THE MINERAL INDUSTRY OF

# VIETNAM

By John C. Wu

Vietnam, which borders the Gulf of Thailand to the north, the Gulf of Tonkin and the South China Sea to the west, Cambodia and Laos to the east, and China to the south in Southeast Asia, was a low-income developing country with a per capita gross domestic product (GDP) of $420 (Vietnam Venture Group, 2003§[1]). The country has a wide variety of mineral resources. According to the Department of Geology and Minerals of Vietnam (DGMV), about 70 kinds of minerals have been discovered in about 5,000 deposits and ore occurrences in Vietnam. About 60% to 70% of these deposits and ore occurrences, however, are small deposits with an insignificant amount of resources.

As a result of the DGMV's recent geologic investigations, bauxite, chromium, coal, copper, natural gas, gold, iron ore, nickel, crude petroleum, phosphate rock (apatite), rare earths, tin, titanium, and tungsten were identified as important mineral resources. Other identified but less important mineral resources were carbonate rocks (limestone and marble), gemstones (ruby and sapphire), graphite, lead, manganese, silica sand, zinc, and zirconium (Le, Van De, 1996; Lai Hong Thanh, 2002§; Troung Duc Chinh, 2002§).

Of the identified mineral resources in Vietnam, none was of world significance, but as a result of exploration by state-owned and foreign companies during the past 3 years, bauxite resources in the Central Highlands and rare earths resources in the northwestern region were believed to be substantial (Le Van De, 1996). A recently discovered polymetallic deposit by a foreign company in northern Vietnam may contain substantial resources of tungsten and other minerals, such as bismuth, copper, fluorite, and gold (Tiberon Minerals Ltd., 2002§).

In 2002, Vietnam was the fifth largest producer of anthracite in the world, the sixth largest producer of crude petroleum, and one of the top producers of ilmenite and zirconium in Asia and the Pacific region (Oil & Gas Journal, 2003; U.S. Energy Information Administration, 2002§).

With the exception of carbonate rocks, coal, and hydrocarbons, most of Vietnam's mineral resources remained largely unexploited because of the country's lack of infrastructure, modern mining equipment and technology, and a competitive Government mining policy to attract foreign investment in the mining sector.

Exploitation of the country's ferrous and nonferrous metals resources was limited and still in the early stage of development. Mining and mineral-processing activities of these minerals by the state- and nonstate-owned companies (limited liability, private, and joint-stock companies, combines, cooperatives, and private individuals) in Vietnam were mostly small- and medium-scale operations.

The mining and quarrying sector, which was dominated by the construction materials, coal, and oil and gas industries, comprised 456 state-owned companies, 120 nonstate-owned limited liability, joint stock, and private companies, 114 nonstate-owned combines and cooperatives, 118 nonstate-owned private individuals, and 18 non-state-owned foreign invested companies (Lai Hong Thanh, 2002§). The total number of employees in the mining and quarrying sector was about 219,000 (General Statistics Office, 2002, p. 41).

In 2001 (the last year for which data are available), the output of the mining and quarrying sector contributed 6.7% to Vietnam's GDP. Of the total output value of the mining and quarrying sector, the output value of oil and gas accounted for 82%; coal, 9%; stones and others, 8%; and metal ores, 1%. The output value of mining and quarrying sector, at 1994 constant prices, was estimated to be $1.3 billion in 2001. Vietnam's GDP, at 1994 constant prices and at 2001 prices, was estimated to be $19.4 billion and $32.7 billion, respectively, in 2001 (General Statistics Office, 2002, p. 57-58, 234; World Bank, 2003§).

In 2002, Vietnam was the second fastest growing economy after China in Asia and the Pacific region. The country's economy, as measured by real GDP, grew by 6.4% compared with 5.8% in 2001, and its inflation rate was 4.0% in 2002, which was considerably higher than 0.8% in 2001. In 2002, the country's total value of exports and imports was $16.5 billion and $19.3 billion, respectively (Asian Development Bank, 2003§).

In minerals trade, Vietnam was a net importer. The major import mineral commodities were refined petroleum products, iron and steel products, and fertilizer, which were valued at $2.0 billion, $1.3 billion, and $464 million, and accounted for about 10%, 7%, and 2%, respectively, of the total imports in 2002. Vietnam's major export mineral commodities were crude petroleum and coal, which were valued at $3.2 billion and $149 million, respectively, and accounted for about 20% and 1%, respectively, of the total exports in 2002 (Vietnam Panorama, 2003b§).

## Commodity Review

### *Metals*

**Bauxite, Alumina, and Aluminum.**—To develop the bauxite resources in Bao Lam District of Lam Dong Province, state-owned Vietnam National Minerals Corp. (VIMICO) submitted to the Ministry of Industry a feasibility study in which the Société Généralé of France and HypoVereinsbank of Germany were named as financiers of the $650 million bauxite mining and processing project in December 2002. Earlier, VIMICO had signed a memorandum of understanding (MOU) with the two banks. The Ministry of Industry was to review the study

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

before presenting it to the Prime Minister Office for approval in 2003 (Mekong Sources, 2002a§).

