

THAILAND

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Thailand has considerable resources of diatomite, dolomite, gypsum, limestone, potash, and rock salt, as well as a wide variety of other industrial minerals. Thailand's resources of metallic minerals and mineral fuels, however, are small. According to the Royal Thai Department of Mineral Resources (DMR), the identified mineral resources with estimated reserves are antimony, ball clay, barite, bentonite, copper, diatomite, dolomite, feldspar, fluorite, gold, gypsum, iron ore, kaolin, lead, limestone, manganese, marl, phosphate, potash, quartz, rock salt, silica sand, tin, and zinc (Department of Mineral Resources, 1998, p. 18). All these mineral resources except copper and potash have been exploited. Nonfuel mineral exploration in the past 5 years has been focused on copper, gold, and potash. Although development plans for these three minerals had been in place, financing arrangements or Government approval had not been finalized.

In 2000, Thailand was the fifth largest producer of feldspar (Potter, 2001) and the eighth largest producer of gypsum in the world (Olson, 2001). The country's estimated reserves of gypsum, limestone, potash, and rock salt are substantial. Most of its mineral production was for domestic consumption. Thailand, however, exported more than 70% of its gypsum and tin production and all byproducts of tin mining and smelting such as ilmenite, monazite, struverite, tantalum, and zircon. Most of the country's requirements for such ferrous and nonferrous metals as iron and steel, primary aluminum, refined copper, lead, precious metals, and other minor metals were met by imports.

The output of the mining and quarrying sector, which accounted for about 2% of Thailand's gross domestic product (GDP), was estimated to have grown by 7.5% in 2000 compared with 9.1% in 1999; the growth was a direct result of a substantial increase in the production of crude petroleum and natural gas. Thailand's economy, as measured by the GDP, continued the 1999 positive growth path and was estimated to have grown by 4.4% compared with 4.2% in 1999 owing mainly to an increase in private consumption and exports in 2000. The GDP, in 1988 constant dollars, was estimated to be \$78.8 billion in 2000. The total labor force increased to 33.4 million from 32.9 million in 1999, and the rate of unemployment decreased to 3.6% from 4.2% in 1999. Inflation, as measured by the Consumer Prices Index, was 1.6% in 2000 compared with 0.3% in 1999 and 8.1% in 1998 (International Monetary Fund, 2001, p. 5, 7, 21, 23).

Government Policies and Programs

The underlying mining policies of Thailand were to promote the domestic mining industry and to conserve the country's mineral resources. To meet these policy goals, the Government has been gradually shifting its emphasis on exploration, development, and exploitation to minerals that are consumed domestically, such as ball clay, feldspar, gypsum, kaolin, silica

sand, limestone, lignite, phosphate, potash, rock salt, and zinc, from minerals that are predominantly exported, such as antimony, barite, fluorite, tantalum-columbium, tin, and tungsten. To conserve minerals for future consumption and to increase value-added mineral products, the Government has been promoting sustainable development and imposing export controls on several byproducts of tin and on several low-unit-value minerals for which domestic demand was increasing (Dheeradilok, 1998).

In 1967, the Government enacted the Mineral Act No. 2, which had been amended in 1973 and 1979, to govern the country's mining and mineral-processing activities. Under this Act, the Government claims exclusive ownership of all minerals upon, in, or under the surface of public and private land but may grant licences to private individuals or entities for prospecting, mining, mineral dressing, metallurgical processing, transportation, sale, and storage of minerals (Dheeradilok, 1998).

Under the Mineral Act of 1967, the Ministry of Industry (MOI) was appointed as the principal Government agency to regulate the mining sector. The DMR, which is under the MOI, is responsible for supervising exploration and production activities in accordance with geoscience in geology, mineral, petroleum and ground water and with requirements in environmental protection. The DMR also is responsible for supervising the coastal zone management program, petroleum development, mineral resources exploration, and environmental protection in offshore areas and for the formulation of a viable program for the inspection of all petroleum and mining operations to ensure enforcement of applicable regulations. It conducts research on such environmental issues as mining land rehabilitation and the effect of offshore mining on shoreline, coral reef mangroves, and recreation areas. It also provides consulting services to the mining companies concerning technologies and equipment to be used to prevent environmental pollution (Dheeradilok, 1998).

Production

Thailand produced more than 50 different minerals and processed mineral products in 2000. The important minerals production were barite, dolomite, feldspar, natural gas, gemstones, gypsum, lead, limestone, crude petroleum, rock salt, silica, tin, and zinc. The important processed mineral products were cement, refined lead, steel, refined tin, and refined zinc. Thailand also produced such minor metals as cadmium, which was a byproduct of zinc refining, and tantalum powder by using domestic and import raw materials, scrap, and tin slag.

The overall output of the mining industry was higher than that of 1999 because of increased production of natural gas and crude petroleum. Production of all industrial minerals except clays, gypsum, pyrophyllite, and rock salt, however, remained steady or decreased, and production of all metallic minerals

except lead decreased in 2000. Production of crude petroleum and natural gas increased substantially; lignite production, however, decreased in 2000. Production of all processed minerals except refined tin increased because domestic demand for refined lead, steel, and refined zinc remained strong as a result of the continued economic recovery in 2000.

