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CHROMIUM [ADVANCE RELEASE]

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CHROMIUM

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In 2007, the U.S. chromium supply (measured in contained chromium) was 162,000 metric tons (t) from recycled stainless steel scrap, 485,000 t from imports, and 263,000 t from Government and industry stocks. Supply distribution was 291,000 t to exports, 126,000 t to Government and industry stocks, and 493,000 t to apparent consumption. Chromium apparent consumption decreased by 16.3% compared with that of 2006. Historically, chromium ferroalloys replaced chromite ore as the leading source of chromium to the U.S. economy. Stainless steel mill products have been accounting for an increasing share of chromium supply to the domestic economy, now rivaling that of ferrochromium. Because stainless steel mill products contribute a significant amount of chromium to the domestic economy, trade in these products has been incorporated into chromium trade statistics and their contribution accounted for in chromium apparent consumption.

Chromium has a wide range of uses in chemicals, metals, and refractory materials. Its use in iron, nonferrous alloys, and steel is for the purpose of enhancing hardenability or resistance to corrosion and oxidation. Production of stainless steel and nonferrous alloys are two of its more critical applications. Other applications are in alloy steel, catalysts, leather processing, pigments, plating of metals, refractories, and surface treatments.

Chromium is an essential trace element for human health. Some chromium compounds, however, are acutely toxic, chronically toxic, and/or carcinogenic. The U.S. Environmental Protection Agency (EPA) regulates chromium releases into the environment. The Occupational Safety and Health Administration (OSHA) regulates workplace exposure.

Because the United States has small chromite ore reserves and a small reserve base, domestic supply has been a concern during every national military emergency since World War I. World chromite ore resources, mining capacity, and ferrochromium production capacity are concentrated in the Eastern Hemisphere. In recognition of the vulnerability of long supply routes during a military emergency, chromium (in various forms, including chromite ore, chromium ferroalloys, and chromium metal) was held in the National Defense Stockpile (NDS) since before World War II. As a result of changed national security considerations since 1991, stockpile goals have been reduced, and inventory is being sold. Material for recycling is the only domestic commercial chromium supply source.

The U.S. Geological Survey (USGS) has conducted mineral resource surveys of the United States to assess the potential for occurrences of chromium and other mineral resources. The National Aeronautics and Space Administration, the National Institute of Standards and Technology, the U.S. Department of Defense (DOD), and the U.S. Department of Energy conduct alternative materials research.

Domestic Data Coverage

Domestic data for chromium materials were developed by the USGS by means of the monthly "Chromite Ores and Chromium Products" and "Consolidated Consumers" consumer surveys. Stainless and heat-resisting steel producers are the leading chromium consumers, and high-carbon ferrochromium is the leading chromium-containing material consumed.

Legislation and Government Programs

The Defense National Stockpile Center (DNSC) disposed of chromium materials under its financial year 2007 (October 1, 2006, through September 30, 2007) Annual Materials Plan (AMP) and announced the financial year 2008 plan. The DNSC's financial year 2008 AMP set maximum disposal goals for chromium materials at 136,000 t of chromium ferroalloys, 45,400 t of refractory-grade chromite ore, and 907 t of chromium metal (Defense National Stockpile Center, 2007).

Production

The major marketplace chromium-containing materials are chromite ore and foundry sand; chromium chemicals, ferroalloys, and metal; and stainless steel. In 2007, the United States produced chromium chemicals, ferroalloys, and metal, and stainless steel. The United States is a major world producer of chromium chemicals, chromium metal, and stainless steel.

Eramet Marietta Inc. produced ferrochromium and chromium metal at its Marietta, Ohio, plant. Eramet produced chromium metal via the electrolytic process with an annual production capacity of 3,000 metric tons per year (t/yr).

Oregon Resources Corporation (ORC) [a subsidiary of Industrial Minerals Corporation (Australia)] developed its chromite ore surface mine in Coos County, OR. ORC obtained Coos County approval for a conditional chromite ore mining permit (Rafferty, 2007; 2008). ORC planned to mine on 7.3 square kilometers (1,800 acres) of land leased from Weyerhaeuser Co. between Charleston and Bandon, about 30 kilometers (20 miles) south of the ORC beneficiation plant at Bunker Hill.

The U.S. stainless steel industry produces more than 2 million metric tons per year (Mt/yr) of stainless steel and imports and exports stainless steel mill products and scrap, which account for a significant amount of chromium in U.S. trade. The stainless steel industry is the leading consumer of chromium materials.

AK Steel Corp. (West Chester, OH) produced stainless steel at Mansfield and Middletown, OH, and Butler, PA (AK Steel Corp., 2007).

ThyssenKrupp AG started to build a stainless steel plant at Calvert, AL. The new plant was planned to have a stainless steel melt shop production capacity of 1 Mt/yr of slabs. Construction of the plant was planned to be completed in 2010 (ThyssenKrupp AG, 2007).

North American Stainless (NAS), part of Acerinox Group (Madrid, Spain), produced stainless steel in Ghent, KY. NAS reported melt shop production of 751,671 t in 2007 compared with 849,504 t in 2006. NAS brought electric furnace no. 2 into production and planned to acquire a second argon-oxygen decarburization converter and a ladle furnace to come into operation in 2008, raising NAS melting production capacity to 1.415 Mt/yr (Acerinox S.A., 2008, p. 148–150).

Environment

EPA regulates chromium releases to the environment and reports there upon (U.S. Environmental Protection Agency, 2006, p. 7, 47, 49, 106). OSHA regulates workplace exposure to chromium (U.S. Department of Labor, 2007).

Prices

Chromium materials are not openly traded. Purchase contracts are confidential between buyer and seller; however, trade journals report composite prices based on interviews with buyers and sellers, and traders declare the value of materials they import or export. Thus, industry publications and U.S. trade statistics are sources of chromium material prices and values, respectively.