To develop other bauxite resources in Dac Nong District of Dak Lak Province, China Non-Ferrous Corp. reportedly was conducting a feasibility study in 2002 following the signing of an MOU with VIMICO in 2001 for the joint development of a bauxite mine in the Dac Nong District. In May 2002, Vietnamese and Chinese officials held talks on a possible partnership to develop a bauxite mine in Dac Nong and to build an $800 million alumina refinery in the Central Highlands of Vietnam. The joint development of the bauxite resources was being considered as a long-term plan with such remaining issues as power cost and financing to be resolved later. The Ministry of Industry indicated, however, that Vietnam was also interested in holding talks with other potential investors, which included Alcoa Inc. of the United States (Metal Bulletin, 2002a, d). Bauxite resources in the Provinces of Dak Lak, Kon Tum, Lam Dong, and Quang Ngai in the Central Highlands area of southern Vietnam were estimated to be more than 4 billion metric tons (Truong Duc Chinh, 2002§).

**Copper.**—Vietnam copper resources are located mainly in the northern Provinces of Bac Giang, Hoa Binh, Lang Son, Lao Cai, and Son La. Sin Queyen, which is located in Lao Cai Province and is the largest deposit, has ore reserves of about 550,000 metric tons (t) of copper plus 35 t of gold and 25 t of silver (Truong Duc Chinh, 2002§). On the basis of an earlier joint exploration by VIMICO and an Australian consortium led by Auridan Consolidated N.L in 1994, the resources at Sin Queyen were estimated to be 52.8 million metric tons (Mt) at a grade of 0.91% copper at a cut off grade of 0.5% copper (Lyday, 1994).

To develop the copper resources in the Sin Queyen area, VIMICO announced that it planned to construct a copper mine with a capacity to produce 2 million metric tons per year (Mt/yr) of ore, a mill with the capacity to produce 50,000 metric tons per year (t/yr) of concentrate that contains between 20% and 22% copper, and a smelter with the capacity to produce about 10,000 t/yr of copper metal. The $70 million project would be financed by a $40 million loan from the Chinese Government, and the remaining $30 million, by Vietnamese banks. Equipment would be supplied by Chinese companies. Design and construction of the new mining and smelting complex reportedly had begun in September 2002. VIMICO planned to bring the new copper complex on stream in 2004. The Sin Queyen Mine, which had been producing a small quantity of copper concentrate since 1995, produced and exported between 3,000 and 5,000 t/yr of copper concentrate to China in the past 4 years. According to VIMICO, domestic demand for copper in Vietnam, which was estimated to be between 15,000 and 20,000 t in 2002, was met by imports mainly from China, Indonesia, and Japan (Metal Bulletin, 2002g, 2003; Mining Journal, 2002a).

**Chromium.**—Production of chromite extended the 5-year upward trend in 2002. Production of chromite increased to 80,000 t in 2001 and to 76,300 t in 2000 from 59,000 t in 1998 (General Statistics Office, 2002, p. 305). In 2001 (the last year for which data were available), about 56% of chromite production was from a state-owned company and 44% from a nonstate-owned company. Thai Nguyen Nonferrous Metal Co. (TNNMC) (a subsidiary of VIMICO) and another nonstate-owned mining company produced chemical- and refractory-grade chromite from two alluvial deposits in the northeastern foothills of Nui Nua Mountain in Nong Cong District of Thanh Hoa Province. The chromite reserves in the area (the Co Dinh Mine) were estimated to be 20.8 Mt of chromium oxide ($Cr_2O_3$) (Truong Duc Chinh, 2002§). Chromite concentrate produced by TNNMC from the Nui Nua Mountain contained 46% $Cr_2O_3$ with less than 27% iron oxide ($Fe_2O_3$), 5% silica ($SiO_2$), and 0.4% water. TNNMC exported chromite concentrate mainly to China.

**Gold.**—Gold was produced by the joint venture of TNNMC and the Russian Geology Federation in Bac Thai Province and many small-scale miners and illegal miners at numerous placer deposits in various parts of the country in 2002.

The Phuoc Son gold exploration project, which is located about 140 kilometers (km) southwest of Danang in central Vietnam, is owned by the joint venture of Olympus Pacific Minerals (57.18%, as the operator), Ivanhoe Mines Ltd. (32.64%), and Zedex Ltd. (10.18%). The joint venture completed a reconnaissance assessment of gold-skarn mineralization associated with intrusive stock in the central and midwestern sector of the Phuoc Son project in November 2002. Reconnaissances drilling within a 4-km radius of an apparent monzonite/granite intrusive center had intersected potentially ore-grade mineralization in skarnoid rock at the Khe Do, the Khe Rin, and the Tra Long prospects. In 2002, the joint venture also was to complete detailed feasibility studies for mining high-grade gold zones at the Bai Dat and the Bai Go sectors of the Phuoc Son gold project and, at the same time, continued exploration drilling in the high-grade gold zones of the two sectors (Olympus Pacific Minerals Inc., 2002a§, b§).