Trade

According to the Bank of Thailand, exports increased to \$67.9 billion compared with \$56.8 billion in 1999, and imports also increased to \$62.4 billion compared with \$47.5 billion in 1999. Thai merchandise trade balance decreased to \$5.5 billion compared with \$9.3 billion in 1999. The Thai baht depreciated by 5.8% to 40.16 Thai baht against one U.S. dollar in 2000 (Bank of Thailand, 2001, Thailand's macro economic indicators, accessed September 24, 2001, at URL http://www.bot.or.th/bothomepage/databank/econdata/macroindicators/thai_keye.htm).

In the minerals trade, Thailand was a net importer of minerals mainly because of its large import bills for coal, crude petroleum, iron and steel, and such nonferrous metals as primary aluminum, refined copper, gold, refined lead, and silver. In 2000, exports of major mineral commodities were as follows: gypsum, 4.2 million metric tons (Mt) that was valued at \$46 million; iron and steel products, 2.3 Mt, about \$1 billion; refined tin, 12,833 metric tons (t), \$69 million; tantalum metal powder, 155 t, \$42 million; and slab zinc and zinc alloy, 16,307 t, \$20 million (Department of Mineral Resources, 2001b, p. 80-82).

In 2000, imports of major nonfuel mineral commodities were as follows: primary aluminum ingots and aluminum alloys, 236,949 t that was valued at \$356 million; refined copper and copper alloys, 159,067 t, \$299 million; pig iron, 312,764 t, \$48 million; steel scrap, 741,332 t, \$116 million; steel billet, ingots, and slab, 2.7 Mt, \$551 million; finished steel products, 4.1 Mt, \$2.2 billion; refined lead and lead alloys, 79,176 t, \$33 million; slab zinc and zinc alloys, 23,832 t, \$30 million; gold, 1,256 t, \$631 million; and silver, 2,163 t, \$98 million (Department of Mineral Resources, 2001a, p. 5-14). In 2000, imported mineral fuels were as follows: coal, 4.2 Mt that was valued at \$125 million, and crude petroleum, 246 million barrels (Mbbbl) about \$6.1 billion (National Energy Policy Office, 2001, Coal import, accessed September 26, 2001, at URL <http://www.nepo.go.th/info/T42.html>; National Energy Policy Office, 2001, Demand and supply of crude oil and products, accessed September 26, 2001, at URL <http://www.nepo.go.th/info/T43.html>).

Structure of the Mineral Industry

Thailand's mining industry consisted of a small mining and mineral-processing sector of ferrous and nonferrous metals and a large mining and mineral-processing sector of industrial minerals. The energy sector, which included production of natural gas, coal (lignite), and crude petroleum, was small but growing. All mining and mineral processing businesses except coal, natural gas, and crude petroleum were owned and operated by private companies incorporated in Thailand. Coal exploration and mining activities were by the state-owned Electricity Generating Authority of Thailand (EGAT) and numerous local private coal mining companies. Oil and gas exploration and production were by the state-owned Petroleum

Authority of Thailand (PTT) and joint ventures of the PTT and foreign oil companies.

The total number of operating mines, except oil and gas, decreased to 730 from 742 in 1999, and the mining industry's employees also decreased to 19,619 from 20,821 in 1999. Limestone quarrying accounted for 34% the total number of operating mines and 24% of the industry's employment in 2000 (Department of Mineral Resources, 2001b, p. 72-75). Of the total number of active mines in 2000, 23 were coal mines, 55 were metal mines, and the remaining 652 were industrial mineral mines.

As a result of Government policy, the production capacity of industrial minerals increased in the 1990s, especially the cement industry, which had expanded its capacity by more than 40% to 51 million metric tons per year (Mt/yr). The production capacity of such export-oriented minerals as antimony, fluorite, kaolin, manganese, tin, and byproducts of tin, however, had been reduced considerably. Production capacity of crude petroleum and natural gas also expanded considerably in the second half of the 1990s following several new developments offshore in the Gulf of Thailand.

Commodity Review

Metals

Copper.—Thailand was not a copper producer in 2000. All Thailand's requirements for refined copper were met by imports. Thailand will produce a small amount of refined copper when the Puthep copper project in the northeastern Thailand begins its heap-leaching and solvent extraction-electrowinning (SX-EW) operations in 2003 or 2004. In August 2000, Pan Australian Resources, N.L. of Australia reached an agreement with Padaeng Industry Public Co. Ltd. (PIC) of Thailand to participate in the Puthep copper project and had the right to earn a flow-through interest of up to 70% in the project.

The Puthep project, which is located 20 kilometers (km) from the town of Loei, involved development of two oxide-supergene deposits—PUT 1 and PUT 2, which are 10 km apart. The main copper deposit PUT 1 has estimated ore reserves of 42 Mt of heap-leachable ore at a grade of 0.52% copper. According to Pan Australian Resources, the Put 1 could be developed as an open pit with heap leaching and SX-EW operations to produce up to 20,000 metric tons per year (t/yr) of copper cathode during a 10-year mine life. At the beginning of 2001, Pan Australian Resources was expected to begin a first-phase feasibility study to confirm the viability of developing the PUT 1 deposit, which would use heap-leach and SX-EW technology (Pan Australian Resources, N.L., 2000, Puthep copper project (Thailand), accessed October 1, 2001, at URL <http://www.panaustralian.com.au/puthep.html>).