The average South African Rand exchange rate is a potentially significant factor in the price of chromite ore and ferrochromium because South Africa was the leading producer of this material. The South African Rand exchange rate increased to a time-weighted average of R7.05 per U.S. dollar in 2007 from R6.77 per U.S. dollar in 2006 (Pacific Exchange Rate Service, 2008). From 2001 through 2006, the change in Rand per U.S. dollar has been strongly affected by the change in U.S. import value of high-carbon ferrochromium; however, in 2007, both the Rand per U.S. dollar and the import value of high-carbon ferrochromium increased.

Foreign Trade

Chromium-containing material exports from and imports to the United States included chromite ore; chromium chemicals, ferroalloys, metal, and pigments; and stainless steel. In 2007, the value of foreign trade of these chromium materials excluding stainless steel mill products and scrap was $150 million for exports and $699 million for imports based on foreign trade statistics collected by the U.S. Department of the Treasury and reported by the U.S. Department of Commerce. A significant amount of chromium exits and enters the U.S. economy via stainless steel mill product and scrap trade. The value of foreign trade of chromium materials including stainless steel mill products and scrap was $3,881 million for exports and $5,200 million for imports.

World Industry Structure

The chromium industry comprises chromite ore, chromium chemicals and metal, ferrochromium, stainless steel, and chromite refractory producers. Several trends are simultaneously taking place in the chromium industry. The chromium chemical industry has eliminated excess production capacity, concentrating on production growth in surviving plants. Chromite refractory use has been declining; however, foundry use has been increasing slowly. Environmental concerns have reduced the use of chromite refractories and chromium chemicals. The proportion of chromite ore from independent producers is declining, while that from vertically integrated producers is increasing. In other words, chromite ore mines tend now to be owned and operated by chromite refractory, chromium chemical, or ferrochromium producers. This trend is associated with the migration of ferrochromium production capacity from stainless-steel-producing countries to chromite-ore-producing countries, a trend that has been interrupted with the emergence of China as a significant ferrochromium and leading stainless steel producer. While ferrochromium production capacity was closed in historically producing countries, which usually have been stainless-steel-producing countries, new furnaces or plants were constructed in chromite-ore-producing areas. The electrical power and submerged-arc electric furnace production capacities used to produce ferrochromium have been increasing. Furnaces built recently have an electrical capacity in the tens of megavoltamperes (MVA), whereas when ferrochromium plants were first built, furnaces rated in the low kilovoltampere range were common.

Production process improvements, such as agglomeration of chromite ore, preheating and prereduction of furnace feed, and closed-furnace technology, have been retrofitted at the plants of major producers and are being incorporated in newly constructed plants. Since the introduction of post-melting refining processes in the steel industry after 1960, there has been a shift in production to high-carbon ferrochromium from low-carbon ferrochromium. After years of ferrochromium production, slag stockpiles have built up. Recently developed processes have efficiently recovered ferrochromium from that slag, and processes have been or are being installed at existing plant sites. In South Africa, the leading chromite-ore- and ferrochromium-producing country, three trends are emerging—ferrochromium plants are being developed in the western belt of the Bushveld Complex, ferrochromium plants are being built in association with chromite ore mines, and ferrochromium production processes are being designed to accommodate chromite ore byproduct recovered from platinum operations.

Capacity.—Rated capacity is defined as the maximum quantity of product that can be produced in a period of time at a normally sustainable long-term operating rate, based on the physical equipment of the plant and given acceptable routine operating procedures involving labor, energy, materials, and maintenance. Capacity includes both operating plants and plants temporarily closed that can be brought into production within a short period of time with minimum capital expenditure.

Because not all countries or producers provide information about production capacity, historical chromium trade data have been used to estimate national production capacities. Reported production capacity changes result from both facility changes and increased knowledge about facilities. New information about a facility may result in the reevaluation of production capacity for that facility. Production capacities have been rated for the chromite ore, chromium chemical, chromium metal, ferrochromium, and stainless steel industries (table 7).

Production.—In 2007, world chromite ore production was about 22.2 million metric tons (Mt) gross weight, of which about 93.7% was produced for the metallurgical industry; 2.4%, for the chemical industry; 3.1%, for the foundry industry; and 0.8%, for the refractory industry (International Chromium Development Association, 2008, p. 1).

Chromium Chemicals.—Major chromium chemical producers included China, Russia, the United Kingdom, and the United States. Chromium chemical production was reported to have been 850,000 t of sodium dichromate equivalent in 2006 (Huvinen, 2007).

Chromium Metal.—Major chromium metal producers included Russia and the United States (by the electrolytic process) and China, France, Russia, and the United Kingdom (by the aluminothermic process). Chromium metal world production was reported to have been 40,000 t in 2006 (Huvinen, 2007).

Stainless Steel.—In 2007, world stainless steel production was 27.8 Mt, a decrease of 1.8% compared with that of 2006 (International Stainless Steel Forum, 2008). From 2003 through 2007, the average annual stainless steel production growth rate in China (38%), Belgium (13%), and India (11%) exceeded the world average annual growth rate (7%).

In 2007, the price of stainless steel rose as did that of its feed materials. The high cost of nickel resulted in some stainless producers shifting away from nickel-containing grades in favor of nickel-free grades, because nickel-free stainless steel cost about one-half that of nickel containing grades. China approached balance between production and consumption of stainless steel; however, balance was not achieved for all grades produced and consumed. As a result, China started exporting stainless steel, mainly to Europe, and continued to import some other grades. Several stainless steel producers sought to diversify their distribution networks by setting up outlets in different parts of the world. Several producers reduced production in an effort to keep the market closer to balance.

