

VIETNAM

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According to the Vietnamese Government's preliminary geologic surveys and detailed exploration of 500 mineral occurrences and deposits, a wide variety of minerals were identified. Those identified minerals were antimony, bauxite, carbonate rocks, clays, chromite, coal, copper, natural gas, gemstones, gold, graphite, iron ore, lead, manganese, nickel, crude petroleum, phosphate rock (apatite), pyrophyllite, rare earths, silica sand, tin, titanium, tungsten, zinc, and zirconium (Le, 1996).

Among those identified minerals, coal, carbonate rocks, crude petroleum, and phosphate rock were produced in large quantity; and other minerals, such as chromite, gemstones, natural gas, gold, iron ore, clays, ilmenite (titanium-bearing mineral), rare earths, salt, silica sand, tin, tungsten, zinc, and zirconium were produced in small quantity. Chromite, coal, gemstones, ilmenite, rare earths, silica sand, tin, zinc, and zirconium were produced for domestic consumption and export; other minerals production were produced for domestic consumption only.

In 2001, Vietnam was the fifth largest producer of anthracite in the world and the sixth largest producer of crude petroleum in the Asia and the Pacific region (U.S. Energy Information Administration, 2001¹; Oil & Gas Journal, 2001). Among all identified mineral resources in Vietnam, estimated resources of bauxite were substantial, but none of Vietnam's mineral resources was of world significance.

The mining and quarrying sector, which was dominated by the production of construction aggregates, coal, and crude petroleum, was an important sector of the Vietnamese economy. The output of the mining and quarrying sector, which included the output of the oil and gas industry, contributed 6.6% to Vietnam's gross domestic product (GDP). Of the total output of the mining and quarrying sector, the value of the output of oil and gas accounted for 82.9%, coal, 8.3%; stones and others, 8.0%; and metal ores, 0.8%. Vietnam's GDP, at 1994 constant prices and at current prices, was estimated to be \$19.3 billion and \$31.4 billion, respectively, in 2000. The output of mining and quarrying sector, at 1994 constant prices and at current prices, was estimated to be \$1.27 billion and \$2.98 billion, respectively, in 2000 (International Monetary Fund, 2002, p. 62; General Statistical Office, 2001, p. 71-75).

In 2001, the country's GDP reportedly grew 6.8%, about 1% higher than that of 2000, owing mainly to a 14.2% increase in industrial production (Embassy of the Socialist Republic of Vietnam, 2002§). Vietnam GDP per capita by the purchasing power parity (international dollars) was \$2,000 in 2001. The Vietnamese economy experienced deflation rates of 0.5% in 2000 and 0.3% in 2001.

According to Vietnam Economic Times, the country's exports

and imports were estimated to be \$16.7 billion and 17.7 billion, respectively, in 2001 (Vietnam Venture Group, 2002§). In minerals trade, the major export mineral commodities were crude petroleum and coal, which were valued at \$2.8 billion and \$119 million, respectively, and accounted for 22% and 1%, respectively, of total exports. The major import mineral commodities were refined petroleum products, iron and steel products, and fertilizer, which were valued at \$1.6 billion, \$777 million, and \$275 million, respectively, and accounted for 12%, 6%, and 2%, respectively, of total imports (International Monetary Fund, 2002, p. 52-53).

Government Policies and Program

Because of the impact of the 1997-98 Asian financial crisis, foreign direct investment (FDI) in Vietnam had been on the downward trend during 1996 and 1999. Annual FDI inflow, based on approved capital, decreased from \$8.6 billion in 1996 to \$4.6 billion in 1997, to \$3.9 billion in 1998, and to \$1.6 billion in 1999, then rebounded to \$2.4 billion in 2000 (Intel Asia, 2001§).

To attract foreign investment in Vietnam, the Government promulgated the Law on Foreign Investment (LFI) in 1987. To create favorable business climate, the law had been amended four times in 1990, 1992, 1996, and 2000.

The amended LFI, which was approved by the 10th National Assembly in May 2000, made several revisions. It removed difficulties and obstacles and reduced risks for FDI enterprises in which responsibilities for compensation and land clearance are shifted from foreign partners to the Vietnamese. It allowed FDI enterprises to mortgage their land-use rights to borrow money from credit organizations and relaxed currency balance regulations on foreign-invested enterprises. It gave more autonomy for FDI enterprises and lessened issues that require consensus in the Management Board. It allowed investors more freely to change the investment form, reorganize enterprises, and transfer capital. It gave more preferences to foreign investors by providing more import tariff exemption and reduction by reducing transmittal tax rates from 10%, 7%, and 5% to 7%, 5%, and 3%, respectively. It allowed 100% foreign-owned enterprises and foreign partners to the Business Cooperation Contract to forward losses. It allowed foreign investors to continue to enjoy preferences provided in case of changes in the Vietnamese law. The foreign investor will be granted more preferential provisions after receiving investment license (Ministry of Foreign Affairs, 2000§).