Thai Copper Industries Co. Ltd., which halted construction of its 165,000-t/yr copper smelter in March 1998 with about 70% of the construction completed, was expected to resume construction as soon as additional financing from new investors is secured. Under the initial plan, the project was expected to be completed in October 1998. Because of the country's economic downturn and a sharp depreciation of the Thai baht, however, the project cost reportedly had increased by 60% (Metal Bulletin, 2000a).

Domestic demand for refined copper was estimated to be

151,000 t. In 2000, Thailand imported 150,864 t of refined copper and 8,203 t of copper alloys at a value of about \$300 million (Department of Mineral Resources, 2001a, p. 6).

Gold.—Thailand has not produced gold since 1996. Akara Mining Ltd. (a wholly owned subsidiary of Kingsgate Consolidated N.L. of Australia) received approval by the MOI in August 2000 for the development its 100% owned Chatree gold project located on the eastern edge of Chao Phraya Basin. In June 1999, Akara Mining was granted a special permit to explore for gold in the Thap Khlo District of Pichit Province and the Wang Pong District of Phetchabun Province. Total measured, indicated, and inferred resources in the area were estimated to be 14.5 Mt at a grade of 2.6 grams per metric ton (g/t) gold and 12 g/t silver, of which proven and probable reserves were 8.2 Mt at a grade of 3.1 g/t gold and 14 g/t silver. The development project for an open pit operation was started in November 2000 and was expected to be completed in 12 months. Under the company plan, the 1.5-Mt/yr operation was expected to produce an average of 4,449 kilograms per year during the first 3 years of the 6.5-year mine life that would begin in late 2001 (Asian Journal of Mining, 2000a). Thungkam Co. of Thailand, which was exploring for gold in the Loei area, reportedly had a licence for gold exploration and production. The estimated ore reserves in the area were 985,000 t at a grade of 5.05 g/t. The company was still waiting for approval from the Land Reform Department in 2000 (Bangkok Post, 2000, Price slump takes luster off mining, accessed December 22, 2000 at URL http://www.bangkokpost.com/today/221200_business18.html).

Iron and Steel.—Iron ore production dropped sharply to 100 t from 122,600 t in 1999 because of a stoppage of operations of iron ore mines in the Provinces of Nakhon Si Thammarat, Phetchabun, and Prachuap Khiri Khan. A large portion of the raw material requirements for Thailand's steel industry in 2000 was met by imports. Thailand imported 2.7 Mt of semifinished products, which included steel billet, slab, and ingot; 741,000 t of steel scrap; about 313,000 t of pig iron; and 55,000 t of ferroalloys in 2000 (Department of Mineral Resources, 2001a, p. 7).

Thailand's crude steel production increased by 37% to 2.1 Mt in 2000 (South East Asia Iron and Steel Institute, 2001, Yearly statistics—Crude steel production, accessed October 1, 2001, at URL <http://www.seaisi.org/document/yearlystat%20for%20pdf.pdf>). The crude steel producers were Bangkok Steel Industry Public Co. Ltd., Nakornthai Strip Mill Public Co. Ltd., Namheng Steel Co. Ltd., Siam Construction Steel Co. Ltd., Siam Iron and Steel Co. Ltd., and Siam Yamato Steel Co. Ltd. According to an estimate by the SCB Research Institute, Thailand's production of steel products rose 28.7% to 9.3 Mt in 2000, of which 2.1 Mt was semifinished steel products and 7.2 Mt was finished products. Of the total finished products, 2.9 Mt was bars, and 4.3 Mt was sheets. The steel industry operated at 41% of its production capacity in 2000. The estimated domestic demand rose by 10.5% to 15 Mt in 2000 (Soonruth Bunyamane, 2000, 2000 yearend economic review—Industry—Slow road to recovery, Bangkok Post, accessed October 1, 2001, at URL <http://www.bangkokpost.com/yereview2000/industry.html>).

In 2000, Thailand imported 4.1 Mt of finished steel products, which included long products, hot-rolled flat products, cold-

rolled flat products, coated products, pipes and fittings, sheet piling, rail and accessories, iron and steel casting, and iron and steel forging. The imports of finished steel products were valued at \$2.2 billion in 2000 (Department of Mineral Resources, 2001a, p. 7-8). The Government imposed a 5% tariff on imports of semifinished steel products and 10% on finished steel products from the Association of South East Asian Nations (ASEAN). The tariff was expected to be reduced to zero in the next 12 years. The Government was expected to extend this tariff structure to all members of the World Trade Organization (WTO) in 2001. The Thai iron and steel industry, however, reportedly resisted extending the current tariff structure agreement among ASEAN to all WTO nations (Metal Bulletin, 2000b).

Tin.—Mine production decreased by 30.5% in 2000 because of reduced output from gravel pumping and open pit mining operations. Of the total mine output in 2000, 52% was produced by dredging offshore; 20%, by open pit; 16%, by Dulang washing and panning; and 12%, by gravel pumping. About 52% of the total mine output was produced from offshore dredging in Phuket Province (Department of Mineral Resources, 2001b, p. 61-62).

