

## THE MINERAL INDUSTRY OF

# IRAN

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Mining continued to be an expanding sector of the Iranian economy in 1994. The Government considered mining to be of high priority, although some expansion projects in the ferrous and nonferrous metal sectors appeared to have fallen victim to Iran's financial problems. The crude petroleum and natural gas sectors played a prominent role in Iran's economy. At \$12.5 billion, oil and gas provided 76% of the country's foreign exchange in 1994.<sup>2</sup> Iran was the world's fourth largest petroleum producer, as the production level reached the 3.4 million barrels per day (Mbbbl/d) level by yearend, with an average for the year of over 3 Mbbbl/d.<sup>3</sup> Its petroleum reserves were among the world's top five. Iran was among the top 10 producers of natural gas, with reserves second only to Russia. About 72 million metric tons (Mmt) of more than 40 other mineral products, ranging from iron ore to base metals, coal, industrial minerals, and dimension stone, were produced in 1994.

In 1994, Iran's gross national product (GNP) totaled \$38.94 billion, with oil, industry and mining accounting for 27% of the total.<sup>4</sup> The nonpetroleum mining sector's contribution to GNP was more than 4%. The Government's target was to increase the latter to 10% by the year 2000. The value of nonpetroleum raw minerals produced in 1993—the last year for which data were available—amounted to \$283 million compared with \$252 million in 1992.

Oil revenues continued to fall from \$20 billion in 1990 to \$14 billion in 1993 to \$12.5 billion in 1994. The debt crisis deteriorated in 1994 as Iran's total external debt reached an estimated \$20 billion, with nearly one-half of this amount in arrears.

As Iran fell further behind on its largely short-term debt, it sought to renegotiate the payments with its major debtholders. Despite U.S. opposition, Germany, with the highest exposure in Iran, took the lead and rescheduled an estimated \$3 billion of Iran's debt. Italian and French state export credit guarantee agencies immediately followed Germany's lead and rescheduled \$2 billion of Iran's debt. Japan, also using the German model, rescheduled about \$700 million of Iran's debt. Austria, Belgium, Denmark, and Switzerland also have adopted the German model and rescheduled Iran's debt. In sum, by mid-1994, Iran had successfully rescheduled more than \$7 billion of its debt.

### Government Policies and Programs

The Government proposed the Second Five-Year Plan

(SFYP) to be implemented between March 1994 to March 1999. The plan's targets include phasing out subsidies on fuels, electricity, and air transport. It encourages a shift from oil to natural gas for industrial and household consumption, and emphasizes free market reforms. Although a complete performance report for the First Five Year Plan (March 1989 to March 1994) was not available, it was widely accepted that the plan's targets were not met, partly as a result of overestimated revenue and underestimated expenditure projections.

One of the Government's most important priorities was the development of the mining sector to ensure that the country developed its own raw materials to meet the needs of domestic industry and to minimize imports of raw materials. One of the key areas was iron ore and steel.

The Mining Act of 1983, consisting of 42 articles and 17 notes, delineates ownership and production procedures for the mining sector. It provides for a Supreme Council of Mining as the highest authority. It is responsible for mine classification, production rates, employment, investment, geographical and other related political issues, and social and economic considerations. Under the initial version of the Mining Act, four mine categories existed as follows: Class 1 includes limestone, gypsum, sand and gravel, salt, and construction stones; Class 2 includes metals, mica, graphite, refractories, bentonite, bauxite, gemstones, and coal; Class 3 includes oil, natural gas, tar, and oil shales; and Class 4 includes uranium and other radioactive minerals. Originally, only Government agencies were authorized to operate Class 2, 3, and 4 mines. In addition, the Ministry of Mines and Metals (MMM) had authorization to assume operation of any mine classified as "large and significant." Thus, many choice mines were nationalized by MMM in the early 1980's. An amendment to the Mining Act was passed in 1985, however, dividing the Class 2 mines into small and large mines and allowing for private ownership of small mines. Currently MMM monitors Class 1 and 2 operations nationwide, with the Oil Ministry and the Iranian Atomic Energy Organization having authority over Class 3 and 4 operations, respectively.

In recent years, Iran has attempted to offset the effects of the obstructive nature of the Mining Act by relaxing many investment constraints created by the legislation. As inducement for private investment, size restrictions on private involvement have been relaxed while regulations for exploitation permits have been liberalized. One-year licenses are now available to individuals for the exploration of up to

40 square kilometers (km<sup>2</sup>), extendable on the basis of work progress. MMM also has the authority to issue 5-year permits for private, small-scale mining, based on low royalties. After the initial 5-year period, permits are renewable by rebidding royalty and taxation terms in competition with other potential producers.

### **Environmental Issues**

Major environmental effects of mining and metallurgical processes in Iran are in terms of emission of particulate matters and other toxic substances that can cause occupational, safety, and health problems. In Iran, environmental activities in the mining sector have yet to be recognized as a priority by the Government although significant problems exist. Examples of these are emission of nearly 100 metric tons per day (mt/d) of sulfur dioxide from the Sar Cheshmeh copper smelter, near Rafsanjan, close to agricultural areas; water and air pollution at steel mills and aluminum smelting plants and oil refineries in Isfahan, Ahwaz, and Arak; and emissions from a lead smelter on the outskirts of Zanjan, adjacent to agricultural areas. The Iranian News Agency reported that the Zanjan smelter had a rotating-system furnace with a closable gas hood, capable of meeting stringent environmental standards; the cost of pollution prevention and other related equipment and systems, installed at the smelter, was reported at about \$10 million. Arak, the site of an aluminum plant, an oil refinery, and a nearly completed petrochemical complex in an area with a population of 300,000, is reported to be the most polluted city in Iran.