Production

In 2001, Vietnam's mineral production included chromite, coal, fluorspar, natural gas, gold, kaolin, ilmenite, lead, crude

¹References that include a section twist (§) are found in the Internet References Cited section.

petroleum, phosphate rock, pyrite, pyrophyllite, salt, silica sand, stone, sulfur, tin, zinc, and zirconium. Production of processed mineral products included cement, fertilizer materials (ammonia and urea), lime, crude steel, rolled steel, and refined tin (table 1). Most mineral production was processed and consumed domestically, although most chromite, ilmenite, crude petroleum, and zirconium production and some coal (anthracite), granite, kaolin, salt, silica sand, and refined tin production were exported. The major imported mineral products were fertilizer materials, iron and steel, and refined petroleum products.

Structure of the Mineral Industry

The mineral industry comprised the following state-owned companies: Vietnam National Cement Corp. (VNCC), Vietnam National Chemical Corp., Vietnam National Coal Corp. (Vinacoal), Vietnam National Gem and Gold Corp. (VIGEGO), Vietnam National Minerals Corp. (VIMICO), Vietnam Oil and Gas Corp. (PetroVietnam), Vietnam National Salt Corp., and Vietnam Steel Corp. (VSC). The industry also included several state-owned and foreign mining and mineral-processing company joint ventures, many small-scale local government-owned mining companies, local government and private mining company joint ventures, and local private miners (table 2).

Among the state-owned companies, the Hanoi-based VIMICO controlled 17 companies that were engaged in mining-related activities, such as geologic surveys, exploration, mine development, mineral production, ore processing, metal smelting, and mineral trade. The major VIMICO-affiliated companies and office location of their main office, in order of importance, were Thai Nguyen Nonferrous Metal Co. (TNNMC) (producer of chromite, lead, tin, and zinc) in Phu Xa District, Bac Thai Province; Cao Bang Nonferrous Metal Co. (producer of iron ore and tin) in Nguyen Binh District, Cao Bang Province; Nghe Tinh Nonferrous Metal Co. (producer of tin) in Quy Hop District, Nghe An Province; Rare Earth Co. (producer of rare earths) in Dong Da District, Hanoi; Mineral Development Co. (producer of marble) in Hoan Kiem District, Hanoi; Mineral Development Co. No. 3 (producer of iron ore and pyrite) in Ba Vi District, Ha Tay Province; Mineral Development Co. No. 4 (producer of ilmenite and zircon) in Vinh City, Nghe An Province; Mineral Development Co. No. 5 (producer of construction aggregates, fluorspar, and ilmenite) in Tuy Hoa District, Phu Yen Province; Mineral Development Co. No. 6 (producer of construction aggregates and ilmenite) in District 10, Ho Chi Minh City; and Geological & Mineral Mining Enterprise No. 304 (producer of iron ore and pyrite) in Duyen Hai Quarter, Lao Cai Provincial Town.

The Hanoi-based VNCC controlled six companies that were engaged in cement production and marketing. The six cement companies were Bim Son Cement Co. in Bim Son, Thanh Hoa Province; But Son Cement Co. in Thanh Chau, Ha Nam Province; Ha Tien Cement Co. in Ho Chi Minh City; Ha Tien II Cement Co. in Kien Luong, Ha Tien Province; Hoang Thach Cement Co. in Minh Tan, Hai Hung Province; and Hai Phong Cement Co. in Hai Phong City.

The steel companies controlled by the state-owned VSC were Da Nang Steel Co. in Da Nang City, Southern Steel Co. in Ho Chi Minh City, Southern Steel's six joint ventures (50-50 joint ventures with three foreign companies) in various locations, and Thai Nguyen Iron & Steel Co. in Thai Nguyen.

Commodity Review

Metals

Bauxite, Alumina, and Aluminum.—To develop Vietnam's bauxite resources in the Central Highlands Province of Lam Dong, the Government reportedly agreed in March 2001 for VIMICO to conduct a feasibility study for building a bauxite-aluminum complex, which would include a hydropower station at Tan Rai. According to an initial proposal by Aluminium Pechiney (AP) of France, the first-phase complex to start operation in 2006 at Tan Rai, which is 220 kilometers (km) northwest of Ho Chi Minh City, included bauxite mines capable of producing 1.7 million metric tons per year (Mt/yr) of ore, a 300,000-metric-ton-per-year (t/yr) alumina refinery, and a 72,600-t/yr aluminum smelter with an estimated cost of \$930 million (Vietnam Venture Group, 2001§; Metal Bulletin, 2001b).

In July, VIMICO announced that the construction work to build a new aluminum smelter was expected to begin in 2003 and that only Vietnam interests would invest in the \$600 million project; however, it will be open for foreign investors following competition of the feasibility. VIMICO indicated that AP would provide the technological support for the project and that alumina feed will be imported. A proposed joint-venture project between VIMICO and AP to build an alumina refinery was still pending despite an agreement between the two companies to conduct a feasibility study. In July, VIMICO also signed a memorandum of understanding (MOU) with China Nonferrous Corp. to develop bauxite mines in the Dac Nong District of Dac Lac Province. According to the MOU, the two companies had agreed to invest in the construction of a railway track connecting the mining site and Thi Vai port in Ba Ria-Vung Tau Province. The estimated project cost was \$1 billion. The construction work was expected to begin following Government approval (Metal Bulletin, 2001e; Metal Bulletin, 2001c).