Ferrochromium.—Ferrochromium demand was strong based on economic expansion in China. As a result, ferrochromium prices were high. Stainless steel demand was expected to recede in the early part of 2008 and then recover in the latter part of the year resulting in continued high demand for ferrochromium. Stainless steel production growth in China resulted in strong demand for ferrochromium, much of which was met by local production based on chromite ore imported from India and South Africa and produced by small domestic ferrochromium plants. A confluence of events could stress the ferrochromium industry. India imposed an export tax on chromite ore to encourage domestic production of value-added products (ferrochromium); however, inexpensive electrical power was not abundantly available in India, and there apparently was no plan to make it available. South Africa intended to discourage chromite ore export in order to encourage domestic production of value added products (ferrochromium); however, electrical power availability was limited in South Africa and was expected to remain so until at least 2011. China, in order to improve the environment and promote more efficient, less costly ferroalloy production, encouraged small ferrochromium producers to close or expand. In addition, China was expected to limit industrial sources of air pollution, like coal-fired electrical powerplants, around Beijing in the lead up to the 2008 summer olympics. China was aggressively developing coal-fired electrical powerplants, which was of concern for the amount of greenhouse gasses those plants would add to the environment. Ferrochromium has been supplied by the U.S. National Defense Stockpile; however, there is not much left in the stockpile.

Stainless Steel Scrap.—Stainless steel scrap is an important source of chromium to the stainless steel industry. Recycling of stainless steel scrap accounts for a significant but undocumented portion of world stainless steel production.

World Review

European Union.—The European parliament adopted the REACH (registration, evaluation, and authorization of chemicals) legislation. The legislation requires that all chemical substances produced in or imported into the European Union (EU) in volumes of greater than 1 t/yr must be registered. Those substances deemed hazardous would have to be replaced with safer alternatives, and where these do not exist, a research plan aimed at finding an alternative would have to be submitted. The European Chemicals Agency, based in Helsinki, Finland, was established to take charge of the authorization process. The registration of substances was expected to take 3.5 years for substances greater than 1,000 t/yr, 6.5 years for substances greater than 100 t/yr, and 11 years for substances greater than 1 t/yr (Jacquet, 2007). Several chromium compounds were specifically cited in the legislation (Official Journal of the European Union, 2006.) The EU was a major stainless-steel-producing region. The leading European producers of stainless flat product were ArcelorMittal Stainless, Outokumpu, and ThyssenKrupp Stainless, which produce 2 to 3 Mt/yr each, and Acerinox, which produces about 1.2 Mt/yr in Europe.

Befesa (Madrid, Spain), an international industrial waste management company, recycled stainless steel dust (capacity of 195,000 t/yr) to produce 79,000 t of ferroalloy in 2007 compared with 63,000 t in 2006. As a result of adding a furnace at its Valera, France plant, Befesa expected to increase ferroalloy production by about 10,000 t/yr (Metal Bulletin, 2008b).

Australia.—Coobina Chromite operation, Western Australia, operated by Pilbara Chromite Pty. Ltd. [a subsidiary of Consolidated Minerals Limited (CML)] produced 256,936 t of chromite ore in financial year 2007 (July 1, 2006, through June 30, 2007) compared with 252,867 t in financial year 2006. Pilbara's chromite ore grade was 42% chromic oxide (Cr_2O_3) (Consolidated Minerals Limited, 2007, p. 27–28). Palmary Enterprises (Australia) Pty. Limited [a subsidiary of Palmary Enterprises Ltd. (Ukraine)] purchased CML and delisted the

company from the Australian stock exchange (Consolidated Minerals Limited, 2008).

Onesteel Ltd., a producer of long products, acquired Fagersta Group, Australia's fourth-leading stainless steel distributor (OneSteel Ltd., 2007).

Brazil.—Brazil produced chromite ore, ferrochromium, and stainless steel. Brazil reported 2006 chromite ore production of 562,739 t (228,721 t Cr_2O_3-content), exported 75,800 t of chromite ore (34,239 t Cr_2O_3-content), and imported 21,701 t (12,461 Cr_2O_3-content). Brazil produced from a chromite ore reserve of 15 Mt containing 4.992 Mt Cr_2O_3, mostly in Bahia State. In 2006, Brazil produced 166,577 t of chromium ferroalloys and 406,740 t of stainless steel. Brazil exported 239 t of ferrochromium and imported 5,800 t (Gonçalves, 2007). Based on production of chromite ore and trade of chromite ore and chromium ferroalloys, Brazilian chromium apparent consumption in 2006 was 253,000 t.

Canada.—Canada reported chromium mineral imports of 49,045 kg in 2006, 60,588 kg in 2005, and 55,853 kg in 2004; exports of 2,733 kg in 2006, 2,991 kg in 2005, and 3,685 kg in 2004 (Natural Resources Canada, 2007, p. 64.9–10).

China.—China produced chromite ore, chromium chemicals, ferroalloys, and metal, and stainless steel. China held the world's leading national stainless steel production capacity.

Finland.—Finland produced chromite ore (Kemi Mine), and ferrochromium and stainless steel (Tornio Works). In 2007, Outokumpu produced 556,000 t of marketable chromite ore from 1.2 Mt of run-of-mine ore and 242,000 t of ferrochromium compared with 549,000 t of chromite ore from 1.2 Mt of run-of-mine ore and 243,000 t of ferrochromium in 2006. Outokumpu reported 2007 chromite ore proven reserves of 38 Mt graded at 26% Cr_2O_3, indicated resources of 13 Mt at 29% Cr_2O_3, and 72 Mt at 29% Cr_2O_3 inferred mineral resources. Outokumpu produced stainless steel at meltshops in Tornio, Avesta (Sweden), and Sheffield (United Kingdom) (Outokumpu, 2008, p. 23).

France.—France produced chromium metal and stainless steel.

Germany.—Germany produced low-carbon ferrochromium and stainless steel. Elektrowerke Weisweiler GmbH produced low-carbon ferrochromium, and ThyssenKrupp AG, a multinational corporation, produced stainless steel. Elektrowerke Weisweiler was owned by Kermas Group (United Kingdom). Kermas also owned Serov Ferroalloys Plant (Russia) and Samancor (South Africa), other low-carbon ferrochromium producers.