According to state-owned Vietnam National Gem and Gold Corp., refined gold production was estimated to be 1 t in 2000 (the last year for which data were available), and domestic demand for gold mainly by the gems and jewelry industry totaled about 40 t/yr. The shortfall was met by imports mostly through illegal channels. In 2000, about 36 t of gold was smuggled in from Cambodia, China, and Laos compared with 10 t that was imported legally. Imports of refined gold averaged 10 t/yr (Ngo The Hoc, 2002§).

**Iron and Steel.**—The proposed $360 million direct-reduced-iron plant by Craft Corp. of the United States was shelved indefinitely because of high gas prices and the lack of gas supply pipelines in Vietnam in 2002 (Metal Bulletin, 2002b).

Crude steel (billets or ingots) production ranged from 306,000 to 340,000 t/yr between 1998 and 2002. Crude steel was produced by Southern Steel Co. (SSC) and Thai Nguyen Iron and Steel Co. (TNISC) [wholly owned subsidiaries of state-owned Vietnam Steel Corp. (VSC)]. Each had a capacity of 200,000 t/yr. Because of growing domestic demand and high cost of imported crude steel, TNISC upgraded its billet plant in late 2001 and raised its capacity to 240,000 t/yr (Metal Bulletin, 2001). To meet the raw material requirements for its growing number of rolling mills, Vietnam imported about 2.1 Mt of crude steel, in the form of billets or ingots in 2002 (Vietnam Panorama, 2003a§).

VSC planned to build two new billet plants by 2005. In the south, SSC planned to build a $129 million billet plant with a capacity of 500,000 t/yr at the Phu My Ingots Steel Processing and Rolling Plant near Ho Chi Minh City, Ba Ria-Vung Tau Province. Construction of the southern plant was expected to begin in 2003 (Southeast Asia Iron and Steel Institute, 2002§). In the north, VSC planned to construct a $105 million billet plant with a capacity of 500,000 t/yr at the Quang Ninh Steel Ingots Processing and Rolling Plant in Cai Lan on the coast of Quang Ninh Province. A feasibility study for construction of the northern plant was commissioned in mid-2002, and a final decision was expected in mid-2003 (Metal Bulletin, 2002e).

According to Southeast Asia Iron and Steel Institute, apparent consumption of steel products in Vietnam increased by 26% to 3.8 Mt in 2001 (the last year for which data were available). A forecasted demand for steel by VSC in early 2002 expected a 13% increase in 2002 to 4.3 Mt because of the planned construction of new powerplants, steelmaking plants, bridges, and several major housing projects (Mekong Sources, 2002f§).

To reduce the country's dependence on imports, the Ministry of Planning and Investment (DPI) called for $6.1 billion foreign investment in five steel production projects in June 2002. The five projects were $5.3 billion for a steel mill with a capacity of 4.5 Mt/yr in central Ha Tinh Province, $365 million for a sponge iron plant with a capacity of between 1.25 and 1.4 Mt/yr in Ba Ria-Vung Tau Province, $350 million for a hot-rolled sheet plant with a capacity of 1 Mt/yr in southern Ba Ria-Vung Tau Province or in Dong Nai Province, and a specialty steel plant with a capacity of 50,000 t/yr in northern Hai Phong City, and $120 million for steel billets plant with a capacity of 500,000 t/yr in northern Quang Ninh Province or Hai Phong City (the same project as the Quang Ninh Steel Ingots Processing and Rolling Plant proposed by VSC). DPI indicated that these projects may be implemented under the joint-venture or wholly foreign invested forms (Vietnam Style, 2002§).

According to the Ministry of Trade and Customs Office, Vietnam's imports of iron and steel in 2002 totaled 4.9 Mt, of which 2.1 Mt was steel billets. The import bills for iron and steel totaled $1.3 billion in 2002 (Vietnam Panorama, 2003b§).

Vietnam began lowering its import tariffs on iron and steel products in May 2001 and was to make further reductions during 2002 and 2005 before participating in the Association of South East Asian Nations (ASEAN) Free Trade Area agreement in 2006. The Government had lowered its import duty on long products to 20% from 40%. The import duty was to be reduced to 15% in 2004, 10% in 2005, and 0% to 5% in 2006. The import tariffs on galvanized steel sheet and coil, which had been cut to 20% from 30%, also were to be reduced to 5% from 0% in 2005 (Southeast Asian Iron and Steel Institute, 2001§).

**Other Metals.**—VIMICO produced lead and zinc in Cho Dien in Bac Can Province. Production of zinc concentrate was between 40,000 and 50,000 t/yr and contained about 25% zinc and from 2% to 3% lead. The zinc concentrate produced from the Cho Dien Mine was exported mainly to China and Thailand. In August 2002, according to a local press report, Dong Bac (Northeast) Geology Union reported discovery of a lead-zinc deposit in Tuyen Quang Province with resources that contained an estimated 500,000 t of metal (about 80% zinc and 20% lead). Vietnam imported between 15,000 and 20,000 t/yr of zinc slab to meet its zinc metal requirements (Metal Bulletin, 2002f).