Chromite.—Production of chromite had been on the upward trend in the past 5 years. Production of chromium ore increased from 51,000 metric tons (t) in 1997 to about 59,000 t/yr in 1998 and reached 60,000 t in 2000 (General Statistical Office, 2001, p. 326). In 2000, about 51% of total chromite production was from state-owned companies and 49% from non-state-owned companies. TNNMC and several small-scale mining companies mined chemical- and refractory-grade chromite from the alluvial deposits in the northeastern foothills of Nui Nua Mountain in Nong Cong District, Thanh Hoa Province. The area has proven reserves of about 20 million metric tons (Mt) of chromium oxide (Nguyen, K.V., 1997). Chromite concentrate produced by TNNMC from Nui Nua contained 46% Cr₂O₃ with less than

27% Fe₂O₃, 5% SiO₂, and 0.4% H₂O. TNNMC exported chromite concentrate mainly to China.

Gold.—Gold was produced by two TNNMC joint ventures—the Russian Geology Federation in Bac Kan Province and Covectory Investment Ltd. of Australia near Da Nang. Additionally, many small-scale miners and illegal miners were at the placer deposits along the Bac Giang, the Ca Long Dai, the Da, the Gam, the Hien, the Hinh, the Lo, and the Ma Rivers (Le, 1996).

In gold exploration, Olympus Pacific Minerals, which owned 67.4% of the Phuoc Son gold project, 40 km southwest of Danang in Central Vietnam, continued its drilling programs in 2001. In July 2001, the company announced that drilling had intersected significant high-grade mineralization in its drill holes at the Phuoc Son gold project. As of July 2001, 28 drill holes had delineated the mineralized Bai Go quartz vein system, which lies in the Dak Sa shear zone. Of these holes, 14 intersected gold mineralization of more than 1 gram per metric ton (g/t). The company also was conducting drill target definition programs at 10 prospective areas to the north of the areas drilled and on parallel structure to the west of the Dak Sa shear zone (Olympus Pacific Minerals Inc., 2001§).

Bureau de Recherches Geologiques Minières of France, which had 40% interest in the Pac-Lang joint-venture gold project in Cao Bang Province with Hindustan Zinc Ltd. of India (30%) and VIGEGO (30%), reportedly had withdrawn from the project. Hindustan Zinc decided to continue with the program, but will wait until the problems of illegal mining are resolved (Asian Journal of Mining, 2001a).

Because of increased purchase of jewelry in Vietnam, consumption of gold in the form of jewelry rose to about 34 t in 2000, about 56.6% of the total demand for gold. In Vietnam, gold import is banned, but gold was being imported illegally. According to the World Gold Council, dozens of tons of gold were imported every year since 1997. The State Bank of Vietnam issued gold import quotas each year to three state-owned companies—Gold and Jewelry Corp., Ho Chi Minh City Jewelry Co., and Phu Nhuan Jewelry Co. (Vietnam Style, 2001a§).

Iron and Steel.—The steel industry comprised VSC-affiliated steel producers, several joint-venture steel producers, and small private or local steel producers. The industry operated 40 rolled steel plants with a total capacity of 2.56 Mt/yr. Production of rolled steel was about 1.9 Mt in 2001, of which 652,000 t was produced from VSC-affiliated companies, 887,000 t was from foreign invested joint-venture companies, and the remainder was from private and joint-stock companies. Vietnam imported about 72% of the crude steel requirements for its rolling mills in 2001. Most of the country's rolled steel production were such construction steel as rod steel and wire steel (long product). The country's requirements for such flat products as plate steel, sheet steel for the manufacturing industry, and specialty steel for the machinery industry were met mostly by imports (Vietnam Economic Times, 2002b§).

Demand for steel in 2001 was about 3.8 Mt in 2001. According to a forecast by VSC, domestic demand for steel was expected to increase by 13% to 4.3 Mt in 2002 because of the

planned construction of new powerplants, steelmaking plants, bridges, and several housing projects (Mekong Sources, 2002b§). To reduce the country's dependence on imports, Vietnam planned to expand its steelmaking capacity and was seeking foreign capital to invest in cold- and hot-rolling mills. According to the Ministry of Trade and Custom Office, Vietnam's imports of iron and steel were 2.3 Mt and were valued at \$626 million in 1999 and 2.9 Mt and valued at \$812 million in 2000 (International Monetary Fund, 2002, p. 53, 80).

In November 2001, Thai Nguyen Iron and Steel Company, a VSC-affiliated company, completed its phase I project to upgrade its billet plant in November. The capacity of the billet plant would be raised to 200,000 t/yr in 2002 from 180,000 t/yr November 2001. The capacity would be increased further to 220,000 t/yr in 2003 and 240,000 t/yr in 2004. The company also operated iron ore mines at the Qui Xa and Tien Bo in Cao Bang Province and produced about 100,000 t/yr of ore. The company's iron ore reserves were estimated to be 3 Mt (Metal Bulletin, 2001d).

Vietnam National Steel Association was established, and the first general meeting had been held at the end of 2000. VSC's chairman was elected as the association's first chairman. The initial activities of the association were to monitor production activities of Vietnamese steel producers and to stabilize prices of long products (Japan Metal Bulletin, 2002§).