In-depth environmental impact assessments and comprehensive procedures for new investment are lacking. MMM and environmental authorities are not linked in an integrated manner. Establishing an efficient environmental framework, particular to the regional and geological circumstances in Iran, will require the coordination of environmental policies and operational linkages with other environmental agencies. The Department of the Environment is the main Government agency responsible for environmental protection and monitoring.

### **Production**

In 1994, more than 40 different minerals were mined by 1,270 active mines. The total mineral output rose from 61 million metric tons per year (Mmt/a) in 1992 to 69.6 Mmt/a in 1993 and 71.7 Mmt/a in 1994, with the expansion mostly from the Gol-e Gohar iron ore and Sar Cheshmeh copper ore mines. According to official MMM figures, Iran had 1,850 mines at the development and production stages, the majority of which were small-scale quarries. The output of aluminum, cement, copper, lead and zinc, and iron and steel was being expanded. Dimension stone also was the focus of attention as a major export revenue earner.

The increase of metal production was high on the Government's agenda for postwar reconstruction and

expansion of the economy. MMM pursued plans for major increases in steel production. Steel production from the Isfahan steelworks and the direct reduction plants of Mobarekeh, near Isfahan and the Nasr complex in Ahwaz, totaled 4.2 Mmt, thus registering an average annual growth rate of 24.4% during the 1989-94 period. Faryab Mining and Chrome Smelting Co. started production of high carbon ferrochrome on a commercial basis and was scheduled to export this product to Japan in early 1995.

Apart from realizing its metal mining potential, Iran also was a major producer of industrial minerals. In particular, the country was the world's third largest producer of gypsum, mainly from the mines, about 200 kilometers (km) east of Tehran in the Semnan region, and in Fars Province. (*See table 1.*)

### **Trade**

In 1994, total exports were estimated at \$16.5 billion, compared with \$17 billion in 1993 and \$20 billion in 1992. Of this total, oil and gas exports were estimated at \$12.5 billion, down from \$14 billion in 1993 and \$17 billion in 1992. The five main export markets for Iranian products, particularly crude oil and gas, in order of importance, were Japan, with about \$1.23 billion worth of imports from Iran during the first half of 1994; France, about \$414 million during the first half of 1994; Italy, \$380 million for the first half of 1994; Germany, \$305 million during the first half of 1994; and the United Kingdom, \$86 million during the first half of 1994. Petroleum exports averaged 2.34 Mbbbl/d in the first half of 1994.

Total imports were estimated to be about \$11 billion for 1994, down from about \$16 billion in 1993 and \$21.5 billion in 1992. The six leading suppliers of goods and services to Iran, in order of importance, were Germany, with \$743 million worth of exports to Iran during the first 5 months of 1994; Japan, \$670 million during the first half of 1994; Italy, \$293 million for the first 4 months of 1994; France, \$294 million during the first half of 1994; the United Kingdom, \$258 million during the first half of 1994; and the United States, \$326 million in 1994.<sup>5</sup> In addition, the proximity of the United Arab Emirates to Iran, particularly Dubai's free port, has made it a busy reexport point for goods destined for Iran. Estimated at more than \$1 billion annually, this trade mainly involves luxury items and consumer goods.

The country's export of nonpetroleum minerals during the first Five-Year Plan was valued at \$1.4 billion. The most significant minerals exported were lead and zinc, accounting for about 75% of nonpetroleum mineral exports, and chromite, 15%. Main export destinations for minerals were Belgium, China, India, Japan, and North Korea. Reversing its previous trend for imports, Iran has become an exporter of various steel products. Iranian National Steel Industries Group (INSIG), the Ahwaz-based producer of bar, wire rod, sections, and pipes, entered the export market during the third quarter of 1992. Kudremukh Iron Ore Co. of India was to supply 1.5 Mmt of iron ore concentrates during the Iranian

year starting March 21, 1994.

Although there was no blanket prohibition against U.S. companies doing business with companies in Iran in 1994 by either Iran or the U.S. Government, restrictions were imposed by the U.S. Government on U.S. exports to Iran, as well as on importation of Iranian-origin goods and services into the United States. U.S. exports to Iran were \$326 million in 1994, compared with about \$700 million in 1993, and included oil drilling and engineering equipment, chemicals, gas turbines, medical equipment, and spare parts for machinery.

Official direct trade between Iran and the United States was relatively small and limited as a result of U.S. trade policy. However, a large volume of indirect trade occurred between the two countries. For example, even though U.S. oil companies were not allowed to buy Iranian crude for the U.S. market, foreign subsidiaries of these companies purchased Iranian oil for their foreign refineries, which, in turn, allowed them to supply the U.S. market with crude that would have otherwise been designated to the foreign refineries. In 1994, Exxon Corp.—the largest single buyer of Iranian crude—and other U.S. firms, including, Mobil Corp. and Coastal Corp., purchased an average of 613,000 bbl/d of Iranian oil, accounting for nearly one-fourth of Iran's oil exports.<sup>6</sup>

### **Structure of the Mineral Industry**

The overall management of the minerals sector was under the authority of MMM, which was created by law in June 1984. MMM's domain of influence covers all mining, except oil and gas and radioactive minerals. MMM also has authority over the Nation's entire metal smelting and refining industry.

MMM is the umbrella ministry for several agencies and parastatals (government-controlled companies), including Geological Survey of Iran; National Iranian Mines and Metals Smelting Co.; National Iranian Steel Co. (NISCO); National Iranian Mining Explorations Co.; National Iranian Copper Industries Co. (NICICO); National Iranian Lead and Zinc Co. (NILZCO); Iran Mines Export Development Co. (IMEDCO); Iran General Mine Co.; Iranian Aluminum Co. (Iralco); and Almahdi Aluminum Corp., a Government joint venture with foreign entities.