In 2002, two foreign companies in joint venture with the Government remained active in exploring for nonferrous metals in Vietnam. AMR Nickel Ltd. [a wholly owned subsidiary of Asian Mineral Resources Ltd. (AMR) of New Zealand] was exploring for copper and nickel in its 70%-owned Ta Khoa concession, which is located about 180 km west of Hanoi, Son La Province. In March 2002, AMR completed a 4,100-meter diamond drilling program of 13 holes in its Ta Khhoa concession; 3 intersected mineralization (Asian Mineral Resources, 2002§). In August 2002, AMR sought investors to help finance a feasibility study at its Ta Khoa nickel project; Falconbridge Ltd. of Canada had a joint-venture option agreement with the company in 1998 but withdrew from the project in March 2002 because none of the targets tested met its size and grade criteria.

According to AMR, the project has measured and indicated resources of about 5.45 Mt at a grade of 1.6% nickel in the massive sulfides and 2% nickel in the footwall shear, which included 1.75 Mt at a grade of 1.1% nickel amenable to open pit mining, 2.25-Mt of underground resources at a grade of 1.58% nickel, and a high-grade underground resource of 1.45 Mt at a grade of 2.3% nickel. The project was operated by Ban Phuc Nickel Mines Ltd., which was 70% owned by AMR's subsidiary AMR Nickel Ltd., 20% by VIMICO's subsidiary Mineral Development Company (Mideco), and 10% by Song La Mechnical Engineering Co. (Metal Bulletin, 2002c).

Tiberon Minerals Ltd (TM) of Canada continued to explore for tungsten and fluorite and associated bismuth, copper, and gold at its 70%-owned Nui Phao polymetallic property, which is about 80 km north of Hanoi, in Thai Nguyen Province. In February 2002, TM announced results from the initial metallurgical study on the Nui Phao deposit. The results indicated that about 80% of the tungsten contained in the samples tested could be recoverable by using a combination of conventional gravity and flotation-processing technologies. By late February, TM completed a four-hole drilling program on its Nui Phao property. In April, TM commissioned a prefeasibility study by AMEC E&C Services Ltd. in conjunction with Knight Piesold Consulting and Laurion Consulting Inc., which was scheduled for completion by January 2003. By December 2002, TM updated its resource estimate for its Nui Phao deposit. The resources calculation for the deposit by AMEC E&C Services, which was based on the results of more than 120 cored drill holes, delineated 27.1 Mt of measured (proven) reserves, which contained 67,800 t of tungsten oxide ($WO_3$), 6,778 kg of gold, 62,400 t of copper, 29,800 t of bismuth, and 2.2 Mt of fluorite ($CaF_2$); 22.2 Mt of indicated (probable) reserves, which contained 42,300 t of $WO_3$, 4,895 kg of gold, 46,700 t of copper, 23,100 t of bismuth, and 1.8Mt of $CaF_2$; and 24.0 Mt of inferred (possible) reserves, which contained 43,300 t $WO_3$, 3,846 kg of gold, 38,500 t of copper 19,500 t of bismuth, and 1.9 Mt $CaF_2$ (Tiberon Minerals Ltd., 2003§).

### *Industrial Minerals*

**Cement.**—In 2002, Vietnam's cement industry expanded its capacity by 21% to about 17 Mt/yr; all 65 plants operated

at full capacity. The cement industry consisted of 6 major cement companies under state-owned Vietnam National Cement Corp. (VNCC), 3 major joint-venture cement companies, and 56 provincial, local, and private cement companies. In 2002, Vietnam's demand for cement rose sharply because of the country's increased spending on construction for infrastructure and housing projects.

According to Government statistics, Vietnam cement production increased by more than 26% to 19.5 Mt in 2002 (Vietnam Panorama, 2003a§). According to the industry sources, however, Vietnam produced 17.6 Mt of cement, imported 3 Mt of clinker, and consumed about 20 Mt of cement. According to the Vietnam Building Materials Association, demand for cement has grown by an annual average of 18% during the past 10 years. In 2002, demand for cement grew by 20% compared with that of 2001 and was expected to grow at an annual rate of between 10% and 12% within the next 3 years. If the Ministry of Construction-forecasted demand for cement reached 22 Mt, then the country would need to import at least 4.5 Mt of clinker and about 500,000 t of cement in 2003 (International Cement Review, 2003a).

The average Vietnamese cement worker produced only between 1,000 and 1,500 t/yr of cement, which was well below the world average of 5,000 t, because many of the old cement plants in Vietnam were still using outdated technology that wasted materials and energy (International Cement Review, 2003b; Vietnam Productivity Center, 2002§).