Other Metals.—production of lead, tin, and zinc was by VIMICO affiliates—Minerals Company No. 1 (tin and iron ore) in Tinh Tuc and Nguyen Binh, Cao Bang Province; Nghe Tinh Non-ferrous Metal Company (tin) in Quy Hop Hamlet, Nghe An Province, and TNNMC (lead, tin, and zinc) in Luu Xa, Thai Nguyen City. In the past 2 years, Vietnamese tin producers had suffered from losses and retrenched workers because of low tin prices. In 2001, tin producers had severely cut back their production and reduced their monthly working days to only 13; they also had asked the Government to impose import tariffs and to lower their taxes (Malaysian Tin Bulletin, 2001).

Zinc production at the Cho-Dian Mine in Bac Can Province increased considerably in 2001. Vietnam reportedly was constructing its first zinc plant in Ha Tinh Province. The zinc plant will come onstream by the end of 2002. The \$1.6 million plant would have the capacity of 6,000 t/yr zinc, and its products would be consumed by the ceramics, pottery, glass, and construction industries (Mekong Sources, 2002a§).

In 2001, two foreign companies in joint venture with the Government were active in exploring for nonferrous metals in Vietnam. Tiberon Minerals Ltd. was exploring for tungsten and associated bismuth, copper, and gold in its 70%-owned Nui Phao polymetallic property, Thai Nguyen Province, 90 km north of Hanoi. AMR Nickel Ltd., which was a wholly owned subsidiary of Asian Mineral Resources Ltd. of New Zealand (a spinoff from Spectrum Resources Ltd. of Canada), was exploring for nickel and copper in its 70%-owned Ta Khoa nickel property, Son La Province.

Tiberon Minerals had drilled a total of 103 holes on the Nui Phao deposit plus 8 large-diameter metallurgical drill holes since late 2000 and expected to drill 11 holes early in 2002. On the basis of the results of 70 drill holes, the preliminary estimate for the Nui Phao deposit is indicated resources of 12.35 Mt at an

average grade of 0.43% WO_3 , 0.31 g/t Au, 0.26% Cu, 0.12% Bi, and 8.1% CaF_2 , and inferred resources of 10.18 Mt at an average grade of 0.47% WO_3 , 0.26 g/t Au, 0.27% Cu, 0.13% Bi, and 11.7% CaF_2 . Both estimates used a 0.25% WO_3 cutoff grade disregarding gold, copper, bismuth, and fluorite values. Updated resource estimates based on further drilling were expected in early 2002. The company also was to begin a prefeasibility study in November and expected to be completed in May 2002 (Mining Journal, 2001; Metal Bulletin, 2001a).

Asian Mineral Resources began a diamond drilling program (4,000 meters) on its Ta Khoa nickel property in 2000 to test geophysical targets at the Ban Nguon, the Ban Phuc, the Ban Tang, and the Hong Ngai deposits. The company started a second diamond drilling program (up to 6,000 meters consisting of 13 to 16 holes) in mid-October 2001 to test the King Snake Conductor and two other separate targets. On the basis of earlier exploration work on the 600-square-kilometer Ta Khoa property, the Ban Phuc nickel deposit was estimated to contain massive sulfide indicated resources of 1 Mt at a grade of 3.4% nickel, 1.3% copper, and 0.08% cobalt within a low-grade halo in a large footwall shear. A separate adjacent ultramafic intrusive body was estimated to contain indicated resources of 4.5 Mt at a grade of 1.3% nickel, 0.15% copper, and 0.02% cobalt (Asian Mineral Resources Ltd., 2001§).

Industrial Minerals

Cement.—Vietnam's cement industry continued to expand its capacity. The industry had 64 plants, of which 55 plants were with vertical kilns and 9 plants with rotating kilns. The industry's total capacity was about 14 Mt/yr in 2001. According to the Vietnam Cement Association, the industry comprised six state-owned cement companies under the supervision of VNCC with a combined total capacity of 7.59 Mt/yr, three joint-venture companies with a combined total capacity of 5.46 Mt/yr, and 10 local or private companies operating small cement factories with a combined total capacity of about 1 Mt/yr (Asean Federation of Cement Manufacturers, 2001§). In 2001, total cement production was estimated to be 14 Mt and was sufficient to meet the domestic demand. According to Vietnam Productivity Center, during 1996 to 2000, demand for cement grew at an annual average rate of 16% and was expected to grow at an annual rate of 10% to 12% in the next 4 years and to reach 20 to 22 Mt by 2005. Vietnam cement demand by region was 46% in the north, 40% in the south, and 14% in the central (Vietnam Productivity Center, 2002§; Vietnam Style, 2001b§).

Production of cement was by VNCC's six affiliated cement companies—Cong Ty Xi Mang Bim Son with a 1.2-Mt/yr plant in Bim Son, Thanh Hoa Province; Cong Ty Xi Mang But Son with a 1.4-Mt/yr plant in Thanh Chau, Ha Nam Province; Cong Ty Xi Mang Ha Tien 1 with a 1.0-Mt/yr plant in Ho Chi Minh City; Cong Ty Xi Mang Ha Tien II with a 1.15-Mt/yr plant in Kien Luong, Ha Tien Province; Cong Ty Xi Mang Hai Phong with a 0.54-Mt/yr plant in Hai Phong City; and Cong Ty Xi Mang Hoang Thach with a 2.3-Mt/yr plant in Minh Tan, Hai Hung (Duong) Province. Production of cement was also by three joint ventures—Chinfon Hai Phong Cement Corp. with a 1.4-Mt/yr plant in Trang Kenh-Min Duc-Thuy Nguyen, near

Hai Phong City; Morning Star Cement Ltd. with a 1.76-Mt/yr plant in Hon Chong, Kien Giang Province; and Nghi Son Cement Corp. with a 2.3-Mt/yr plant in Nghi Son, Thanh Hoa Province. Ten local or private cement companies with vertical-shaft kiln plants had a total combined capacity of 1.004 Mt/yr (Asean Federation of Cement Manufacturers, 2001§).