Production of refined tin decreased slightly but remained at about the record-high level of 1999, which was sustained by record-high exports of refined tin in 2000. Thailand Smelting and Refining Co. Ltd., which operated a 30,000-t/yr tin smelter in Phuket, operated at about 57% of its capacity in 2000. The smelter feed in 2000 consisted of 2,145 t of domestic ore and 15,143 t of imported ore and concentrate. Production of refined tin decreased slightly from that of 1999 because of decreased feed of domestic and imported ores to the smelter (Department of Mineral Resources, 2001a, p. 3).

Domestic demand for refined tin decreased to 4,366 t from 4,818 t in 1999. Exports of refined tin rose to 12,833 t from 12,250 t in 1999. The major buyers of Thai refined tin in 2000 were Japan (38%), the Republic of Korea (19%), the Netherlands (16%), Australia (13%), the United Kingdom (7%), and Taiwan (5%) (Department of Mineral Resources, 2001b, p. 63-65).

Zinc.—Mine production of zinc ore decreased by 14.4% in 2000 owing mainly to reduced output from the Padaeng deposit, which is 12 km southeast of Mae Sot in Tak Province. At the deposit, measured reserves were estimated to be 3.5 Mt at a grade of 11.6% zinc. A small amount of zinc ore was produced from lead-zinc operation at the Song Toh deposit, which is 16 km north of Nong Phai in Kanchanaburi Province. All zinc ore and concentrate was delivered to the zinc smelting and refining facilities at Tak in Tak Province, which was owned and operated by PIC.

According to PIC, production of zinc silicate ore totaled 133,759 t, and ore grade averaged 20.41% zinc in 2000 compared with 153,218 t ore and averaged 15.62% zinc in 1999. To supplement the short fall of raw materials for its zinc smelting and refining operations, PIC imported 163,667 t of zinc-sulfide concentrate that contained 86,760 t of zinc in 2000. PIC's zinc concentrate intake, in metal content, consisted of 29,020 t of domestic ore and 78,846 t of imported ore in 2000. Zinc metal produced by PIC consisted of 77,526 t of slab zinc and 23,618 t of zinc alloy (Padaeng Industry Public Co. Ltd., 2001, Operational results—Zinc ore production, Production &

Operation, accessed October 2, 2001, at URL <http://www.padaeng.co.th/mini.htm>; Padaeng Industry Public Co. Ltd., 2001, Operational results—Zinc production, Production & Operation, accessed October 2, 2001 at URL <http://www.padaeng.co.th/zion.htm>).

Domestic demand for zinc increased by 16.5% to 73,966 t, of which 58,541 t was slab zinc and 15,425 t, zinc alloy in 2000. Exports of slab zinc and zinc alloy dropped by 46.8% to 16,307 t because of increased domestic consumption in 2000. The principal buyers of slab zinc in 2000 were Taiwan (69%) and Myanmar (11%). The major buyer of zinc alloy in 2000 was Hong Kong (91%) (Department of Mineral Resources, 2001b, p. 69-70).

Industrial Minerals

Cement.—Despite a lower demand for cement in the domestic market, cement production held steady owing to increased exports. Thailand's cement industry had expanded considerably during the past 5 years. The industry's capacity stood at 51 Mt/yr but operated at between 45% and 50% of its capacity in between 1998 and 2000 because of substantial cutbacks in major construction projects since the Asian financial crisis that started in 1997. As a result of that crisis and the resulting regional economic downturn, several Thai cement companies were forced to restructure or seek multinational companies as partners. The country's second largest cement company Siam City Cement Co. Ltd. sold 25% of its equity interest to Holderbank Financière Glaris Ltd. of Switzerland; Jalapathan Cement Co. Ltd. teamed up with Ciments Français of France; and Siam Cement Co. Ltd. obtained financial help from Crown Property Bureau, which was the investment arm of Thailand's royal family, which had become a prominent shareholder of the company (International Bulk Journal, 2000).

In 2000, cement was produced mainly by, in decreasing order, Siam Cement, Siam City Cement, TPI Polene Co. Ltd., Asia Cement Co. Ltd., and Jalapathan Cement (see table 2). Siam Cement was the largest cement producer in Thailand and also the largest in South East Asia with an annual capacity of 18.8 Mt of clinker and about 23 Mt of cement. It operated five integrated plants with 14 kilns in the Provinces of Lampang, Nakhon Si Thammarat, and Saraburi. Its 10,000-metric-ton-per-day-capacity dry-process kiln at the Khao Wong plant in Saraburi was the world's largest (Siam Cement Public Co. Ltd., 2001, Company profile, 2001, accessed April 4, 2001, at URL http://www.cementai.co.th/products/cement/cm_prof.htm).

Domestic demand for cement decreased in 2000 because of lower Government spending on public works projects. Domestic demand for cement was estimated to be between 18 and 19 Mt in 2000. Exports of cement and clinker increased owing to an expanded export market into Bangladesh, Hong Kong, India, Sri Lanka, and the United States (Bank of Thailand, 2001, Annual report 2000, Section 2.2—Manufacturing production, construction materials, accessed September 24, 2001, at URL http://www.bot.or.th/bothomepage/databank/articlesandpublication/annual_report_e.htm).