Most of the principal nonpetroleum mineral commodity production facilities were under Government control in 1994 through more than 30 companies administered by MMM. These included the aforementioned parastatals, as well as entities categorized as joint-stock companies. The latter were generally partially nationalized private enterprises in which the Government has taken a majority position by assuming at least a 50% share of the operation's stock. Examples of such joint-stock operations include Emarat Mine Co., Calcimine Co., Bafg Mining Co., and Bama Co., all of which are lead and zinc mining operations.

The "private" or "nonpublicly owned" sector contained two subclassifications: mines operated by cooperatives and

foundations ("Bonyads") and mines operated privately or on a contractual basis. In 1992, the last year for which data were available, there were 395 and 688 operations in these categories, respectively. Individually, foundations operate the largest share of Iran's nonpublic-sector mines. Foundations are giant organizations functioning independently of parliamentary oversight, enjoying special rights and privileges, and operating without the economic incentives and constraints faced by a private enterprise. In the aftermath of the 1979 Iranian Revolution, about 40% of the private industrial sector was nationalized and placed under the control of foundations. These included mining operations owned by the deposed Shah and his surrogates and previously managed by the Pahlavi Foundation. During the post-1979 revolution years, the largest number of transferred properties went to the Mostazafan Foundation, later named the Mostazafan and Janbazan (translated "oppressed" and "life sacrificers or martyrs") Foundation, created to provide for the needs of the war handicapped and other deprived persons. The foundation's Industry and Mining section consists of more than 140 enterprises employing more than 50,000 persons. Some enterprises still include private individual shareholdings, estimated at between 10% and 20% of the enterprise's total value. Privately held mines and mines operated on a contractual basis, akin to oil and gas lease operations, constitute the second division of the nonpublic sector. The mines in this category are relatively small; however, the 100% increase in the number of operations during the 1989-93 period signifies the efforts of privatization and industry expansion.<sup>7</sup>

The Government continued to emphasize privatization of the mining industry. This included mostly small mines and excluded large operations, such as the Sar Cheshmeh copper complex; the Chadormalu, Choghart, Gol-e Gohar, and Sangan iron deposits; and the Angouran lead-zinc mine. However, many of the operations for sale, which deteriorated owing to ineffective management and lack of technical expertise in the 1980's, did not attract buyers.

### **Commodity Review**

#### **Metals**

**Aluminum.**—Aluminum production from the reconstructed Iralco plant in Arak reached 97,000 metric tons (mt) in 1993. The Arak expansion project was to increase plant capacity to 120,000 metric tons per year (mt/a).<sup>8</sup>

Construction of the Almahdi Aluminum Corp.'s \$1.5-billion smelter, at the Persian Gulf port of Bandar Abbas, was behind schedule owing to unavailability of credit. First scheduled to commence production in 1994 at an initial rate of 220,000 mt/a and later expand to 330,000 mt/a of aluminum, the startup date is now uncertain. The plant would rely on Iran's abundant natural gas reserves as a readily available cheap source of power. Almahdi is 60% owned by MMM and 40% by the Dubai-based International Development Corp., a partnership of Arab, United Kingdom,

and Swiss investors and traders.

Mining and construction work continued for the production of alumina from the bauxite deposit at Jajerm, 150 km northeast of Shahroud, in northeastern Iran. The deposit contains reserves of about 19 Mmt with an alumina content of 41% to 69%. An estimated 100,000 mt/a of ore was mined and reportedly stockpiled in readiness for the start-up of the alumina refinery in 1995. Technical assistance, budgeted at \$330 million, was being received from Technoexport of Czechoslovakia. The alumina refinery, with an initial capacity of 100,000 mt/a, was to feed the aluminum smelters at Arak and Bandar Abbas.<sup>9</sup> Reportedly a large bauxite mine was being developed in the southern province of Kohkiluyeh and Boyer Ahmadi, but no further details were available.<sup>10</sup>

**Chromium.**—Faryab Mining and Chrome Smelting Co., a state-owned entity, completed construction of a ferrochromium smelter near Bandar Abbas, the major port on the Persian Gulf. The plant consists of two 15-megavolt-ampere Chinese-made electric furnaces with a combined production capacity of 14,000 mt/a, operating one electric furnace for ferromanganese production and the other for ferrochrome production. Since autumn 1994, the company has been operating these two furnaces at full capacity. In principle, ferrochrome produced by Faryab Mining is primarily for domestic demand and the rest for export to the Far East. The first shipment of Iranian-produced high-carbon ferrochrome to Japan Metals and Chemicals Co. was scheduled for April 1995. This cargo will be the first lot of 5,000 mt for delivery to the Far East.<sup>11</sup>

**Copper.**—Expansion of the Sar Cheshmeh copper mine-concentrator-smelter-refinery complex of NICICO, about 150 km southwest of Kerman, continued in 1994. A new smelter was being built in Khatounabad, 40 km from the Sar Cheshmeh copper complex in southeastern Iran. NICICO signed an agreement with China's National Non-Ferrous Metals Co. to build the \$106-million copper smelter with a capacity of 80,000 mt/a. Iran will pay for about \$17 million of the cost through copper exports to China.<sup>12</sup>

An underground copper mine and concentrator, Qal'eh Zari, about 150 km south of Birjand, also was operated by NICICO. The mine has about 1.8 Mmt of sulfide ore containing 2% to 4% copper, 2 to 3 grams per metric ton (g/mt) of gold, and 15 to 20 g/mt of silver. About 30 mt/d of copper concentrate, grading 25% copper, was trucked to Sar Cheshmeh.<sup>13</sup>

A new copper mine at Meiduk, 120 km northwest of Sar Cheshmeh, was being developed by NICICO, with the assistance of Outomec, a subsidiary of Finland's Outokumpu. Economic reserves of the deposit vary from 50 Mmt to 125 Mmt, depending upon copper prices under consideration. Mining at Meiduk, which has been described as "a mini Sar Cheshmeh," is by open pit. Extraction of 30-to-70-meter (m)-thick overburden and premining work started in 1993. The project includes the construction of an on-site concentrator to

treat 3 Mmt/a to 5 Mmt/a of ore grading about 1.1% copper. Capital costs are projected at \$300 million for the open pit mine and concentrator.<sup>14</sup>

Excavation work continued at the large Sungun porphyry deposit in the East Azerbaijan Province, north of Tabriz. Mineralization extends to a depth of at least 1,000 m. Reportedly, reserves in excess of 100 Mmt of ore grading 1% copper have been outlined.