Because of the growing demand for cement in the north region, the Government had approved construction of four new cement plants in 2001. In 2001, a joint venture of New Century Co. of Taiwan and Eve Glory Corp. of the United States was to build a 1.4-Mt/yr cement plant in Quang Ninh Province. New Century replaced SAS Group of Thailand, which had failed to secure funding for the project. The local Mining and Energy Mechanic Corp. was expected to join the two foreign companies to implement the project (Mekong Sources, 2001c§).

In May 2001, Provincial government-owned Ninh Binh Cement Company had placed an order with Danish F.L. Smidth & Co. for a complete cement production line with the capacity of 1.23 Mt/yr and an estimated cost of more than \$100 million. The new cement plant would be located in the Ninh Binh Province, about 120 km southwest of Hanoi (F.L. Smidth & Co., 2001a§).

In December 2001, state-owned VNCC had placed an order with F.L. Smidth & Co. and Marubeni Corp. of Japan to build a cement plant with a capacity of 1 Mt/yr for an estimated cost of about \$80 million. The new cement plant, which is located just north of Haiphong, will replace the existing and environmentally unsustainable facility of VNCC-affiliated Cong Ty Xi Mang Hai Phong. The construction work would begin the fall of 2002 and was expected to be completed in early 2005 (F.L. Smidth & Co., 2001b§; Nikkei Weekly, 2001).

In 2001, a new cement plant with the capacity of 1.5 Mt/yr reportedly was being built in the Thai Nguyen Province for an estimated cost of about \$186 million, of which \$70 million was from foreign aids and more than \$110 million was from the Fund for Development and several commercial banks. The plant was scheduled for completion by 2005 (Vietnam Economic Times, 2002c§).

Ilmenite.—Production of ilmenite continued its upward trend and was estimated to have reached about 145,000 t in 2001, of which more than 90% was exported and 10% was consumed domestically. Exports of ilmenite were mainly to Japan (136,925 t) in 2001. Malaysia imported 26,384 t of ilmenite from Vietnam in 2000, the latest year for which data are available. Domestic demand for ilmenite was estimated to be 10,000 t/yr. In domestic market, ilmenite was consumed by the welding electrode and titanium dioxide pigment industries (Phung Viet Ngu, 2001§).

Bimal Minerals Co. Ltd., which was a joint venture of Binh Dinh Minerals Co. (40%) and Malaysia Mining Corp. and Syarikat Pendorong Sdn. Bhd. (combined 60%) of Malaysia, operated the Cat Khanh Mine and a processing plant at Qui Nhon, Binh Dinh Province. Binai Joint Venture of Binh Dinh Province in cooperation with Phu Yen Mineral Development Company reportedly was to export 40,000 t of ilmenite in 2001. Its ilmenite contains 52% TiO_2 , 0.08% P_2O_5 , and 15% Fe_2O_3 . The company exported its ilmenite to China, Japan, and Malaysia (Vietnam Trade Information Center, 2001§). Other

producers of ilmenite were the Institute of Industrial Chemistry, Meteco, and other local mining companies at Cam Hoa, Ky Anh-Cam Xuyen, Ky Khan, and Ky Ninh, Ha Tinh Province; Quang Ngan and Vinh My, Thua Thien Hue Province; Vinh City, Nghe An Province; and Dong Xuan, Phu Yen Province.

Vietnam's ilmenite resources include 4.5 Mt of ore in Cay Tram and Nui Chua in Thai Nguyen Province and 10 Mt of beach placer ore in the coastal Provinces of Binh Dinh, Ha Tinh, Phu Yen, Quang Binh, Quang Ninh, Quang Tri, Thanh Hoa, Thuan Hai, Thua Thien Hue, and Ba Ria-Vung Tau. There had been mining operations at about 40 beach placer deposits since 1991. Most of these operations used such home-made equipment as screw washing benches and magnetic and electrical dressing machines; others used modern equipment imported from Australia and Malaysia. Most of these operations produced ilmenite, which contains up to 52% TiO₂. They also produced smaller amount of zircon that contains between 60% and 65% ZrO₂ (Phung Viet Ngu, 2001§).

Mineral Fuels

Coal.—Vinacoal controlled most of the country's coal mining, distribution, and export. In 2001, the country's coal production increased by 19% to about 13 Mt because of increased exports and increased domestic demand by the utility industry. Vinacoal produced coal from six large-scale open pit mines that produced between 800,000 t/yr and 2.5 Mt/yr each, five large-scale underground mines that produced between 200,000 t/yr and 1 Mt/yr each, and many small-scale open pit mines and underground mines that produced less than 100,000 t/yr each (Vietnam National Coal Corp., oral commun., 2000).