India.—India produced chromite ore, chromium chemicals, ferrochromium, and stainless steel. India exported lumpy and friable chromite ore and chromite ore concentrates. India imposed a duty of $44 per metric ton on chromite ore exports and a limit of 400,000 t/yr on lumpy and friable chromite ore. There were 17 mines collectively that produced 3,422,880 t of chromite ore in financial year 2005–06 (April 1, 2005, through March 31, 2006) compared with 3,621,394 t from 19 mines in financial year 2004–05, from chromite ore reserves of 66.128 Mt (Indian Bureau of Mines, 2007). India reported chromite ore exports of 692,673 t in financial year 2005–06; 1,116,644 t in financial year 2004–05, and 745,119 t in financial year 2003–04 (Indian Bureau of Mines, 2008).

Tata Steel Ltd., a member of Tata Group, purchased Rawmet Industries Private Limited (Rawmet), with offices in Kolkata, West Bengal State, for Rupee 1,010 million ($25 million). Rawmet operated a ferrochromium smelter near Cuttack, Orissa State, comprised of two 16.5-MVA semiclosed electric arc furnaces with a combined capacity of nearly 50,000 t/yr of high-carbon ferrochromium (Tata Group, 2007).

Indian Metals & Ferro Alloys Ltd. (IMFA) reported financial year production in 2007–08 of 418,524 t of chromite ore and 169,947 t of ferrochromium compared with 323,183 t of chromite ore and 129,848 t of ferrochromium in the previous financial year. IMFA planned to add a 30-megawatt (MW) powerplant at Choudwar, bringing its electrical power production capacity to 138 MW. The powerplant was to begin operation in 2009 (Indian Metals & Ferro Alloys Ltd., 2008).

Balasore Alloys Limited, a member of Ispat Group of Companies that was formerly Ispat Alloys Limited, produced ferrochromium at its plant in Orissa State.

Rohit Ferro-Tech Limited produced ferrochromium from two plants. Kalinganagar Industrial Complex plant, Jajpur District, Orissa State, operated four 16.5-MVA furnaces with a collective production capacity of 110,000 t/yr. Ferro Alloy plant, Bishnupur, Bankura District, West Bengal State, had four 9-MVA furnaces with a collective ferrochromium production capacity of 55,000 t/yr. Ferro Alloy plant was adding a fifth 9-MVA furnace.

Nava Bharat Ventures (NBV) Ferro Alloy Plant at Kharagprasad Village, Dhenkanal District, Orissa State, produced ferrochromium from two 22.5-MVA electric arc furnaces with a combined production capacity of 75,000 t/yr. NBV operated a 94-MW coal-fired electrical powerplant at Kharagprasad and worked on the construction of an additional 64-MW coal-fired electrical powerplant.

Jindal Stainless Ltd., a stainless steel and ferrochromium producer, expanded its annual stainless steel and ferrochromium production capacity. Jindal produced ferrochromium at Vizag and developed a greenfield operation in Orissa State to produce ferrochromium and stainless steel. At Vizag, Jindal operated a high-carbon ferrochromium plant with production capacity of 40,000 t/yr from which it produced 31,414 t of high-carbon ferrochromium during financial year 2006–07 (April 1 through March 31) compared with 30,861 t during the preceding year and was installing a metal-from-slag recovery plant. In Orissa, Jindal operated a high-carbon ferrochromium plant with production capacity of 150,000 t/yr from which it produced 92,176 t of ferrochromium, and chromite ore mines. The company produced 92,415 t of chromite ore and 25,642 t of chromite ore concentrate in financial year 2006–07 compared with 82,201 t of ore and 34,318 t of concentrate in the previous year. A plant that can recover 3 MW of power from waste gas was commissioned. Jindal was constructing stainless steel and ferrochromium production facilities in Orissa. Stainless steel production capacity was to reach 1.6 Mt/yr in two steps of 0.8 Mt/yr each (Jindal Stainless Ltd., 2007, p. 46–47).

Indonesia.—Tsingshan Holding Group (China) (51% ownership) and PT Aneka Tambang (Antam) (49% ownership) planned to build an integrated stainless steel plant at Antam's nickel laterite ore concession on Obi Island, North Maluku Province. The stainless plant was to produce 300,000 t/yr

of stainless steel billets, mainly in nickel-containing grades, beginning in 2010. Antam and Tsingshan also planned to construct a powerplant and a ferronickel plant. Billets were to be transported to China for further fabrication (Metal Bulletin, 2007d).

Iran.—Iran produced chromite ore and ferrochromium. Rohit Ferro-Tech Limited (India) planned a joint venture to develop chromite ore supply from Iran (Metal Bulletin, 2007c).

Italy.—Nichel Leghe Spa, a member of the Cronimet Group that supplied about 1.319 Mt of raw materials to the high-quality steel industry in 2006, bought Ferinox S.p.A. (Molteno and Milan), a company that recycles alloy raw materials for high-grade steel production. Ferinox processes up to 10,000 metric tons per month (t/m) of turnings and 5,000 t/m of scrap (Cronimet Group, 2007).

Japan.—Japan produced chromium chemicals, ferroalloys, and metal, and stainless steel. Japan had the world's second leading national stainless steel production capacity.

Japan applied a 5.37% import duty on high-carbon ferrochromium that it imported predominantly from India, Kazakhstan, and South Africa; however, Japan planned to eliminate the tariff subject to parliamentary approval (Metal Bulletin, 2007a, b).

Kazakhstan.—Kazakhstan produced chromite ore, and chromium chemicals, ferroalloys, and metal. Chromite ore was produced at Donskoy Mine, Aqtobe Oblysy; ferrochromium at Aksu, Pavlodar Oblysy, and Aktobe, Aqtobe Oblysy, ferroalloy smelters; and chromium metal at Aktobe.

Oriel Resources plc reported progress towards bringing the Voskhod Mine into production in 2008 (Oriel Resources plc, 2007a; 2008).