**Gold.**—A number of small gold deposits occur at an elevation of 1,800 m to 2,000 m in the vicinity of Mouteh, 140 km northwest of Isfahan. The total geological resource is estimated at 5.1 Mmt of ore grading 4 grams per metric ton (g/mt) of gold based on a cutoff grade of 1 g/mt. The largest deposit, Chahar-khaton, which accounts for about 50% of total area resources, was developed by Iranian General Mine Co., with technical assistance from Broken Hill Pty. Ltd. (BHP) of Australia. Mining is by open pit. Construction of surface facilities and infrastructure and a gold refinery plant were completed, at a cost of \$35 million, with assistance from BHP. The operation produced 405 kilograms (kg) of gold in 1994 compared with 417 kg in 1993. It has a capacity of 500 kilograms per year (kg/a) of gold.<sup>15</sup>

The precious-metals recovery plant at Sar Cheshmeh, which treats the copper anode slimes, produced 318 kg of byproduct gold in 1994. The plant is targeted to produce about 800 kg/a of gold and 14 mt/a of silver. Other gold deposits are due to be explored at Zarkouh, 200 km east of Tehran; Astaneh near Arak, and on the Zare-shouran River north of Takab, 100 km west of Zanjan, in northwestern Iran.

**Iron and Steel.**—Iron ore exploitation was stepped up to feed a fast-growing steel manufacturing industry. Government-owned NISCO, under the direction of MMM, owned and operated all major iron mines and steel plants. Iron ore output was about 8.7 Mmt in 1994. Crude steel production increased by 23% and direct-reduced iron (DRI) was up by 75%.

Iran had four main iron mines: Chadormalu, 125 km northeast of Yazd; Choghart in Bafq, 200 km east of Yazd; Gol-e Gohar, 55 km southwest of Sirjan; and Sangan, about 250 km southeast of Mashad, close to the border with Afghanistan. To meet the country's anticipated iron ore needs of more than 10 Mmt/a, the combined 2 billion tons of reserves of these four mines was being developed or expanded. In 1994, Choghart supplied about 4.2 Mmt/a of lumpy ore to the Isfahan steelworks, but the mill required an additional 1.5 Mmt/a of iron ore concentrate, grading 66% iron. NISCO has embarked on the Choghart Iron Ore Expansion Project to achieve the national objective of creating more value-added domestically and providing cheaper raw materials for more competitive steel exports from Iran. The Gol-e Gohar Mine, with 180 Mmt of proved ore reserves, came into production at the end of March 1994 with an initial capacity of 2.7 Mmt/a of concentrate, expected to rise to 5 Mmt/a by 1997. The Chadormalu Mine, with 400

Mmt of reserves, is scheduled to come on-stream in 1998 at an initial capacity of 5 Mmt/a of concentrate. Eisenbau Essen of Germany carried out the engineering studies, and a consortium of Japanese steel companies, comprised of Kobe Steel, Marubeni, and Mitsubishi, were to provide all the process equipment worth \$400 million. Additionally, feasibility and preengineering studies for the Sangan iron ore project were being carried out by Australia's BHP Minerals, based on an eventual production of 3.4 Mmt/a.

All these projects were to provide iron ore concentrates for the steel plants at Mobarakeh, near Isfahan, and for the plants in Ahwaz. NISCO's main steelworks, originally built by the former Soviet Union (FSU) before the 1979 revolution in Iran and which now is being expanded, are in Mobarakeh, about 70 km west of Isfahan. Ahwaz Steel Co. (ASCO), a subsidiary of NISCO, is operating the Ahwaz steel complex in the southwestern Iran.

DRI production was growing at a rapid pace as 12 gas-fueled DRI modules, with a total capacity of 5.84 Mmt/a, were either in operation or were being constructed in Ahwaz and Mobarakeh. As of January 1, 1994, the country's total DRI production capacity stood at 4.46 Mmt/a. DRI modules were of three different designs, namely Midrex of the United States, HYL of Mexico, and Purofer of Germany. The oldest DRI unit, a 330,000-mt/a Purofer module, operated by ASCO in Ahwaz, has been in operation since 1977. ASCO also operated three 400,000-mt/a Midrex modules at its Ahwaz works, commissioned in 1985, 1990, and 1992, respectively. DRI production at ASCO's Ahwaz steel complex—originally planned for startup in 1979 but interrupted because of the revolution—started in 1993 from its first Mexican HYL module. Total DRI capacity from ASCO's three HYL units, to be completed by 1995, is targeted at 1.11 Mmt/a. Total planned DRI capacity of the Mobarakeh's five Midrex units is 3.2 Mmt/a. A 4.5-Mmt/a iron ore pellet plant was commissioned to feed Mobarakeh's five Midrex DRI modules. Iron ore concentrate was railed 1,000 km from the Gol-e Gohar Mine.