Gypsum.—Thailand was one of the world's leading producers and exporters of gypsum in 2000. Production began to rebound in 1999 and continued to move higher in 2000 with increased exports to Indonesia, Malaysia, the Philippines, and

Vietnam. In 2000, about 72% of the gypsum production was from the Provinces of Nakhon Si Thammarat and Surat Thani. The number of productive gypsum mines rose to 36 from 34 in 1999, although that of gypsum miners decreased to 1,126 from 1,167 in 1999. In 2000, domestic consumption of gypsum was about 1.6 Mt, of which a large portion was consumed by the manufacturers of cement and gypsum board and a small portion was consumed by the agricultural sector. Exports of gypsum totaled about 4.2 Mt in 2000. The major buyers were Japan (24%), Indonesia (17%), Malaysia (15%), the Republic of Korea (12%), Taiwan (11%), Vietnam (7%), and the Philippines (6%). In 2000, about 4,000 t of ground gypsum was exported mainly to Taiwan (62%), Australia (24%), and Japan (11%) (Department of Mineral Resources, 2001b, p. 28-29, 72-75).

Potash.—Thailand was not a potash producer in 2000 but may become an important potash producer in Asia and the Pacific region in the next 3 to 4 years. In 2000, Asia Pacific Potash Corp. Ltd. (APPC), which was 90% owned by Asia Pacific Resources Ltd. (APR) of Canada, APR announced that Norsk Hydro ASA of Norway through its subsidiary Norsk Hydro Asia Pty. Ltd. had agreed to participate in its Somboon potash development project in northeastern Thailand as a minority partner with a 20% equity interest. APPC also was negotiating with Bechtel International Inc. of the United States for equity participation of up to 20% interest in the project in 2000 (Asian Chemical News, 2000). The project's Environment Impact Assessment (EIA) had been reviewed by the Office of Environmental Policy and Planning and by the Department of Mineral Resources' Environmental Division. APPC was expected to apply for mining licenses after the Government approved its EIA (Engineering and Mining Journal, 2000).

According to APR, APPC held the Udon Thani potash concession in northeastern Thailand. APR had a direct and indirect 90% beneficial interest in APPC; the Thai Government held the remaining 10%. Since 1993, APPC had conducted extensive exploration on the concession and discovered two large potash deposits—the Somboon and the Udon. The Somboon deposit was estimated to contain more than 300 Mt of sylvinitic ore at a grade of 24% K₂O, and the Udon deposit was estimated to contain more resources than that of the Somboon deposit. Kilborn Western Inc. had completed a bankable feasibility study for development of 2-Mt/yr potash mine at the Somboon deposit (Asia Pacific Resources Ltd., 2001, Executive summary, 2001 Annual Report, accessed October 4, 2001, at URL <http://www.apq-potash.com>).

Mineral Fuels

Coal.—Coal accounted for about 12% of Thailand's primary energy supply. About 20% of the annual coal requirements was met by imports. Coal production decreased by 2.6% to 17.8 Mt, and imports rose by 27.3% to 4.2 Mt in 2000. Coal, mostly lignite, was produced by EGAT from the Mea Mo Mine in Lampang Province and the Li Mine in Lamphun Province. The combined output of these two major mines accounted for more than 95% of the country's total lignite production in 2000. Coal resources at the Mea Mo deposit in the Province of Lampang were estimated to be 1,240 Mt. Other important productive coal mines were the Mae Chaem in Chiang Mai Province and the Mae Than in Lampang Province. About 20 private small coal

mines were operated in Chiang Mai, Lampang, Lamphun, Phayao, and Tak Provinces in the northern region and in Phetchaburi Province in the central region. Ban Pu Co. Ltd., and Lanna Lignite Co. Ltd. were two major private coal mining companies in 2000 (Asian Journal of Mining, 2000c, p. 26).

Consumption of domestic coal totaled 17.8 Mt in 2000. According to DMR, demand by end user in 1999 was 73% for power generation, 20% for cement manufacturing, 3% for paper manufacturing, and the remaining 4% for the manufacturing of fiber and lime, tobacco-curing, and other users. Imported coal was mostly anthracite and bituminous and was consumed mainly by the cement, nonferrous metal smelting, and iron and steel industries (Asian Journal of Mining 2000c, p. 27).

To secure a long-term fuel supply for its Mae Mo coal-fired powerplant, EGAT asked DMR for the rights to explore for coal in a mining concession in the Wiang Haeng District of Chiang Mai Province in mid-2000. On the basis of a preliminary investigation, coal reserves in the concession area were estimated to be 15 Mt of high-grade lignite, which is equivalent to 15 years of fuel supply for the powerplant (Asian Journal of Mining, 2000b).

Natural Gas and Petroleum.—Natural gas and crude petroleum, which included condensate, accounted for 28% and 60%, respectively, of Thailand's primary energy supply. Thailand's hydrocarbon resources were located mostly offshore in the Gulf of Thailand. Its proven natural gas reserves were estimated to be 333 billion cubic meters, and its proven reserves of crude petroleum were estimated to be 351.6 Mbbl in 2000 (Oil & Gas Journal, 2000).