Eurasian Natural Resources Corporation (ENRC) reported (2007b) that it owned Joint Stock Company Kazchrome, which comprised Donskoy Mining and Processing Combine GOK (mines and processing plants) and (Aksu and Aktobe) smelters. The chromite ore mined and beneficiated at Donskoy was mostly smelted at the Aksu and Aktobe smelters. Donskoy comprised two underground (Molodezhnaya Mine and 10th Anniversary of Kazakhstan Independence Mine) and two open pit mines (Poiskovoye Pit and Yuzhny Pit), which produced 4.4 Mt run-of-mine ore in 2006. Donskoy processing comprised two concentrators, DOF-1 and DOF-2, which beneficiated 2.1 Mt and 3.8 Mt, respectively, in 2006. Donskoy produced 2.4 Mt of concentrate, 0.4 Mt of pellets, and 0.2 Mt of briquettes in 2006. In 2006, Donskoy's combined production (concentrate, pellets, briquettes, and crushed high-grade ore) was 3.410 Mt with an average grade of 41.8% Cr_2O_3, most of which was used by Aksu and Aktobe to make ferrochromium. In 2006, Aktobe produced 358,000 t of ferrochromium (281,000 t of high-carbon ferrochromium, 42,000 t of medium-carbon ferrochromium, and 35,000 t of low-carbon ferrochromium), while Aksu produced 682,000 t of high-carbon ferrochromium and 103 t of ferrochromiumsilicon. Aktobe Ferroalloy Plant comprised a 98-MW gas turbine powerplant and a 37-MW steam turbine, seven submerged arc furnaces for the production of high-carbon ferrochromium, seven open arc furnaces for the production of low- and medium-carbon ferrochromium, and a metal recovery plant comprised of crushing, screening, jigging, and magnetic separation equipment. Aktobe used coal, coke, and semicoke as reductants. The Aksu Ferroalloy Plant comprised six submerged electric arc furnaces for the production of high-carbon ferrochromium, a metal from slag recovery plant, and a coke plant. ENRC reported (2008) Australasian Joint Ore Reserves Committee (JORC) compliant ore reserves of 166 Mt at 42% Cr_2O_3 and resources of 331 Mt at 49% Cr_2O_3. ENRC planned to add a 700,000-t/yr pelletizer at a cost of about $110 million for completion in 2009 and to increase ferrochromium production capacity by 200,000 t/yr at Aksu by 2011. Upon completion in 2009, Donskoy will have a pellet production capacity of 1.4 Mt/yr (Outotec Oyj, 2007). ENRC also planned to purchase the Serov ferroalloy plant (Russia) for $210 million, which had a ferrochromium production capacity 200,000 t/yr. ENRC chromium metal production capacity of 5,000 t/yr was idle (Eurasian Natural Resources Corporation PLC, 2007a).

Korea, Republic of.—The Republic of Korea produced stainless steel and had the world's fourth leading national stainless steel production capacity. Korea planned to add chromium to its national stockpile of metals to insulate the country from unexpected surges in price or sudden shortfall of supply (Korea Culture and Information Service, 2007).

Oman.—Gulf Mining and Materials Company (GMM) produced chromite ore. Hatton FZE, a Free Zone Enterprise company registered in the United Arab Emirates, started open pit mining chromite ore in the Sohar, Somail, and Sur regions. Hatton exported its ore via bulk cargo container (25 t per 20-foot container) from the mines to the ports. Hatton's chromite ore production capacity was 480,000 t/yr (Hatton FZE, 2008)

Philippines.—The Philippines produced chromite ore. The Republic of the Philippines Mines and Geosciences Bureau, Department of Environment and Natural Resources, reported chromite ore production in 2005 of 38,080 t (15,010 t of metallurgical concentrate, 5,010 t of metallurgical ore, 16,230 t of chemical ore, and 1,830 t of refractory ore) compared with 42,710 t in 2004 (7,710 t of metallurgical concentrate, 4,790 t of metallurgical ore, 22,110 t of chemical ore, and 8,100 t of refractory ore) (Republic of the Philippines Mines and Geosciences Bureau, 2007).

Russia.—Russia produced chromite ore, chromium chemicals, ferroalloys, and metal, and stainless steel.

Oriel Resources plc commissioned its ferrochromium smelter at Tikhvin (59°38′N, 33°31′E), Tikhvinsky District, Leningrad Oblast. The first furnace was commissioned in April; the second in August. The smelter comprised four 22.5-MVA semiclosed submerged electric arc furnaces. Upon completion of the four furnaces in 2011, the plant's ferrochromium production capacity would be 180,000 t/yr. The plant produced ferrochromium containing 70% to 71% chromium. Tikhvin reported ferrochromium production of 28,770 t in 2007 (Oriel Resources plc, 2007b; 2008).

South Africa.—South Africa produced chromite ore, chromium chemicals and ferroalloys, and stainless steel. In 2006, South Africa produced 7.418 Mt chromite ore and 3.030 Mt ferrochromium, and exported 735,000 t chromite ore and 2.581 Mt ferrochromium (Mosiane, 2007, p. 119–123).

The Government of South Africa considered including a windfall profits tax in the Mining Royalties Bill and how

to limit the export of chromite ore, by quota or by tax, the preferred option. Eskom, South Africa's electrical power utility, implemented rolling blackouts to avoid unplanned power outages. Eskom planned new power stations that were expected to come online in 2011 to 2012. Until then, Eskom could not provide power for ferrochromium capacity expansion (Metal Bulletin, 2008c).