Production of anthracite was mainly from Quang Ninh Province. The major operating coal mines were the Cam Pha (open pit and underground), the Cao Son (open pit), the Coc Sau (open pit), the Deo Nai (open pit), the Dong Trieu (underground), the Ha Tu (open pit), the Hong Gai (open pit and underground), the Mao Khe (underground), the Mong Duong (underground), and the Uong Bi (underground) areas. Production of brown coal was mainly from two open pit mines with a capacity of less than 500,000 t/yr each in the northern delta area.

The Vietnamese coal mining industry's capacity was estimated to be 14 Mt/yr of raw coal and 12 Mt/yr of clean coal. Raw coal was washed and cleaned at three coal preparation plants, which include the Cam Pha plant with a capacity of 2.5 Mt/yr, the Hong Gai plant with a capacity of 2.0 Mt/yr, and the Vang Danh plant with a capacity of 600,000 t/yr (Doan, 1997).

In 2001, Vinacoal alone produced 12.5 Mt of coal, of which 8 Mt was sold on the domestic market and 4 Mt was exported. Total sales increased by 18% to \$240 million, of which about \$104 million was from coal exports. Coal was exported mainly to Japan (40%) and China (20%). In 2000, the company cut production and reduced wages of its employees by up to 50% because of oversupply (Mekong Sources, 2002c§).

Vietnam's coal reserves were estimated to be 165 Mt, and most of that was anthracite (U.S. Energy Information Administration, 2001§). Vietnam peat reserves were estimated to be 7.1 billion cubic meters in the southern plain areas, of which about 5 billion cubic meters were in the Mekong Delta

area. According to the Mining and Industrial Investment Consultation Co., which was an affiliate of Vinacoal, Vietnam can develop and produce about 75 Mt/yr of peat in the next 5 years; firstly in Hanoi, the Central Region, and then in the southern Provinces of Kien Giang and Can Tho (Asian Journal of Mining, 2001b).

Natural Gas and Petroleum.—Production of natural gas and crude petroleum was mainly by the state-owned PetroVietnam in joint venture with foreign partners from Canada, France, Japan, Malaysia, Russia, Sweden, and the United States. In 2001, Vietnam produced about 16.9 Mt, or an average of 328,000 barrels per day (bbl/d) of crude petroleum, and 1.7 billion cubic meters of natural gas, or an average of 4.66 million cubic meters per day of natural gas (Vietnam Economic Times, 2002a§). Production of crude petroleum was from six offshore oilfields—the Bach Ho (White Tiger), the Bunga Kekwa, the Dai Hung (Big Bear), the Hong Ngoc (Ruby), the Rang Dong (Dawn), and the Rong (Dragon); all are in the Cuu Long Basin except the Dai Hung, which is in the South Con Son Basin, and the Bunga Kekwa Oilfield, which is offshore the southern coast of Vietnam between Vietnam and Malaysia.

The output from the Bach Ho Oilfield accounted for 78% of Vietnam's crude petroleum production; the Hong Ngoc and the Rang Dong, 8% each; the Rong, 3%; Bunga Kekwa, 2%; and the Dai Hung, 1%. The output from the Bunga Kekwa was shared equally by Vietnam and Malaysia. All six blends of crude petroleum produced from the six oilfields were classified as light, sweet crude with the American Petroleum Institute gravity of between 30.7° and 40.5° with low sulfur content of between 0.05% and 0.14% by weight. The major importers of Vietnam's crude petroleum, in decreasing order, were the United States, Japan, China, and Singapore.

In April 2001, Conoco Inc. of the United States announced that it had completed development of well 15P in block 15-2 offshore Vietnam. The well had increased crude petroleum production in the Rang Dong Oilfield from about 45,000 bbl/d to 55,000 bbl/d. The well tested at a flow rates of about 10,000 bbl/d from the basement reservoir and was expected to produce 10,000 bbl/d to 12,000 bbl/d increasing total field production to more than 55,000 bbl/d. The 1,615-square-kilometer block 15-2 was owned by Japan Vietnam Petroleum Co. Ltd. (46.5%, operator), Conoco (36%), and PetroVietnam (17.5%) (Conoco Inc., 2001c§).

In August 2001, Conoco and its partners had issued a commercial declaration for the Sutu Den discovery in block 15-1 offshore Vietnam and expected to produce at least 200 million barrels (Mbb) with the potential to produce more than 400 Mbb of crude petroleum. Block 15-1 (covering 4,634 square kilometers in the Cuu Long Basin) is about 180 km southeast of Ho Chi Minh City. Commerciality was based on a comprehensive analysis of results from three wells drilled in block 15-1, which included 15-1-SDX, 15-1-SD-2X, and 15-1-SD-2X (ST). The block 15-1 was owned by PetroVietnam (50%), Conoco of the United States (23.25%), Korean National Oil Corp. (14.25%), SK Corp. of Korea (9%), and Geopetrol of France (3.5%). In addition to a 23.25% interest holding in block 15-1, Conoco also holds a 36% interest in block 15-2 in the Trang Dong Oilfield, a 40% interest in block 16-2, and a

70% interest in the deepwater blocks 133 and 134 in Nam Con Son Basin (Conoco Inc., 2001b§).