Thailand's natural gas production increased by 4.6% to an average of 55 million cubic meters per day in 2000. Natural gas was produced from 18 gasfields, of which 16 were offshore and 2 onshore. In 2000, about 56% of Thailand's natural gas output was produced by Unocal Thailand Ltd. (UT) from offshore gasfields (Baanpot, Erawan, Funan, Gomin, Jakarawan, Pailin, Platong, Satun, South Satun, and Trat); 28%, by a joint venture of PTT Exploration and Production (44.4%), TOTAL Exploration and Production (Thailand) (33.3%), and British Gas Thailand PTE Ltd. (22.2%) from offshore Bongkot Gasfields; 5% by Chevron Offshore (Thailand) Ltd. (COT) from offshore Benjamas (Benchamas) oilfields and gasfields; 4%, by Esso Exploration and Production Khorat Inc. from onshore Nam Phong oilfields and gasfields in Khon Kaen Province; 3%, by Thai Shell Exploration and Production Co., Ltd. (TSEP) from onshore Sirikit oil and gasfields in Kamphaengphet Province; and the remaining 4%, by other companies (Department of Mineral Resources, 2001, Table 7—Production of natural gas by field, accessed April 4, 2001, at URL <http://www.nepo.go.th/info/nb-t07.html>).

Because of increased demand for natural gas, production was expected to increase considerably when the development of new gasfields is completed in the next 1 to 3 years. The major new development of gasfields were the Arhit, the Pakarang, and the Plamuk of UT; the Maliwan and the North Jarmjeree of COT; and three blocks (A-18, B-17, and C-19) offshore between Malaysia's Lawit-Jerneh fields and Thailand's Bongkot field of the Malaysia-Thailand Joint Development Area.

Consumption of natural gas increased by 13.3% in the first 9 months of 2000 to about 291,000 barrels per day (bbl/d) of oil equivalent largely owing to the stronger demand by the utility sector, which accounted for 91% of Thailand's natural gas

consumption. Demand for natural gas increased—EGAT, 6.4% to 203,000 bbl/d of oil equivalent; independent power producers and small power producers, 38% to 62,000 bbl/d of oil equivalent; and industrial sector, 22.2% to 26,000 bbl/d of oil equivalent (Boonson Kositchotethana, 2000, 2000 yearend review—Petroleum—Oil prices hit consumption, Bangkok Post, accessed September 27, 2001, at URL <http://www.bangkokpost.net/yereview2000/petroleum.html>).

Production of crude petroleum jumped by 70.8% to an average of 58,100 bbl/d, and that of condensate increased by 5.5% to an average of 52,400 bbl/d in 2000. In 2000, crude petroleum was produced from nine oilfields. The onshore Sirikit of TSEP, which was the largest onshore oilfield, produced 41% of the total crude petroleum output. The newly developed offshore Benjamas of COT, which was the largest offshore oilfield, produced 42% of the total. The Tantawan offshore oilfield and gasfield of Thaipo Ltd. produced 13% of the total. The remaining 4% was produced from six small oilfields. Production of condensate was produced from 13 offshore gasfields operated by UT and TOTAL Exploration and Production (Thailand). UT's condensate production accounted for 71% of the total, and TOTAL Exploration and Production (Thailand) accounted for 26% of the total in 2000. The remaining 3% was produced by other companies (Department of Mineral Resources, 2001, Table 5—Production of crude oil by location, accessed April 4, 2001, at URL <http://www.nepo.go.th/info/nb-t05.html>; Department of Mineral Resources, 2001, Table 6—Production of condensate by field, accessed April 4, 2001, at URL <http://www.nepo.go.th/info/nb-t06.html>).

Despite a substantial increase in the output of crude petroleum and condensate, Thailand continued to import about 86% of its crude petroleum requirements for its petroleum refining industry. Imports of crude petroleum totaled 673,133 bbl/d compared with 698,895 bbl/d in 1999. As of January 2000, Thailand's petroleum refining industry had a total crude capacity of 712,750 bbl/d. The Refinery Company had a 275,000-bbl/d-crude-capacity refinery in Map Ta Phut, Rayong; Thai Oil Co. Ltd. had a 203,000-bbl/d-crude-capacity refinery in Sriracha, Chonburi; Esso Standard Thailand Ltd. had a 173,000-bbl/d-crude-capacity refinery in Sriracha, Chonburi; and Petroleum Authority of Thailand had a 61,750-bbl/d-crude-capacity refinery in Bang Chak, Bangkok (Penn Well Corp., 2000).

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Major Sources of Information

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Major Publications

Department of Mineral Resources:
Mineral Statistics of Thailand, annual.
Metal Statistics of Thailand, annual.
Bank of Thailand:
Annual report, annual.
Economic report, annual.
Economic condition and Economic data.