Xstrata S.A. (Pty.) Ltd. and Merafe Resources Limited reported 3.592 Mt of chromite ore production from 8 chromite ore mines with a combined ore production capacity of 7.056 Mt/yr. The companies also produced 1.533 Mt of ferrochromium from 5 ferrochromium plants with a total production capacity of 1.979 Mt/yr. Chromite ore mine production and capacities shown in parentheses, were—Boshoek Opencast Mine (1.8 Mt/yr), Boshoek, North West Province, 602,000 t; Chrome Eden Mine (0.096 Mt/yr), Pilansberg, North West Province, none; Horizon Mine (0.180 Mt/yr), Pilansberg, North West Province, 68,000 t; Kroondal Mine (1.920 Mt/yr), Rustenburg, North West Province, 1.226 Mt; Kroondal Opencast Mine (0.540 Mt/yr), Rustenburg, North West Province, 126,000 t; Thorncliffe Mine (1.440 Mt/yr), Steelpoort, Mpumalanga Province, 1.195 Mt; Helena Mine (0.600Mt/yr), Steelpoort, Mpumalanga Province, 335,000 t; and Waterval Mine (0.480 Mt/yr), Rustenburg, North West Province, none. Xstrata's ferrochromium plant production and capacities shown in parentheses were: Boshoek Plant (240,000 t/yr), Boshoek, North West Province, 192,000 t/yr; Lion Plant (360,000 t/yr), Steelpoort, Mpumalanga Province, 230,000 t; Lydenburg Plant (396,000 t/yr), Lydenburg, Mpumalanga Province, 341,000 t/yr; Rustenburg Plant (430,000 t/yr), Rustenburg, North West Province, 381,000 t/yr; and Wonderkop Plant (553,000 t/yr), Marikana, North West Province, 389,000 t/yr (Merafe Resources Limited, 2008; Xstrata, 2008, p. 93). The Bokamoso pelletizing plant started operation and reached 80% of its 1.2 Mt/yr-production capacity by yearend. Pelletizing chromite ore feed for ferrchromium production provides the potential use of lower cost chromite ore that can not be fed into an electric arc furnace without agglomeration, such as chromite ore fines or chromite byproduct from platinum mining operations. Pelletized feed reduces environmental pollution, reduces unit consumption of electrical energy, and improves chromium recovery. The Bokamoso Plant is the world's largest chromite ore pelletizing plant. Naiker and Riley (2006) reported the historic and current plant capacity for Xstrata's Boshoek, Lydenburg, Rustenburg, and Wonderkop smelter operations, and described the conventional, Premus, and Outokumpu ferrochromium production processes. All of the plants operated electric arc furnaces, agglomeration, and metal-from-slag recovery. Ferrochromium production capacity at Boshoek was 240,000 t/yr; Lydenburg, 402,000 t/yr; Rustenburg, 430,000 t/yr; and Wonderkop, 460,000 t/yr. The conventional process used lumpy ore and reductant whereas the Outokumpu process used lump and fine ore (from 65% to 85% of total ore feed), and the Premus process used only fine ore. The Premus process consumed 2,400 kilowatthour per metric ton of product (kWh/t) and had 90% recovery compared with 3,900 kWh/t and 70% for the conventional process.

Hernic Ferrochrome (Pty.) Ltd. produced chromite ore and ferrochromium at Brits, North West Province, with a ferrochromium production capacity of 420,000 t/yr and a chromite ore production capacity of 500,000 t/yr at its Bokfontein Mine. Hernic planned to add an underground mineshaft at Bokfontein to increase its production capacity to 1.5 Mt/yr to replace opencast production. Hernic held chromite ore reserves of 250 Mt at Maroelabult and Bokfontein.

International Ferro Metals Ltd. (IFM) (Australia) operated the Lesedi chromite mine near Buffelsfontein, North West Province, on the western limb of the Bushveld Complex. IFM started operation of its chromite ore beneficiation plant, pelletizing plant, and ferrochromium plant. The Buffelsfontein ferrochromium plant comprised two 66-MVA electric arc furnaces for a combined ferrochomium production capacity of 267,000 t/yr and planned to increase production capacity to 665,000 t/yr by adding three furnaces. IFM produced 49,370 t of ferrochromium in 2007 from chromite ore supplied by its Lesedi Mine and planned to bring the SkyChrome Mine into production (International Ferro Metals Ltd., 2007, p. 3, 8, 11–12).

Chromex Mining Plc developed the Mecklenburg Project to mine chromite ore from the LG–6 and LG–6a reefs in the western limb of the Bushveld Complex, Mecklenburg Farm, Limpopo Province. Chromex reported chromite ore resources compliant with South African Mineral Reserve and Resource Estimating Code (SAMREC) to be 9.42 Mt in situ resources of which 7.15 Mt are indicated and 2.27 Mt are inferred. Chromex planned to start chromite ore production in 2008 and to reach run-of-mine production capacity of 720,000 t/yr in 2010, of which 60% (432,000 t/yr) would be recovered as marketable product (Chromex Mining Plc, 2007a). Chromex purchased the chrome assets held by Mkhombi Stellite (Pty.) Ltd., namely the Ilitha Mining (Pty.) Ltd. Ilitha was developing a property thought to host about 15 Mt of chromite in the LG6, MG1, MG2, and MG4 layers of the Western Limb of the Bushveld Complex (Chromex Mining Plc, 2007b).

Chrome International South Africa became Lanxess CISA (Pty.) Ltd. upon completion of Lanxess acquisition of Dow Group's 50% interest in the company. Lanxess CISA (Pty.) Ltd. operated under the Lanxess Leather business unit producing chromite ore at the Rustenburg Mine. Lanxess reported that resources at Rustenburg were increased by 80 Mt in 2007 (LANXESS Corporation, 2007). Rustenburg Mine produced about 500,000 t/yr of marketable chromite ore from about 1 Mt/yr of run-of-mine production. Lanxess converted about 150,000 t/yr of chromite ore to chromic acid in Newcastle and leather tanning chemicals in Merebank, and sold the remaining 350,000 t/yr on the world market (Wehling, 2007).

African Rainbow Minerals Ltd. (ARM) and Assmang Ltd. produced chromite ore at Dwarsrivier Mine and Nkomati Mine, and ferrochromium at Machadodorp smelter, Mpumalanga Province. ARM planned to produce about 720,000 t/yr of chromite ore for smelting at Assmang's smelter or for export. ARM planned to crush and screen the ore to get a salable product of 38% Cr_2O_3 with a chromium:iron ratio of 1.65:1. ARM reported chromite ore production by financial year (July 1 through June 30) to have been—0.7 Mt, 2002; 0.85 Mt, 2003; 0.96 Mt, 2004; 0.92 Mt, 2005; 0.82 Mt, 2006; and 1.07 Mt, 2007 (African Rainbow Minerals Ltd., 2007).