In September 2001, the joint venture of PetroVietnam and Petronas of Malaysia announced that a new oilfield had been discovered through the Topaz North-1X exploration well in blocks 01 and 02 in the Cuu Long basin, 168 km offshore Vietnam (Mekong Sources, 2001a§).

Production of natural gas was from the Bach Ho Oilfield as associated gas, which accounted for more than 99% of Vietnam natural gas production, and an onshore Tien Hai—C Gasfield, near Hanoi, about 1%. Natural gas production was delivered as fuel to the Ba Ria and the Phu My electric powerplants in Ba Ria-Vung Tau Province and as raw materials to liquefied petroleum gas processing plants in Vietnam.

In 2001, PetroVietnam announced that it would construct a 34-km pipeline between the Bach Ho and the Rang Dong Oilfields to bring associated gas ashore at a rate of one million cubic meters per day and deliver the gas to a gas-processing plant in Ba Ria-Vung Tau Province via the existing pipeline. The construction work was expected to be completed by the end of 2001 (Mekong Sources, 2001b§).

To use natural gas from the Cuu Long and Nam Con Son basins, PetroVietnam began construction on the country's largest nitrogen fertilizer plant at the Phu My Gas-Power-Urea Complex in Ba Ria Vung Tau Province in southern Vietnam in March 2001. The \$486 million fertilizer plant would use natural gas as feed to produce 51,000 t/yr of ammonia and 740,000 t/yr of urea beginning in 2004 (PetroVietnam, 2001§).

In December 2001, Conoco announced an agreement with Statoil ASA of Norway to purchase a portion of its interests in the \$1.3 billion Nam Con Son natural gas project offshore Vietnam. The Conoco's purchase included Statoil's 50% interest in the 462,000-acre block 05.3. Conoco also acquired all shares of Statoil's subsidiary, Statoil Vietnam AS, which owned a 16.33% equity interest in the Nam Con Son pipeline, a 386-km delivery system that would transport natural gas in the Nam Con Son fields to the Phu My industrial complex near Ho Chi Minh City (Conoco Inc., 2001a§).

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General Statistical Office, Hanoi, Vietnam
 The Statistical Yearbook, annual.

TABLE 1
VIETNAM: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

| Commodity 2/ | | 1997 | 1998 | 1999 | 2000 | 2001 e/ |
|---------------------------------------|----------------------------|-----------|-----------|------------|------------|------------|
| Cement, hydraulic | thousand tons | 8,019 | 9,738 r/ | 10,489 r/ | 13,347 r/ | 14,000 |
| Chromium ore, gross weight | | 51,000 | 59,000 r/ | 58,500 r/ | 60,000 r/ | 60,000 |
| Clays, kaolin e/ | | 1,100 | 1,100 | 1,100 | 1,200 | 1,300 |
| Coal, anthracite | thousand tons | 11,388 | 11,672 r/ | 9,629 r/ | 10,857 r/ | 12,962 3/ |
| Fluorspar e/ | | 2,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Gas, natural, gross | million cubic meters | 705 | 1,000 | 1,150 | 1,550 | 1,700 3/ |
| Gold e/ | kilograms | 1,000 | 1,500 | 1,500 | 2,000 | 2,000 |
| Ilmenite, gross weight e/ | | 50,000 | 80,000 | 91,000 | 109,000 | 145,000 |
| Lead, mine output, Pb content e/ | | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Lime | thousand tons | 1,066 r/ | 939 r/ | 1,026 r/ | 1,024 r/ | 1,030 |
| Nitrogen, N content of ammonia | | 54,000 | 32,900 | 33,000 | 41,900 | 53,400 3/ |
| Petroleum, crude | thousand 42-gallon barrels | 71,457 | 88,525 r/ | 107,767 r/ | 115,252 r/ | 119,686 3/ |
| Phosphate rock: | | | | | | |
| Gross weight | thousand tons | 581 | 599 r/ | 681 r/ | 707 r/ | 750 |
| P ₂ O ₅ content | do. | 174 | 180 r/ | 204 r/ | 212 r/ | 225 |
| Pyrite, gross weight e/ | do. | 150 | 150 | 150 | 200 | 200 |
| Pyrophyllite e/ | | 20,000 | 20,000 | 20,000 | 30,000 | 30,000 |
| Salt | thousand tons | 743 | 867 r/ | 653 r/ | 635 r/ | 650 |
| Silica sand e/ | do. | 20,000 | 50,000 | 60,000 | 60,000 | 62,000 |
| Sulfur e/ | | 22,000 3/ | 22,000 | 22,000 | 22,000 | 22,000 |
| Stone, building stone | thousand tons | 41,200 | 46,900 r/ | 49,800 r/ | 53,800 r/ | 55,000 |
| Steel, crude | do. | 314 | 306 | 308 | 306 | 310 |
| Steel, rolled | do. | 978 r/ | 1,077 r/ | 1,357 r/ | 1,672 r/ | 1,900 3/ |
| Tin: | | | | | | |
| Mine output, Sn content e/ | | 4,800 | 4,500 | 4,000 r/ | 3,700 r/ | 3,500 |
| Metal, smelter | | 2,376 r/ | 2,320 r/ | 1,693 r/ | 1,490 r/ | 1,200 |
| Tungsten, mine output, W content e/ | | 210 | -- | -- | -- | -- |
| Zinc, mine output, Zn content e/ | | 16,000 | 18,000 | 18,000 | 22,000 r/ | 36,000 |
| Zirconium, gross weight e/ | | 800 | 600 | 300 | 150 | 100 |

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through July 26, 2002.