Italy's Danieli & Co. renegotiated a \$660-million contract to expand the Isfahan steel mill to include two other new mills, in Neishabur, in Khorassan Province, and in Mianeh, in Azerbaijan Province. The Khorassan steel mill contract, worth about \$160 million, involved the construction of the first 600,000 mt/a phase of a complex that will eventually produce 1.8 Mmt/a of long steel products. The Mianeh Steel Co. contract with Danieli involved \$45 million. A 350,000 mt/a rolling mill is to be set up to process slabs imported from the FSU republics on the western side of the Caspian Sea. Danieli also began a \$330-million expansion of capacity at the existing Isfahan Steel Company complex to 3.2 Mmt/a by adding a line for nearly 800,000 mt/a of flat products. The Isfahan steel mill is now completing its own \$470-million expansion to raise output to 2.4 Mmt/a by March 1996 from the current 2 Mmt/a level.<sup>16</sup>

Iran's new 25,000-mt/a standard-grade ferrosilicon plant in Semnan, 200 km east of Tehran, under construction by Mannesmann Demag of Germany for the privately owned

Iran Ferrosilice Co., experienced further delays, and was not expected to come on-stream until at least 1995. Construction of a 30,000-mt/a ferromanganese plant has started at the Isfahan steelworks.<sup>17</sup>

**Lead and Zinc.**—The bulk of lead and zinc production comes from eight principal mines—Ahangaran, Angouran, Douna, Emarat, Irankouh, Kushk, Nakhlak, and Ravanj. The deposits have a wide regional distribution but, except for the Angouran Mine, southwest of Zanjan, the major mines are centered near Yazd and Isfahan. A new 40,000-mt/a-capacity lead smelter came on-stream in late 1992 at the Angouran Mine, considered to be the largest lead-zinc mine in the Middle East. However, most lead and zinc companies exported their product as concentrate. The lead smelter at Angouran produced only about 10,000 mt of lead bar in 1994. A 60,000-mt/a zinc smelter, also planned for Angouran, was scheduled to start up in 1997. A second zinc smelter, with the capacity of 27,000 mt/a, was proposed for the Kushk Mine, near Yazd.

### *Industrial Minerals*

**Cement.**—Iran continued to expand its cement industry owing to an aggressive rebuilding program begun after the Iran-Iraq war ended in 1988. More than 20 plants were either under construction or planned for future construction. Cement production has increased from 17 Mmt/a to 20 Mmt/a due to the high domestic demand for reconstruction and new projects, mainly transportation facilities.

**Dimension Stone.**—The Government continued its efforts to promote expansion of the production of decorative and dimension stone from the extensive deposits in Iran. With a rapid rate of growth in international trade, this sector should provide a great opportunity to earn export revenues for the country. In addition to marketing quantities of marble, onyx, and travertine, Iran has been actively seeking export markets for its substantial range of granites. In view of the added value of the finished stone products, companies affiliated with MMM have purchased during the past 5 years several modern stone processing plants. Most plants were purchased from Italian companies. Some of the plants were in production and the rest under construction.

### *Mineral Fuels*

**Coal.**—In 1994, the Babnizou and Pabedana coal mines, near Kerman, and other mines around Shahroud, all operated by NISCO, supplied about 65% of the coking coal used in Iran's steel industry, up from 55% in 1993. Imports supplied the remaining coking coal requirements. A major new underground coal mine at Tabas, 300 km northeast of Yazd, was being considered for development. The project would necessitate construction of access roads, an airport, a 100-km-long water pipeline, and a 200-km-long railway. The

total cost of the project was estimated at \$400 million. However, due to the lack of sufficient foreign exchange, the Government has expressed concern about the cost and was reportedly hesitant about proceeding with the Tabas project.<sup>18</sup>

**Petroleum and Natural Gas.**—Petroleum crude production was about 1,090 million barrels (Mbbbl) in 1994. Natural gas output was estimated at about 54 billion cubic meters per year (m<sup>3</sup>/a). Iran's petroleum crude exports were about 2.4 Mbbbl/d. Several U.S. oil companies bought Iranian oil for their refineries outside of the United States.

Iran's eight refineries treated a total of about 1 Mbbbl/d of crude oil for domestic consumption. The four major refineries, in order of importance, at Abadan, Isfahan, Tehran, and Arak, treated about 320,000 barrels per day (bbl/d); 280,000 bbl/d; 225,000 bbl/d; and 90,000 bbl/d of crude, respectively.

The National Iranian Oil Co. (NIOC) started up its new 150,000-bbl/d Arak refinery, 240 km southwest of Tehran. Crude was delivered via trucks pending completion of a pipeline. The Arak refinery would be Iran's first to produce high-octane unleaded fuel. Construction of a new refinery in Bandar Abbas continued. The export terminal at war-damaged Kharg Island, including its 500,000-bbl reservoir, was repaired and expanded. According to the managing director of the Chahbahar free-trade zone, a large oil refinery was to be built by the private sector in the southeastern port of Chahbahar. The \$3.2-billion refinery was to have a capacity of 225,000 bbl/d.

The Iranian News Agency (IRNA) reported a new onshore oilfield discovery at Shour in the southwestern province of Khuzestan with estimated reserves of 80 Mbbbl to 130 Mbbbl. Field production could reportedly reach 30,000 bbl/d.<sup>19</sup>

International engineering firms submitted bids in August for the design and management of the South Pars Gasfield in the Persian Gulf, an apparent extension of Qatar's giant North Field and one of the largest fields in the world with estimated reserves of 3 trillion m<sup>3</sup> of gas and 2.5 billion bbl of natural gas liquids. Bidders were the United Kingdom's John Brown Engineers and Constructors, Italy's Snamprogetti, France's Technip, the Zurich, Switzerland-based ABB Lummus Crest, and Chiyoda Corp. and JGC Corp. both of Japan. The field was expected to produce 35 million cubic meters per day of gas for the domestic market and up to 60,000 bbl/a of condensate for export.<sup>20</sup>

The production of refinery products totaled 342 Mbbbl in 1992, the last year for which data were available. Iran's petrochemicals industry was undergoing an expansion that had already produced nearly a tenfold increase in output since 1988. By the mid-1990's, existing capacity was to be doubled.