ASA Metals (Pty.) Ltd. (ASA), owned 60% by Sinosteel (China) and 40% by Limpopo Province Development Corp., produced chromite ore from the Dilokong Mine (30°09' E, 24°33' S) and ferrochromium at Burgersfort, Mpumalanga Province. ASA's chromite ore production capacity was 420,000 t/yr (run-of-mine) and ferrochromium production capacity was 120,000 t/yr. ASA contracted Outotec Oyj (Finland) to build two closed 66-MVA furnaces, two preheating kilns, and a 600,000-t/yr pelletizing plant that would add 240,000 t/yr ferrochromium production capacity at a cost of $440 million. ASA expected completion of its expansion in 2010. ASA also planned to increase its chromite ore production capacity by adding two 540,000-t/yr mine shafts (Metal Bulletin, 2008a; Outotec Oyj, 2008).

Sylvania Resources Limited built chrome washing plants and platinum-group-metal (PGM) extraction plants to produce chromite and PGMs from Samancor's Millsell, Steelpoort, and Elandsdrift Mines and to process mine waste dumps in those areas. The Millsell plant was completed and produced 9,961 t/m of chromite ore in 2007. Chromite ore tailings retreatment plants comprised crushing, washing, and PGM and chromite recovery by spiral separation. Construction at the Elandsdrift, Lannex, and Steelpoort Mines started or was being planned (Sylvania Resources Limited, 2007; 2008).

Minmetals Development Co. Ltd., a subsidiary of the state-owned Minmetals Group mining and metals trading company (China), purchased the Naboom chromite mine from Mission Point and Versatex for $6.5 million. China National Minerals was expected to begin exploration work at the deposit (Reuters, 2007).

Samancor Chrome, a wholly owned subsidiary of Kermas South Africa (Pty.) Ltd. (Kermas SA), which is owned by Kermas Ltd. (British Virgin Islands), operated chromite ore mines and ferrochromium smelters. Kermas was a vertically and horizontally integrated chromium materials producer. In addition to its South African operations, Kermas owned Serov Ferroalloys and Chrome 1915, a chromium chemical producer in Russia, Electrowerk Weisweiller (EWW) in Germany, and chromite mines in Turkey. EWW and Serov produced low-carbon ferrochromium in Germany and Russia, respectively. Samancor Chrome comprised five business units—Eastern Chrome Mines and Western Chrome Mines, producing chromite ore, and Ferrometals, Middelburg Ferrochrome, and Tubatse Ferrochrome, producing ferrochromium. Samancor had joint ventures in South Africa with stainless steel producers Nippon Denko (Japan), Nishin (Japan), Posco (Korea), and Sinosteel (China). Visser (2006) reported Samancor Chrome's historical and current plant capacity. Eastern Chrome Mines comprised Lannex, Tweefontein, and Winterveld Mines. Western Chrome Mines comprised Elandsdrift, Millsell, and Mooinooi. Samancor operated Outokumpu pelletizing plants at its Ferrometals and Tubatse ferrochromium plants. Samancor produced chromite ore for the chemical, foundry, metallurgical, and refractory industries; and produced high-, medium-, and low-carbon ferrochromium for the production of alloy, stainless, and tool steels. Ferrometals, Witbank, Mpumalanga Province, produced ferrochromium from a plant with a production capacity of 550,000 t/yr, some of which could be converted to medium-carbon ferrochromium. Middelburg, Middelburg, Mpumalanga Province, produced ferrochromium from a plant with a production capacity of 285,000 t/yr. Tubatse Ferrochrome, Steelpoort, Mpumalanga Province, produced ferrochromium from a plant with a production capacity of 360,000 t/yr. Ferrometals and Tubatse also operated metal-recovery-from-slag plants. Middelburg operated a direct current arc furnace.

Tata Steel (KZN) (Pty.) Limited [a subsidiary of Tata Steel (India)] started construction of a ferrochromium plant at Richards Bay, South Africa. The plant was to have a high-carbon ferrochromium production capacity of 1.05 Mt/yr (Tata Steel, 2007, p. 57, 76).

Columbus Stainless (Columbus) produced stainless steel in Middelburg, Mpumalanga Province. Columbus reported melt shop production of 657,051 t in 2007 compared with 727,132 t in 2006, 564,877 t in 2005, and 718,094 t in 2004. Columbus' melting capacity exceeded 1 Mt in 2006 (Acerinox S.A., 2008, p. 19, p. 151–153).

Feralloys Limited, owned by Assmang Ltd. produced chromite ore at the Dwarsrivier Mine and ferrochromium at Machadodorp plant.

The 2007 average South African Rand exchange rate increased to 7.050 Rand per U.S. dollar from 6.767 Rand per U.S. dollar in 2006 (Pacific Exchange Rate, 2008). There has been a strong negative correlation between the unit value of U.S. high-carbon ferrochromium and the exchange rate between the United States and South Africa. When the exchange rate provided fewer Rand per dollar, the unit value of U.S. high-carbon ferrochromium increased. From 2001 through 2006, the change in Rand per U.S. dollar was the opposite of the change in U.S. import value of high-carbon ferrochromium; however, in 2007, both the Rand per U.S. dollar and the import value of high-carbon ferrochromium increased.

Spain.—Acerinox S.A. produced 2.31 Mt of stainless steel in 2007 at three plants, one each in South Africa, Spain, and the United States. Acerinox produced 0.901 Mt of stainless steel (melt shop production) at the Campo de Gibraltar plant, Cadiz Province, compared with 1.012 Mt in 2006, 0.909 Mt in 2005, and 0.921 Mt in 200(Acerinox S.A., 2008, p. 19, 142–147).

Sweden.—Sweden produced ferrochromium and stainless steel. Vargön Alloys AB, Vargön, Västra Götalands Län, produced ferrochromium. Outokumpu (Finland) produced stainless steel at its Avesta plant in Avesta, Dalarnas Län (Outokumpu, 2008, p. 25–28).

Taiwan.—Taiwan produced stainless steel. Tang Eng Iron Works Co., Ltd. raw stainless steel production capacity was about 260,000 t/yr at Kaohsiung Hsiao Kang Lin-Hai Industrial District. Yieh United Steel Corp. raw stainless steel production was more than 1 Mt/yr at Kang Shan Kaohsiung.