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

(Metric tons unless otherwise specified)

Commodity	1996	1997	1998	1999	2000
METALS					
Antimony:					
Ore					
Gross weight	149	125	442	130 r/	178
Sb content	63 r/	53 r/	199 r/	59 r/	84
Metal, smelter	949	782	242	40	16
Cadmium	385	238	238 r/	238 r/	238
Gold kilograms	32	--	--	--	--
Iron and steel:					
Iron ore:					
Gross weight	85,880	43,840	90,700	122,633	100
Fe content e/	43,000	22,000	45,000	61,000	50
Crude steel thousand tons	2,143	2,101	1,814 r/	1,547 r/	2,100
Lead:					
Ore					
Gross weight	48,631	12,438	15,346	23,783	24,760
Pb content	21,000	5,400 r/	6,700 r/	11,900 r/	15,600
Metal, refined:					
Primary	4,922	4,112	3,219	3,025 r/	3,390
Secondary	12,789	14,968	18,906	23,741	23,803
Total	17,711	19,080	22,125	26,766 r/	27,193
Manganese ore:					
Battery- and chemical-grade, 75% MnO ₂	707	208	26 r/	46 r/	225
Metallurgical-grade, 46% to 50% MnO ₂	2,388	291	26 r/	675 r/	--
Total, gross weight	3,095	499	52	721 r/	225
Total Mn content e/	1,550	260	25	360 r/	110
Rare earths, monazite, gross weight	--	12	--	--	--
Tantalum, powder	59	70	56	98	210
Tin:					
Concentrate:					
Gross weight	1,457	756	2,028	3,400	2,363
Sn content	1,300	746	1,656	2,712	1,930
Metal, smelter, primary	10,981	11,984 r/	15,353	17,306	17,076
Tungsten concentrate:					
Gross weight	67	54	61	54	54
W content e/	37	30	35	30	30
Zinc:					
Ore					
Gross weight	181,233	91,132	195,122	185,752 r/	159,093
Zn content e/	18,700 r/	15,000 r/	25,000 r/	24,000 r/	27,000
Metal, primary	59,738	72,035 r/	75,904	75,639	77,525
Alloy	12,642 r/	12,018	15,076 r/	21,653	23,617
Zirconium concentrate, gross weight	5	--	--	--	100
INDUSTRIAL MINERALS					
Barite	48,074	54,817	105,221 r/	76,092 r/	56,180
Cement, hydraulic thousand tons	38,749 r/	37,115 r/	22,722 r/	25,354 r/	25,499
Clays:					
Ball clay	386,334	288,406	206,349 r/	317,877 r/	394,154
Kaolin, marketable:					
Beneficiated (washed)	535,040 r/	296,510 r/	248,461 r/	113,005	201,226
Nonbeneficiated (unwashed)	153,682 r/	205,560 r/	154,511 r/	243,213	286,912
Filler	22,564	18,588 r/	14,398 r/	14,765	19,836
Diatomite	1,576	91	912 r/	2,332 r/	390
Feldspar	684,983	611,789	440,288 r/	626,415 r/	542,991
Fluorspar, crude, metallurgical-grade	17,247	7,826	3,743 r/	13,005	4,745
Gemstones thousand carats	677	962	1,010	1,267 r/	928
Gypsum thousand tons	8,934	8,558 r/	4,334	5,005	5,830
Phosphate rock, crude	3,528	3,818	3,029	3,880	3,260
Salt:					
Rock	529,674	554,891	546,096	739,502 r/	792,250
Other e/	100,000	100,000	100,000	100,000	100,000

See footnotes at end of table.

TABLE 1--Continued
THAILAND: PRODUCTION OF MINERAL COMMODITIES 1/ 2/

(Metric tons unless otherwise specified)

Commodity	1996	1997	1998	1999	2000	
INDUSTRIAL MINERALS--Continued						
Sand, silica (glass)	447,050	515,859	323,937	531,588 r/	471,547	
Stone:						
Calcite	32,700	29,550	12,250	72,130	87,100	
Dolomite	1,064,699	803,511	520,826	485,393	625,127	
Limestone for cement manufacture only	thousand tons	50,058	58,757 r/	36,593 r/	48,306 r/	43,492
Limestone, construction and other uses	do.	10,754	28,932	19,068	35,853	37,017
Marble, dimension stone and fragment	cubic meters	261,051	332,839	394,419 r/	294,337 r/	270,036
Marl for cement manufacture only		566,500	9,543	6,995	32,044 r/	7,290
Quartz		9,831	5,133	3,730 r/	3,760 r/	5,177
Shale for cement manufacture only	thousand tons	4,605	5,387	2,704 r/	3,223 r/	3,110
Talc and related materials:						
Pyrophyllite		64,330	304,524	40,241	38,053 r/	46,011
Talc		7,238	7,139	2,172 r/	4,960 r/	7,390
MINERAL FUELS AND RELATED MATERIALS						
Coal:						
Anthracite		3,000	--	--	--	--
Lignite	thousand tons	21,686 r/	23,443	20,162	18,266	17,714
Natural gas (gross production)	million cubic meters	13,095 r/	16,165 r/	17,550 r/	19,307 r/	20,196
Petroleum:						
Crude	thousand 42-gallon barrels	9,643 r/	10,024	10,738	12,412	21,205
Natural gas condensate	do.	13,008 r/	16,352 r/	16,914 r/	18,115 r/	19,112
Refinery products:						
Liquefied petroleum gas	do.	21,970	26,613 r/	25,962 r/	28,853 r/	32,511
Gasoline	do.	50,127 r/	59,247 r/	55,353 r/	54,290 r/	50,862
Jet fuel	do.	22,467 r/	23,969 r/	22,438 r/	25,908 r/	27,347
Kerosene	do.	1,190	772 r/	723 r/	2,181 r/	3,090
Distillate fuel oil	do.	52,546 r/	54,733 r/	49,351 r/	49,242 r/	43,970
Residual fuel oil e/	do.	23,000	24,000	22,000	22,000	22,000
Unspecified e/ 3/	do.	3,500	3,500	3,500	3,500	3,500
Total e/	do.	175,000	193,000	179,000	186,000	183,000

