11,000	9,750	10,000 e/
Nitrogen: N content of ammonia	216,000	243,000	224,000	220,000	215,000
Salt, marine	82,800	195,000	25,700	176,000	186,000
Sodium compounds, n.e.s.:					
Caustic soda	111,000	120,000	131,000	141,000	172,000
Soda ash	120,000 e/	109,000	91,500	100,000 e/	100,000 e/
Stone:					
Dolomite thousand tons	339	363	254	281	264
Limestone do.	13,900	15,400	16,900	13,100	13,300
Marble do.	11,300	11,400	14,600	17,700	17,700
Serpentine do.	388	414	405	433	475
Sulfur	95,500	126,000	119,000	153,000	155,000
Talc	22,100	18,500	6,090	5,020	5,000 e/
MINERAL FUELS AND RELATED MATERIALS					
Carbon black	62,200	60,300	65,400	62,500	80,700
Coal, bituminous thousand tons	473	403	335	328	285
Coke do.	70	14	--	--	--
Gas, natural:					
Gross e/ million cubic meters	1,130	928 r/	872 r/	826 r/	867
Marketed e/ do.	1,100	870 r/	840 r/	790 r/	820
Petroleum:					
Crude thousand 42-gallon barrels	1,150	694	452 r/	445 r/	431
Refinery products:					
Gasoline do.	32,600	37,100	40,700	44,100	47,300
Kerosene do.	2,200 e/	2,350	2,000 e/	2,000 e/	2,000 e/
Diesel oil do.	29,300	30,200	30,800	33,800	36,500
Fuel oil do.	76,500	83,600	81,900	84,800	88,600
Lubricants fuel oil do.	1,000 e/	1,000 e/	1,000 e/	1,000 e/	1,000
Asphalt. do.	3,000 e/	3,000 e/	3,000 e/	3,000 e/	2,500 e/
Liquefied petroleum gas do.	14,500	14,200	14,900	15,000	15,400
Other 3/ do.	9,080	8,740	8,120	7,990	4,000
Total e/ do.	168,000	180,000	182,000	192,000	197,000

e/ Estimated. r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Includes data available through May 30, 1995.

3/ Includes naphtha, solvent oil, and base oil.

TABLE 2
TAIWAN: STRUCTURE OF THE MINERAL INDUSTRY FOR 1994

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies	Location of main facilities	Annual capacity e/	
Cement	Asia Cement Corp.	Hsinchu	1,800	
Do.	do.	Hualien	11,200	
Do.	Chia Hsin Cement Corp.	Kaoshiung	2,200	
Do.	Lucky Cement Corp.	Tungao	1,800	
Do.	Chien Tai Cement Co. Ltd.	Kaoshiung	1,760	
Do.	Hsing Tai Cement Co. Ltd.	Taipei	1,300	
Do.	Taiwan Cement Corp.	Chutung	1,400	
Do.	do.	Hualien	280	
Do.	do.	Kaoshiung	1,900	
Do.	do.	Suao	2,230	
Do.	Universal Cement Corp.	Kaoshiung	1,400	
Coal, bituminous	Numerous independent operators	Taipei Prefecture (22 pits)	400	
Marble	Taiwan Marble Co., Ltd.	Panchiao	10	
Nickel	Taiwan Nickel Refinery	Kaoshiung	12	
Petroleum:				
Crude	thousand barrels per year	Chinese Petroleum Corp.	Chuhuankeng and Tungtzechiao	850
Refinery products	do.	do.	Kaoshiung	150,000
Do.	do.	do.	Taoyuan	33,000
Steel		China Steel Corp.	Kaoshiung	6,400
Do.		Tung Eng Iron Work Co. Ltd.	do.	90
Sulfur		China Petrochemical Development Corp.	Taipei	50

TABLE 3
TAIWAN: RESERVES OF MAJOR MINERAL COMMODITIES FOR 1994
(Thousand metric tons unless otherwise specified)

Commodity	Reserves	
Coal	170,000	
Dolomite	110,000	
Limestone	395,000	
Marble	280,000,000	
Natural gas	thousand cubic meters	200,000,000
Talc	2,000	