2/ In addition to the commodities listed, barite, bauxite, benonite, refractory clay, construction aggregates, copper, granite, graphite, iron ore, marble, gemstones, and rare earths were mined, but not reported. Available information is inadequate to make reliable estimates of output levels.

3/ Reported figure.

Sources: Vietnam's General Statistical Office, Statistical Yearbook, 2000; British Geological Survey, World Mineral Statistics, 1992-99; World Metal Statistics, May 2002, and South East Asia Iron and Steel Institute, Crude Steel production, Quarterly Statistics, 1998-2000.

TABLE 2
VIETNAM: STRUCTURE OF THE MINERAL INDUSTRY IN 2001

(Thousand metric tons unless otherwise specified)

| Commodity | Major operation companies and major equity owners | Location of main facilities | Annual capacity |
|--------------------|--|--|-----------------|
| Cement | Chinfong Hai Phong Cement Corp. (Chingfong Group of Taiwan owned 70%, Hai Phong Municipal Government; and Vietnam National Cement Corp., 14.44%) | Min Duc near Hai Phong City | 1,400 |
| Do. | Morning Star Cement Ltd. (Holderbank Financiere Glaris Ltd. of Switzerland owned 65% and Vietnam National Cement Corp.-Ha Tien 1, 35%) | Hon Chong, Kien Giang Province | 1,760 |
| Do. | Nghi Son Cement Corp. (Taiheiyu Cement Corp. and Mitsubishi Materials Corp. of Japan owned 65% and Vietnam National Cement Corp., 35%) | Nghi Son, Thanh Hoa Province | 2,270 |
| Do. | Vietnam National Cement Corp. (100% state owned) | Bim Son, But Son, Ha Tien, Hoang Thach, and Hai Phong | 7,590 |
| Chromite | Thai Nguyen Nonferrous Metal Co. (wholly owned subsidiary of state-owned Vietnam National Minerals Corp.) | Nui Nua, Thanh Hoa Province | 30 |
| Coal, anthracite | Vietnam National Coal Corp. (100% state owned) | Cam Pha, Cao Son, Coc Sau, Deo Nai, Dong Trieu, Ha Tu, Hong Gai, Mao Khe, Mong Duong, and Uong Bi in Quang Ninh Province | 12,000 |
| Gas, natural | million cubic meters per day VietSovPetro (a joint venture of Vietnam Oil and Gas Corp. and Zarubezhneft, a Russian oil company) | Offshore Bach Ho Oilfield | 3 |
| Fertilizer: | | | |
| Apatite | Vietnam National Chemical Corp. (100% state owned) | Lao Cai in Lao Cai Province | 700 |
| Superphosphate | Do. | Lam Thao, Phu Tho Province | 800 |
| Iron ore, pyrite | Mineral Development Co. No. 3 and Geological & Mineral Mining Enterprise 304 (wholly owned subsidiaries of Vietnam National Minerals Corp) | Ba Vi District, Ha Tay Province; Duyen Hai Quarter, Lao Cai Province | 200 |
| Nitrogen, ammonia | Vietnam National Chemical Corp. | Ha Bac in northern Vietnam | 55 |
| Petroleum, crude | thousand 42-gallon barrels per day VietSovPetro | Offshore Bach Ho and Rong oilfields | 330 |
| Salt | Vietnam National Salt Corp. | Nam Dinh, Nghe An, and Hai Tin Provinces | 750 |
| Steel, crude | Vietnam Steel Corp. | Cai Lan in northern Vietnam | 320 |
| Tin: | | | |
| Concentrate | Cao Bang Nonferrous Metal Co. and Nghe Tinh Nonferrous Metal Co. (wholly owned subsidiaries of state-owned Vietnam National Minerals Corp.) | Pia Oac, Cao Bang Province; Quy Hop, Nghe An Province; and Tam Dao, Tuyen Quang Province | 4 |
| Refined | Thai Nguyen Nonferrous Metal Co. | Thai Nguyen, Bac Thai Province | 2 |
| Titanium, ilmenite | Bimal Minerals Co. Ltd. (Binh Dinh Minerals Co. owned 40% and Malaysia Mining Corp. and Syarikat Pendorong Sdn. Bhd., 60%) | Cat Khanh, Qui Nhon, Binh Dinh Province | 80 |
| Do. | Mineral Development Co. No. 4 and No. 5 (wholly owned subsidiaries of Vietnam National Minerals Corp.) | Vinh City, Nghe An Province; Tuy Hoa, Dong Xuan, Phu Yen Province; and Quang Ngai and Vinh My in Thua Thien-Hu Province | 60 |
| Zinc, concentrate | Thai Nguyen Nonferrous Metal Co. (wholly owned subsidiaries of Vietnam National Minerals Corp.) | Bac Thai and Cho Dien, Bac Kan Province | 38 |