Because of the continued growth in demand for cement, the Government approved several new cement projects in 2002. The major new cement projects by state-owned and local companies were the Song Da Construction Corp. and Thang Long Co. plan to build a $210 million plant with 1.7 Mt/yr of clinker capacity in Ha Long, Quang Ninh Province, and a $50 million clinker grinding plant with 1.22 Mt/yr of cement capacity in Hiep Phuoc Industrial Park in Ho Chi Minh City; the state-owned Ha Tien I Cement Co. plan to build a plant with 2 Mt/yr of clinker capacity in Binh Phuoc Province; and the Midland Construction Corp. (an affiliate of the Ministry of Construction) plan to build a grinding plant with 1.23 Mt/yr of cement capacity in Quang Binh Province (International Cement Review, 2002).

The major new cement projects by joint venture with foreign companies were the Swiss company Holcim and VNCC plans for the $500 million project to build a plant with 3 Mt/yr of cement capacity near a limestone source in Quang Nam Province and for the $50 million project to build a clinker grinding plant with 1 Mt/yr of cement capacity in Ba Ria-Vung Tau Province (Vietnam News, 2002a, c).

The Ministry of Planning and Investment agreed in principle to allow the Holcim and VNCC joint venture to raise the capacity of its Sao Mai plant in Kien Giang Province to 2.2 Mt/yr from 1.75 Mt/yr. The Taiwanese company Chinfon Cement Co. plan to increase its capacity to 2.6 Mt/yr by 2005 by adding a second 1.6-Mt/yr capacity production line in its joint-venture plant with VNCC and Hai Phong municipal government in Hai Phong was still pending (Mekong Sources, 2002b§).

**Titanium.**—Production of ilmenite was estimated to be at the same level as that of 2001. The major ilmenite producers were Bimal Minerals Co. Ltd. in Binh Dinh Province, Ha Tinh Minerals and Trading Co. in Ha Tinh Province, the Institute of Industrial Chemistry, and such local mining companies as Mineral Development Co. No. 4 and No. 5 in the north-central and south-central coastal Provinces of Nghe An, Phu Yen, and Thua Thien-Hue.

Vietnam exported most of its ilmenite production. Exports of ilmenite went mainly to Japan (116,487 t in 2002), China, and Malaysia. Domestic demand for ilmenite was about 10,000 t/yr. In the domestic market, ilmenite was consumed by the titanium dioxide pigment and welding electrode industries (Phung Viet Ngu, 2001§).

Vietnam's ilmenite resources include from 4.0 to 4.5 Mt of ore in Cay Tram (Cay Cham) and Nui Chua in Thai Nguyen Province and from 6 to10 Mt of beach placer ore in the coastal Provinces of Binh Dinh, Ha Tinh, Phu Yen, Quang Binh, Quang Ninh, Quang Tri, Thuan Hai, Thanh Hoa, Thua Thien-Hue, and Vung Tau. Mines have been operated at about 40 beach placer deposits since 1991. Most of these operations used such homemade 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 contained up to 52% titanium oxide ($TiO_2$). They also produced smaller amount of zircon that contains between 60% and 65% zirconium oxide ($ZrO_2$) (Phung Viet Ngu, 2001§).

### *Mineral Fuels*

**Coal.**—After crude petroleum, coal was the second most important mineral commodity produced in Vietnam. In the domestic market, coal was the main fuel for thermal powerplants; primary fuel by the manufacturers of cement, chemicals, metals, and processed foods; and cooking fuel for urban and rural households. In the export market, coal was one of the major export commodities to earn foreign currency. Because of its high heat value and low contents of ash, nitrogen, phosphorus, and sulfur, Vietnamese anthracite retained a large percentage share of the anthracite market in Japan and Western European countries, where strict environmental protection regulations were being implemented (Le Tri Hung, 2002§).

In 2002, the coal mining industry's capacity was estimated to be 16 Mt/yr. The total number of employees in the coal industry was about 70,000 regular employees and about 10,000 seasonal employees. Only about 55,000, however, were actually engaged in coal mining activities. To improve productivity and coal miners' income, about 20,000 workers reportedly would be separated from the industry in the coming years.

Vietnam National Coal Corp. (Vinacoal) controlled most of the mining, distribution, and export of coal. According to General Statistical Office, the coal industry produced 15.9 Mt and exported 5.9 Mt of coal in 2002. Domestic demand for coal was estimated to be between 9 and 10 Mt in 2002 (Vietnam News, 2002b; Le Tri Hung, 2002§; Vietnam Panorama, 2003a§, b§).

Production of anthracite was mainly from Quang Ninh Province. According to Vinacoal, two major coal mines—the Cua Ong and the Hon Gai with a combined capacity of 5 Mt/yr using imported new technology from Australia—were

capable of processing coal at the mine sites to meet customers' specifications. Other important coal mines were in the Cam Pha, the Cao Son, the Coc Sau, the Deo Nai, the Dong Trieu, the Ha Tu, the Mao Khe, the Mong Duong, and the Uong Bi areas. Production of brown coal was mainly from the Na Duong Mine in Lang Son Province.