NIOC started transferring the first shipment of crude oil to the Persian Gulf from Kazakhstan for export to Europe. A shipment of 3,600 mt is part of a recent agreement to help Kazakhstan export a total of 200,000 mt.<sup>21</sup>

Various agreements were reached with China on the

construction of a joint oil refinery in China, renovation of Chinese refineries, the supply of 20,000 bbl/d of crude to China, and cooperation in petroleum exploration and exploitation. Under an agreement reached with Pakistan, a joint oil refinery is to be built in Pakistan, and Iran is to supply that country with natural gas and refined petroleum products.<sup>22</sup>

### **Reserves**

Published reserve data are inadequate to provide a meaningful inventory of Iran's mineral resources. The Oil Ministry has reported the country's total oil and gas reserves at 92,000 Mbbbl and 20 trillion cubic meters, respectively. The Geological Survey of Iran was actively involved in a number of exploration programs for base and precious metals and had commissioned French and German companies to carry out a nationwide survey of all mineral resources. A collaborative mapping program on the scale of 1:100,000 is under way with technical teams from Australia, Azerbaijan, China, Czechoslovakia, and Germany.

### **Infrastructure**

Major efforts were being made to rehabilitate or improve transportation facilities throughout the country. A rail link from Kerman to Bandar Abbas was a high priority for imports and exports, as well as internal trade. A rail extension from Kerman to Zahedan was a longer-term project that would open trade to Pakistan and India and aid development of southeastern Iran. Another rail line extension also was planned in the northeast from Mashad into Turkmenistan to link the rail systems of the central Asian republics to the Iranian network and the Persian Gulf. A dedicated 220-km rail spur was planned to link Chadormalu Mine with the existing rail route running through Yazd to Isfahan. A strategic road linking Isfahan and the country's central regions to the Persian Gulf ports was being constructed. This road will reduce the distance between the two areas by about 250 km. Construction of large mineral loading and unloading facilities at the Persian Gulf port of Bandar Abbas was underway. The facilities will be used for the export of mineral products from eastern and southeastern mines, as well as the import of iron ore for the large steel complexes of Isfahan and Ahwaz.

Electricity generated by the country's powerplants totaled about 48,000 gigawatt-hours in the first 9 months of 1992, the latest period for which data were available. Thermoelectric plants accounted for about 85% of power generation. An ambitious electric power generation and distribution program was underway throughout the country. Several new powerplants were connected to the national power grid. The total installed capacity amounted to more than 16,000 megawatts (MW). The Ministry of Energy plans called for an addition of 2,000 MW yearly through the year 2000 to achieve a balance between power supply and demand.

An agreement was signed between the Government and China for construction of two nuclear power stations in the southern part of the country, near the Persian Gulf. The agreement to build two 300-MW reactors, as well as two 30-MW research reactors, followed a nuclear energy cooperation accord between the two countries. The Government also purchased two 440-MW power reactors from Russia. The Atomic Energy Organization of Iran appeared to be aiming at a nuclear program of 3,000-5,000 MW as part of its plan for a greater reliance on renewable sources of energy, leaving its hydrocarbon resources for export.<sup>23</sup>

## Outlook

Expansion of the mineral industry can be expected to continue by encouraging a larger role for private enterprise at home and relying on financing from abroad. The mineral resource base is estimated to be large, and the trends favoring privatization and extending opportunities for foreign investment should persist. This should result in expansion of the industry and the economy in general.

Iran has a number of comparative advantages in terms of steel production. Low labor costs, cheap energy from natural gas, sizable—if relatively low-grade—iron ore deposits, and domestic supplies of coking coal and limestone should support the development of a world-class steel industry. With a number of projects in the construction and commissioning phase, Iran is projected to become a major producer and exporter—assuming it can compete with other low-cost producers such as South Africa, Turkey, and Eastern European countries—of various types of steel in the next few years.

The Government's main challenge in the near term is to implement its economic restructuring phase without creating a level of public dissatisfaction threatening the political order. Since taking effect in 1993, the Government's economic reform measures have met widespread hostility from Iran's cleric-led right-wing, which has seized the opportunity for political gain. As Iran continues its painful shift to a less centralized economy, the antireformist's divisive tactics will certainly increase. This could possibly prolong Iran's economic difficulties while further complicating the Government's task.

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<sup>1</sup>Text prepared June 1995.

<sup>2</sup>Most yearly statistics are for the Iranian year starting on Mar. 21 of the year stated. See footnote 1 of table 1.

<sup>3</sup>As a result of a long-awaited currency reform in early 1993, the Government eliminated the three-tiered exchange rate system, relying on a variable, or floating, rate of IR1,538=US\$1.00. The floating rate dropped to IR1,640=US\$1.00 in Apr. 1993 and continued its decline throughout 1993. By yearend 1993, the rate had reached the IR2,000=US\$1.00 level. In a reversal of policy, the Government reintroduced the multiple exchange rate in 1994. The rial continued its decline throughout 1994 and reached IR4,400=US\$1.00 by yearend.

<sup>4</sup>Mining Annual Review, Mining Journal, 1995.

<sup>5</sup>Middle East Economic Digest, Sept. 23, 1994, p. 22.

<sup>6</sup>The Wall Street Journal, May 9, 1995, p. A2.

<sup>7</sup>Grannayeh, Sina, Iran's Mineral Industry in the 1990's: Developments and Strategies, M.A. Dissertation, the University of Texas at Austin, Dec. 1994.