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

1/ Includes data available through October 12, 2001.

2/ Estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ Includes refinery fuel and refinery gains or losses.

Sources: Department of Mineral Resources, Mineral Statistics of Thailand, 1996-2000 and Metal Statistical Yearbook, 2000; Ministry of Commerce, National Energy Policy Office, Energy Data Notebook, 1988-2000, 13-year Series Report.

TABLE 2
THAILAND: STRUCTURE OF THE MINERAL INDUSTRY IN 2000

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies	Location of main facilities	Annual capacity e/
Barite		Asian Mineral Resources Co. Ltd.	Loei, Mae Hong Son, Nakhon Si Thammarat, and Satun Provinces	100
Cement		Asia Cement Co. Ltd.	Prabuddhabath, Saraburi Province	4,500
Do.		Jalaprathan Cement Co. Ltd.	Takli, Nakhorn, Sawarn Province; and Cha-Am, Petchburi Province	1,800
Do.		Samukee Cement Ltd.	Nakhon, Ratchasima Province	120
Do.		Saraburi Cement Co. Ltd.	Muang, Saraburi Province	420
Do.		Siam Cement Co. Ltd.	Kaeng Khoi, Phabudhabat, and Ban Moh, Saraburi Province; Chae Hom, Lampang Province; and Thung Song, Nakhon Si Thammarat Province	23,000
Do.		Siam City Cement Co. Ltd.	Saraburi Province	12,350
Do.		TPI Polene Co. Ltd.	do.	9,000
Coal		Electric Generating Authority of Thailand	Mae Moh, Lampang Province; and Li, Lamphun Province	23,000
Fluorspar, concentrate		Asian Mineral Resources Co. Ltd.	Mae Hong Son Province	15
Gas, natural	million cubic meters per day	Esso Exploration and Production Khorat Inc.	Namphong, Khon Kaen Province	4
Do.	do.	TOTAL Exploration and Production (Thailand)	Bongkot in the Gulf of Thailand	15
Do.	do.	Unocal Thailand Ltd.	Baanpot, Erawan, Funan, Kaphong, Pladang, Satun, Paili, Trat, in the Gulf of Thailand	33
Gypsum		Thai Gypsum Product Public Co. Ltd. and numerous companies	Nong Bau, Nakhon Sawan Province; Ban Munnak, Phichit Province	2,000
Lead, in concentrate		Kanchanaburi Exploration and Mining Co. Ltd.	Song Toh, Kanchanaburi Province	30
Petroleum, crude included condensate				
Do.	thousand 42-barrels per day	Chevron Offshore (Thailand) Ltd.	Benjamas, offshore in the Gulf of Thailand	25
Do.	do.	Thai Shell Exploration and Production Co. Ltd.	Sirikit in Kamphaenghet Province	24
Do.	do.	TOTAL Exploration and Production (Thailand)	Bongkot, offshore in the Gulf of Thailand	12
Do.	do.	Unocal Thailand Ltd.	Baanpot, Erawan, Funan, Gomin, Jakrawan, Kaphong, Pailin, Platon, Satun, Surat, Trat	38
Steel, rolled		The Bangkok Iron and Steel Works Co. Ltd.	Phrapradaeng, Samutprakarn Province	120
Do.		Bangkok Steel Industry Public Co. Ltd.	do.	300
Do.		Namheng Steel Co. Ltd.	Lopburi Province	350
Do.		NTS Steel Groups Public Co. Ltd.	Chon Buri Province	408
Do.		Siam Construction Steel Co. Ltd.	Muang Rayong Province	540
Do.		Siam Iron and Steel Co. Ltd.	Ban Moh, Saraburi Province	375
Do.		Sahaviriya Group Corp. Ltd.	Bang Saphan, Prachuap Khiri Khan Province	2,400
Do.		Siam United Steel Co. Ltd.	Rayong Province	1,000
Do.		Siam Yamato Steel Co. Ltd.	Muang, Rayong Province	600
Tin:				
Concentrate		Numerous small companies	Nakhon Si Thammarat, Phangnga, Pkuket, and Ranong Provinces	3
Refined		Thailand Smelting and Refining Co. Ltd.	Phuket, Phuket Province	30
Zinc:				
In concentrate		Padaeng Industry Public Co. Ltd.	Mae Sot, Tak Province	30
Refined		do.	Tak, Tak Province	105