In the past 2 years, Vinacoal has focused its investments on importing new equipment and technology for the expansion of its production capacity. The ongoing expansion and development were at the Cao Son, the Khe Cham, the Khe Tam, the Mao Khe, the Nui Beo, the South Ha Tu, the Vang Danh,and the Yen Tu Mines, all in the northeastern part of the country. Coal processing (washing) and port facilities at Cua Ong and Hon Gai in Quang Ninh Province were to be upgraded and expanded (Mining Journal, 2002b; Le Tri Hung, 2002§).

In 2002, coal demand in domestic market was about 9 Mt, of which 3 Mt was consumed by coal-fired powerplants; 1.7 Mt, by cement plants; 450,000 t, by paper and fertilizer plants; and 3.9 Mt, by such other manufacturers as chemicals, iron and steel, nonferrous metals, and processed foods; general households; and other end users. According to Vinacoal, coal demand in the domestic market was projected to reach between 12 and 13 Mt by 2005. The Government had shifted its focus from hydropower to coal in 2000 and was promoting the construction of coal-fired powerplants in 2002. To implement the Government's energy policy, Vinacoal planned to build as many as seven new powerplants that will range from 100 to 300 megawatts (MW) each in the next 10 years (Le Tri Hung, 2002§).

In March, Vinacoal signed a $121 million contract with Marubeni Corp. of Japan for the construction of a 100-MW coal-fired powerplant next to the Na Duong coal mine in northern Lang Son Province by April 2004 (Mekong Sources, 2002c§). In December 2002, the Government approved construction of a 600-MW thermal powerplant with two turbines in Tam Hung Commune in the northern port city of Hai Phong. Construction of the $640 million powerplant project would start in early 2003 and was scheduled for completion in October 2006 (Mekong Sources, 2002e§).

In overseas markets, Vietnam's exports of anthracite totaled 5.9 Mt and were valued at $149 million in 2002. In 2001, Vietnam exported about 4.3 Mt of anthracite and accounted for about 36% of about 12 Mt of anthracite traded in the world market. Vietnam's exports of anthracite went, in decreasing order, mainly to Japan, the European Union member countries, the ASEAN member countries, and the North American countries, which included the United States. In the past 2 years, Vietnamese anthracite has lost market shares in the Japanese and European markets to Chinese anthracite because of price competition. Vietnamese anthracite, however, had increased its market share in the Southeast Asian and the South African markets (Le Tri Hung, 2002§).

**Natural Gas and Petroleum.**—Vietnam's natural gas industry was still in the early stage of development despite its considerable offshore gas reserves in the Malay-Tho Chu and the Nam Con Son Basins. In 2002, PetroVietnam in joint venture with a foreign partner from Russia produced natural gas from the small onshore Tien Hai–C Gasfield in the Hanoi Trough (part of the Song Hong Basin) and associated gas from the larger offshore Bach Ho and Rang Dong Oilfields in the Cuu Long Basin. In 2002, the overall gas production totaled 2,260 million cubic meters, or an average of about 6.19 million cubic meters per day. In the domestic market, natural gas was consumed as fuel for power generation at the Ba Ria and the Phu My electric powerplants and as raw material by the liquefied-petroleum-gas (LPG)- and condensate-processing plants for the production of LPG and gasoline in Vung Tau, Ba Ria-Vung Tau Province.

According to state-owned PetroVietnam, natural gas would play an increasingly important role to meet the country's growing energy needs in the coming years. To use its offshore natural gas resources in the Nam Con Son Basin, PetroVietnam and its foreign partners (BP Amoco of the United Kingdom, Conoco of the United States, and ONGC of India) completed the development of the Lan Do and the Lan Tay fields in block 06.1, which have an estimated reserve of 2 trillion cubic feet, or 56.6 billion cubic meters of natural gas; a 400-km pipeline with the capacity to transport 7.5 billion cubic meters per year of natural gas; a gas-processing station at Dinh Co; and a gas distribution center at Phu My, Ba Ria-Vung Tau Province, in 2002. As a result, an additional 2.7 billion cubic meters per year of natural gas would be supplied by the pipeline from new gasfields in the Nam Con Son Basin to the Phu My power generation complex in 2003 (PetroVietnam, 2002§; Nguyen Xuan Nham, 2003§).

Other important gas utilization projects undertaken and to be undertaken by PetroVietnam were the construction of a 332-km pipeline to deliver 2 billion cubic meters per year of natural gas from the Bunga Kekwa Field in block PM3 CAA and the Cai Nuoc Field in block 46 Cai Nuoc to the $1.2 billion Ca Mau gas-power-fertilizer complex in the Province of CaMau and another gas pipeline from Phu My to Ho Chi Minh City to transport natural gas to Thu Dic, the Hiep Phuoc powerplants, and a planned Nhon Trach powerplant from the Rong Doi and the Hai Thach gasfields in the Nam Con Son Basin (Nguyen Xuan Nham, 2003§).

PetroVietnam produced crude petroleum in joint venture with foreign partners from Canada, France, Japan, Malaysia, Russia, Sweden, and the United States. According to the General Statistical Office, Vietnam produced about 19.3 Mt, or an average of 374,500 barrels per day (bbl/d) of crude petroleum in 2002 (Web News, 2003§).