<sup>8</sup>Work cited in footnote 7.

<sup>9</sup>The Economics of Bauxite and Alumina, Roskill Information Services Ltd., 2d Edit. 1993.

<sup>10</sup>Middle East Economic Digest, Mar. 17, 1995, p. 24.

<sup>11</sup>The Tex Report, V. 27, No. 6318, Mar. 22, 1995.

<sup>12</sup>Work cited in footnote 5.

<sup>13</sup>Work cited in footnote 4.

<sup>14</sup>Work cited in footnote 4.

<sup>15</sup>Work cited in footnote 4.

<sup>16</sup>Work cited in footnote 5, p. 9.

<sup>17</sup>Work cited in footnote 4.

<sup>18</sup>Work cited in footnote 4.

<sup>19</sup>World Oil, May 1995, p. 23.

<sup>20</sup>Middle East Economic Digest, Aug. 26, 1944, p. 18.

<sup>21</sup>\_\_\_\_\_. Dec. 23, 1994, p. 10.

<sup>22</sup>Work cited in footnote 5.

<sup>23</sup>Work cited in footnote 9, p. 7.

## Major Sources of Information

Geological Survey of Iran

P.O. Box 13185-1491

Tehran, Iran

Iranian Mining Development and Services Co.

96 Ibn Sina Ave., Yussef Abad

Tehran, Iran

Ministry of Mines and Metals

P.O. Box 1416

14155 Tehran, Iran

Telephone: (98) 21 836050

Ministry of Petroleum

Taleghani St.

Tehran, Iran

Telephone: (98) 21 895905/06/07/08

National Iranian Steel Co.

Valiye Asr Ave.

Tehran, Iran

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

(Metric tons unless otherwise specified)

Commodity	1990	1991	1992	1993	1994
<b>METALS</b>					
Aluminum: e/					
Bauxite, gross weight	100,000	100,000	100,000	100,000	100,000
Metal, primary ingot	60,000	80,000	92,000	90,000 r/ 3/	116,000 3/
Arsenic: Orpiment and realgar, concentrates	382	552	492	500 e/	500 e/
Chromium: Chromite, mine output:					
Concentrate (48% to 50% Cr <sub>2</sub> O <sub>3</sub> ):					
Gross weight	77,200	90,100	130,000	130,000 r/ e/	129,000
Cr <sub>2</sub> O <sub>3</sub> content e/	38,000	44,000	64,000	64,000 r/	64,000
Copper:					
Mine output:					
Ore mined (1% to 1.2% Cu):					
Gross weight thousand tons	6,830	9,240	9,230	10,800	12,100
Cu content	78,600	105,000	108,000 r/	120,000 r/ e/	130,000
Concentrate (29% to 35% Cu):					
Gross weight	220,000	290,000	304,000	290,000 r/ e/	350,000 e/
Cu content	65,800 r/	84,300 r/	105,000 r/	86,600 r/	120,000
Metal:					
Smelter output, blister/anode	54,800 r/	81,900 r/	86,400 r/	85,000 r/	125,000
Refinery output, cathode	47,800 r/	79,700 r/	101,800 r/	84,900	64,000
Gold: Mine output, Au content e/ kilograms	500	500	500	417 3/	723 3/
Iron and steel:					
Ore and concentrate:					
Gross weight thousand tons	3,240	4,890	5,650	9,870	8,690
Fe content e/ do.	1,800	2,700	3,000	4,800	4,300
Metal:					
Pig iron do.	1,270	1,950	2,050	1,960	1,880
Direct reduced iron do.	264	470	709	1,630	2,860
Ferroalloys, ferrochromium e/ do.	--	--	--	--	5
Steel, crude, ingots and castings do.	1,430	2,200	2,940	3,670	4,500
Lead: e/					
Mine output, concentrate (56% to 60% Pb): 4/					
Gross weight	19,300 3/	27,500 3/	50,000	50,000	60,000
Pb content	11,000	16,000	25,000	25,000	30,000
Refinery output:					
Primary	--	--	--	--	10,000 3/
Secondary	10,000	8,000	7,800	8,000	8,000
Manganese, mine output, (30% to 35% Mn):					
Gross weight	54,400	48,400	39,800	55,000 r/ e/	40,000 e/
Mn content e/	18,000	16,000	13,000	18,000 r/	13,000
Molybdenum, mine output, concentrate (56% Mo):					
Gross weight	967	707	1,510	1,700 e/	1,700 e/
Mo content	542	395	847	1,000 e/	1,000 e/
Silver: Mine output, Ag content e/	38	40	50	60	60
Zinc, mine output, concentrate (50% to 55% Zn): 4/					
Gross weight e/	54,800 3/	135,000 3/	130,000 r/	150,000 r/	150,000
Zn content	29,000 e/	70,000 e/	66,000 r/	77,000 r/	75,000
<b>INDUSTRIAL MINERALS</b>					
Asbestos:					
Concentrate, (3% to 8% marketable fiber)	51,500	62,000	86,200	90,000 e/	80,000
Marketable fiber e/	2,800	3,000	4,300	4,500	4,500
Barite	77,400	191,000	181,000	105,000	225,000
Boron: Borax	1,820	1,030	420	500 e/	500 e/
Cement, hydraulic e/ thousand tons	13,000	15,000	18,000	18,000 r/	20,000
Clays:					
Bauxite and refractory clays	92,500	98,400	215,000	220,000 e/	220,000 e/
Bentonite	51,100	40,500	47,700	85,000	84,000
Other:					
Industrial clays	213,000	217,000	120,000	250,000 e/	250,000 e/
Kaolin	150,000 e/	150,000	264,000	452,000	450,000 e/
Total e/	363,000	367,000 3/	384,000 3/	702,000	700,000
Diatomite	2,150	90	100 e/	85	90 e/
Feldspar	32,100	64,800	52,100	25,000	30,000 e/
Fluorspar: Fluorite	4,770	12,300	9,180	10,000 e/	10,000 e/
Gemstones: Turquoise e/ kilograms	24,900 3/	20,000	1,000	5,000	5,000
Gypsum thousand tons	7,720	8,050	8,720	8,600	8,430

See footnotes at end of table.



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

(Metric tons unless otherwise specified)

Commodity	1990	1991	1992	1993	1994
<b>INDUSTRIAL MINERALS--Continued</b>					
Industrial sand and gravel (quartzite and silica)	870,000 e/	832,000	756,000	932,000	950,000 e/
Lime e/ thousand tons	650	650	650	650	650
Magnesium compounds: Magnesite and huntite 5/	1,410	29,300	36,200	40,000 e/	65,000
Mica	1,350	4,140	7,850	8,000 e/	8,000 e/
Nitrogen: Ammonia, N content	420,000	468,000	664,000 r/	723,000 r/	696,000
Perlite	2,270	6,280	5,000	6,000 e/	6,000 e/
Pigments, mineral, natural iron oxide	3,720	3,750	2,310	2,500 e/	2,500 e/
Pumice and related volcanic materials	238,000	215,000	330,000	185,000	200,000 e/
Salt	848,000	901,000	1,110,000	720,000	1,050,000
Sodium compound: Caustic soda e/	15,000	15,000	15,000	15,000	15,000
Stone:					
Construction and building, crushed, n.e.s. thousand tons	3,520	3,070	4,340	4,500 e/	4,800 e/
Dimension and decorative: e/					
Granite do.	21	11 3/	24 3/	30	20
Marble: 6/					
Blocks do.	4,400	4,470 3/	3,970 3/	3,200	4,500
Crushed do.	600	425 3/	786 3/	400	450
Slabs do.	80	73 3/	19 3/	20	50
Travertine:					
Blocks do.	300	463 3/	341 3/	300	500
Crushed and slabs do.	70	56 3/	93 3/	60	70
Total 3/ do.	5,470	5,500	5,230	4,010	5,590
Dolomite do.	71	105	227	173	200 e/
Limestone do.	20,500	24,200	23,800	26,000	28,000 e/
Seashell do.	81	73	71	75 e/	80 e/
Strontium: Celestite	34,100	28,500	13,100	20,000 e/	20,000 e/
Sulfates, natural:					
Aluminum potassium sulfate (alum) e/	12,000	12,000	12,000	12,000	12,000
Sodium sulfate	177,000	144,000	237,000	280,000	280,000 e/
Sulfur: e/					
Byproduct of petroleum and natural gas	635,000	650,000	700,000	750,000	830,000
Byproduct of metallurgical processing, S content of acid	45,000	50,000	50,000	50,000	50,000
Total	680,000	700,000	750,000	800,000	880,000 3/
Talc	31,100	6,680	23,700	18,000	27,000
<b>MINERAL FUELS AND RELATED MATERIALS</b>					
Coal thousand tons	1,440	1,480	1,510	1,680	1,720
Coke do.	441 r/	496 r/	506 r/	600 e/	700 e/
Gas, natural:					
Gross e/ million cubic meters	6,500 3/	50,000	54,000	53,000	54,000
Dry 7/ do.	23,800	29,500	32,000	31,500	31,800
Natural gas plant liquids thousand 42-gallon barrels	12,800	18,300	20,000	23,300	23,500
Petroleum:					
Crude do.	1,130,000	1,220,000	1,300,000	1,100,000	1,090,000
Refinery products:					
Liquefied petroleum gas do.	9,860	13,500	19,000	20,000 e/	20,000 e/
Motor gasoline do.	43,800	49,600	50,400	50,000 e/	50,000 e/
Jet fuel 8/ do.	3,650	7,300	8,030	8,000 e/	8,000 e/
Kerosene do.	31,000	29,200	30,700	32,000 e/	32,000 e/
Distillate fuel oil do.	94,900	90,500	101,000	100,000 e/	100,000 e/
Residual fuel oil do.	110,000	95,300	96,700	100,000 e/	100,000 e/
Other 9/ do.	24,800	39,800	35,800	40,000 e/	40,000 e/
Total 10/ do.	318,000	325,000	342,000	330,000 e/	330,000 e/

e/ Estimated. r/ Revised.

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

2/ Data are for Iranian years beginning Mar. 21 of that stated, except data for natural gas, plant liquids, and petroleum, which are for Gregorian calendar years. Table includes data available through June 30, 1995.

3/ Reported figure.

4/ Total lead and zinc ore mined in 1991, 1992, and 1994 amounted to 788,000 metric tons (mt), 1,080,000 mt, and 1,750,000 mt, respectively.

5/ Figures for 1990 are for magnesite; the 1991 and 1992 figures include 3,340 tons and 220 tons of huntite ("white clay"),  $Mg_3Ca(CO_3)_4$ , respectively.

6/ Includes marmarite and varieties of dolomitic crystalline marble.

7/ Excludes natural gas used for reinjection, flaring, venting, or consumed in the extraction of liquids.

8/ Includes naphtha-type jet fuel and kerosene-type jet fuel.

9/ Includes lubricants and greases, asphalt, coke, aviation gasoline, naphthas, paraffin wax, petrochemical feedstocks, unfinished oils, white spirits, and blending components.

10/ Refinery fuel and losses are included in output of individual products; totals are as follows, in thousand 42-gallon barrels: 1990--12,000; 1991--12,400; 1992--13,100; 1993--14,000 (estimated); and 1994--14,000 (estimated).