According to PetroVietnam, crude petroleum was produced from six offshore oilfields in three basins. In the Cuu Long Basin, the Bach Ho oilfield averaged 256,000 bbl/d; the Rong, 12,000 bbl/d; the Rang Dong, 43,000 bbl/d; and the Ruby, 21,000 bbl/d. In the Malay-Tho Chu basin offshore the southern coast of Vietnam between Vietnam and Malaysia, the Bunga Kekwa oilfield averaged 14,000 bbl/d. In the Nam (South) Con Son Basin, the Dai Hung oilfield averaged 3,000 bbl/d. The output from the Bunga Kekwa oilfield was shared equally by Vietnam and Malaysia. The output from the Rang Dong oilfield will be increased to 70,000 bbl/d from 43,000 bbl/d after two new derricks (S1 and E1) are installed and operational in the coming years. The newly developed Su Tu Den oilfield in block 15-1 in the Cuu Long Basin was set to begin production by the end of 2003, and the country's crude oil production was expected to reach an average of 450,000 bbl/d in 2004 (PetroVietnam, 2002§; Nguyen Xuan Nham, 2003§).

To explore for oil and gas, PetroVietnam, through its subsidiary PetroVietnam Investment & Development Co. (40%), signed its 44th production-sharing contract with PETRONAS Carigali Overseas Sdn. Bhd. of Malaysia (30%) and Pertamina of Indonesia (30%) in January 2002 for oil and gas exploration and development in blocks 10 and 11.1 in the Nam Con Son Basin. The Con Son Joint Operating Co. joint venture was established by the three companies to explore for and develop hydrocarbon resources in the 7,915-square-kilometer area (Vietnam Economy, 2002§).

To finance the $1.3 billion oil refinery project at Dung Quat, Russia reportedly extended a $250 million loan for the project in January 2002. Under the credit agreement signed in December 2001, an interest rate of 1.5% will be charged on the first $150 million. The balance would be charged at 5% during the 12-year loan period. PetroVietnam was to invest about $250 million in the project, and state-owned Vietcombank was to provide a loan for the balance of the funding shortfall of about $500 million. In April 2002, a group of construction companies led by France's Technip-Coglexip was selected by the Vietnamese Government to build the $670 million main refining facilities for the Dung Quat oil refinery project. These companies were Technip-Coflexip, JGV Corp. of Japan, and Technicas Reunidas of Spain. In December 2002, the Russian coinvestor, Zarubezhneft, however, decided to withdraw from the Dung Quart oil refinery project. The Russian oil company became the project contractor, and PetroVietnam would be the single investor and would handle the project alone. PetroVietnam was expected to pay back all the capital plus interest to Zatubezhneft (Mekong Sources, 2002d§; Vietnam Venture Group, 2002§).

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Vietnam National Minerals Corp.
Mr. Nguyen Van Chung, Director
International Cooperation and Marketing
105 Nguyen Van Cu Rd.
Gia Lam District
Hanoi, Vietnam
Telephone: 84-4-8770016
Fax: 84-4-8770034
E-mail: vimico@hn.vnn.vn
Vietnam National Coal Corp.
Mr. Le Tri Hung, Deputy General Manager
Investment and International Cooperation Department
108 Le Duan St.
Hanoi, Vietnam
Telephone: 84-4-8519927
Fax: 84-4-8510724
E-mail: htqt@fmail.vnn.vn

## Major Publication

General Statistical Office, Hanoi, Vietnam:
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TABLE 1
VIETNAM: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

| Commodity[2] | | 1998 | 1999 | 2000 | 2001 | 2002[e] |
|---|---|---|---|---|---|---|
| Cement, hydraulic | thousand tons | 9,738 | 10,489 | 13,298 [r] | 15,374 [r] | 19,500 |
| Chromium ore, gross weight | | 59,000 | 58,500 | 76,300 [r] | 80,000 [r] | 80,000 |
| Clays, kaolin[e] | | 190,000 [r] | 200,000 [r] | 520,000 [r] | 600,000 [r] | 600,000 |
| Coal, anthracite | thousand tons | 11,672 | 9,629 | 11,609 [r] | 12,962 | 15,900 |
| Copper concentrate, gross weight[e] | | 15,000 | 15,000 | 15,000 | 2,000 | 5,000 |
| Fluorspar[e] | | 3,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Gas, natural, gross | million cubic meters | 1,039 [r] | 1,435 [r] | 1,598 [r] | 1,724 [r] | 2,260 |
| Gold[e] | kilograms | 1,500 | 1,500 | 3,000 [r] | 3,000 [r] | 3,000 |
| Ilmenite, gross weight[e] | | 80,000 | 91,000 | 174,000 [r] | 180,000 [r] | 180,000 |
| Lead, mine output, Pb content[e] | | 1,000 | 1,000 | 1,200 [r] | 900 [r] | 1,000 |
| Lime | thousand tons | 939 | 1,026 | 1,156 [r] | 1,180 [r] | 1,200 |
| Manganese concentrate, gross weight[e] | | 65,000 | 65,000 | 65,000 | 67,000 | 68,000 |
| Nitrogen, N content of ammonia | | 32,900 | 33,000 | 41,900 | 52,600 [r] | 58,400 |
| Petroleum, crude | thousand 42-gallon barrels | 88,525 | 107,767 | 115,373 [r] | 120,464 [r] | 136,700 |
| Phosphate rock: | | | | | | |
| Gross weight | thousand tons | 599 | 681 | 785 [r] | 750 | 770 |
| $P_2O_5$ content | do. | 180 | 204 | 236 [r] | 225 | 230 |
| Pyrite, gross weight[e] | do. | 150 | 150 | 200 | 200 | 200 |
| Pyrophyllite[e] | | 20,000 | 20,000 | 30,000 | 30,000 | 30,000 |
| Sand and gravel | thousand tons | 63,600 | 77,800 | 83,200 | 85,100 | 87,000 |
| Salt | do. | 867 | 653 | 590 [r] | 575 [r] | 600 |
| Silica sand[e] | do. | 50,000 | 60,000 | 60,000 | 62,000 | 62,000 |
| Sulfur[e] | | 22,000 | 22,000 | 22,000 | 22,000 | 22,000 |
| Stone, building stone | thousand tons | 46,900 | 49,800 | 57,600 [r] | 60,300 [r] | 62,000 |
| Steel: | | | | | | |
| Crude | do. | 306 | 308 | 306 | 319 [r] | 340 |
| Rolled | do. | 1,077 | 1,357 | 1,583 [r] | 1,906 [r] | 2,200 |
| Tin: | | | | | | |
| Mine output, Sn content[e] | | 4,500 | 4,000 | 4,100 [r] | 4,500 [r] | 4,000 |
| Metal, smelter | | 2,320 | 1,693 | 1,490 | 1,400 [r] | 1,400 |
| Zinc, mine output, Zn content[e] | | 18,000 | 18,000 | 12,000 [r] | 9,000 [r] | 10,000 |
| Zirconium, gross weight[e] | | 2,000 [r] | 2,500 [r] | 5,000 [r] | 5,400 [r] | 5,500 |

[e]Estimated; estimated data are rounded to no more than three significant digits. [r]Revised.

[1]Table includes data available through August 22, 2003.

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

Sources: Vietnam's General Statistical Office, Statistical Yearbook, 2001; British Geological Survey, World Mineral Statistics, 1992-99; World Metal Statistics, May 2003; South East Asia Iron and Steel Institute, Crude Steel Production, Quarterly Statistics, 1999-2001; and U.S. Geological Survey Minerals Questionnaire, 2000 and 2001.

TABLE 2
VIETNAM: STRUCTURE OF THE MINERAL INDUSTRY IN 2002

(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. (Holcim Group Switzerland, 65%; Vietnam National Cement Corp.-Ha Tien I, 35%) | Hon Chong, Kien Giang Province | 2,300 |
| Do. | Nghi Son Cement Corp. (Taiheiyo Cement Corp. and Mitsubishi Materials Corp. of Japan, 65%; Vietnam National Cement Corp., 35%) | Nghi Son, Thanh Hoa Province | 2,150 |
| Do. | Vietnam National Cement Corp. (100% state owned) | Bim Son, But Son, Ha Tien I, Ha Tein II, Hai Phong, and Hoang Thach | 9,400 |
| Chromite | Thai Nguyen Nonferrous Metal Co. (wholly owned subsidiary of state-owned Vietnam National Minerals Corp.) | Nui Nua, Thanh Hoa Province | 50 |
| Coal, anthracite | Vietnam National Coal Corp. (100% state owned) | Cam Pha, Cao Son, Coc Sau, Vang Danh, Dong Trieu, Ha Tu, Hong Gai, Mao Khe, Mong Duong, Cua Ong, Uon Bin in Quang Ninh Province | 15,000 |
| Gas, natural million cubic meters per day | VietSovPetro (a joint venture of Vietnam Oil and Gas Corp. and Zarubeznheft, a Russian oil company) | Offshore Bach Ho Oilfield | 5 |
| 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, Thai Nguyen Province, and Phu My, Ba Ria-Vung Tau Province | 440 |
| 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., 40%; Malaysia Mining Corp. and Syarikat Pendorong Sdn. Bhd., 60%) | Cat Khanh, Qui Nhon, Binh Dinh Provinces | 60 |
| Do. | Ha Tinh Minerals and Trading Co. | Cam Hoa, Ky Annh-Cam, Xuyen, Ky Khan, and Ky Ninh, Ha Tinh Province | 110 |
| 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 in Phu Yen Province; and Quang Ngan, Vinh My in Thua Thien-Hu Province | 30 |
| Zinc, concentrate | Thai Nguyen Nonferrous Metal Co. (wholly owned subsidiaries of Vietnam National Minerals Corp.) | Cho Dien in Bac Can Province | 50 |