Turkey.—Turkey produced chromite ore, chromium chemicals, and ferrochromium. ŞETAT Madencilik Gıda Sanayi ve Ticaret A.Ş. planned to increase chromite concentrate production by 100,000 t/yr to 120,000 t/yr at its Orhaneli chromite mine at a cost of $20 million (Metal Bulletin, 2006).

United Kingdom.—United Kingdom produced chromium metal and stainless steel. Outokumpu (Finland) produced stainless steel at its Sheffield plant (Outokumpu, 2008, p. 16). London & Scandinavian Metallurgical Co. Limited produced

chromium metal by aluminothermic reduction at Rotherham, United Kingdom.

Vietnam.—Vietnam produced chromite ore. Jindal Stainless (India) planned to construct a ferrochromium plant with production capacity of 200,000 t/yr. The plant was to use domestically produced chromite ore and to start up with production capacity of 60,000 t/yr (Investment and Trade Promotion Center, The, 2007).

Zimbabwe.—Chirasha, Shoko, and Machikicho (2006) reported on the first 50 years of ferrochromium production at Zimbabwe Alloys. The plant was founded in 1949 to meet the then growing demand for low-carbon ferrochromium by an expanding stainless steel industry. The plant was located to take advantage of local chromite ore supply and transportation infrastructure. Zimbabwe Alloys' most recent technical advance was the technology sharing agreement with Japan Metals and Chemicals (Japan) that improved low-carbon ferrochromium production efficiency at Zimbabwe Alloys.

Outlook

The long term outlook for chromium will depend on research and technology currently being developed at South Africa's Council for Mineral Technology (Mintek), which conducted Government- and commercial-sponsored research and development on chromite ore and ferrochromium. Mintek developed mine-specific processes for chromite ore beneficiation, developed a platinum recovery process applied to chromite ore tailings, developed furnace controller technology for ferrochromium-producing furnaces, and developed stainless steel dust recycling technology (Mintek 2007, p. 16–17, 24, 26–27; 2008, p. 20–21, 31, 34).

Papp and Lipin (2006, p. 309–333) reviewed commodity, market, and use aspects of chromite ore. India, Kazakhstan, and South Africa were identified as the leading world chromite ore producers. The chemical specifications for a wide range of commercial chromite ore grades (ranging from 30% to 56% Cr_2O_3) from a variety of countries were described.

Johnson, Reck, Wang, and Graedel (2008) estimated the energy required to make austenitic stainless steel from primary materials and scrap. They estimated energy consumption and carbon dioxide production per metric ton of stainless steel producted by the current mix of scrap and primary materials. From primary materials alone, 79 gigajoules (Gj) was consumed and 5.3 t of CO_2 was produced. From scrap materials alone, 26 Gj was consumed and 1.6 t of CO_2 was produced. From the current global mix of operations, 53 Gj was consumed and 3.6 t of CO_2 was produced.

The outlook for chromium consumption in the United States and the rest of the world is about the same as that for stainless steel, which is the major end use for chromium worldwide. Thus, stainless steel industry performance largely determines the performance of the chromium industry in the United States and worldwide. In 2007, China and India were in the process of economic expansion that resulted in demand growth for chromium for the production of stainless steel used to support those economic expansions.

The practice of supplying chromium in the form of ferrochromium by countries that mine chromite ore was interrupted as China became a major consumer of chromite ore; however, the trend was expected to continue as China closed small, less efficient, less environmentally friendly ferroalloy production facilities. The rising cost of ferrochromium sustained independent ferrochromium producers; however, other factors being equal, ferrochromium production is most cost effective when the ferrochromium plant is close to the chromite mine. With new efficient and reliable ferrochromium production facilities in chromite-ore-producing countries, ferrochromium capacity and production are expected to diminish in market-driven economies that produce ferrochromium without nearby chromite ore resources. Other factors of production, such as electrical energy or labor costs can offset chromite ore transportation costs. Further vertical integration of the chromium industry is expected as countries that produce chromite ore expand ferrochromium or stainless steel production capacity.

Chromite Ore.—Chromite ore production capacity is in balance with average consumption. To improve chromite ore availability and to stabilize feed material price, ferrochromium producers invest in mines that produce chromite ore. Indeed, most chromite ore is produced under vertically integrated mine-smelter or mine-plant ownership. As PGM mining moves to chromite-bearing seams in South Africa, a greater proportion of chromite is likely to be supplied as byproduct from such operations. In addition, PGM may become a byproduct of some chromite operations.

Chromium Chemicals.—Leading chromium-chemical-producing countries where large sodium dichromate plants (production capacity in excess of 100,000 t/yr) operate included Kazakhstan, Russia, and the United States. Moderate-sized production facilities were located in China, Japan, Romania, South Africa, Turkey, and the United Kingdom. Small-scale local producers operated in China and India.

Ferrochromium.—Ferrochromium production is electrical energy intensive. Charge-grade ferrochromium requires 2,900 to 4,100 kilowatthours of electrical energy per metric ton of product, with efficiency varying by ore grade, operating conditions, and production process. Thus, ferrochromium plant location will reflect a balance between electrical power cost and other costs.

Stainless Steel.—Stainless steel production is the leading source of chromium demand and was expected to continue to be so.

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TABLE 1

SALIENT CHROMIUM STATISTICS[1]

		2003	2004	2005	2006	2007
World, production, contained chromium:						
Chromite ore (mine)[2]	metric tons	4,670,000 r	5,350,000 r	5,680,000 r	5,720,000 r	6,470,000
Ferrochromium (smelter)[3]	do.	3,460,000	3,750,000 r	3,940,000 r	4,190,000 r	4,770,000
Stainless steel[4]	do.	3,860,000	4,180,000	4,160,000 r	4,830,000 r	4,890,000
U.S. supply:						
Components of U.S. supply, contained chromium:						
Domestic mines	do.	--	--	--	--	--
Secondary[5]	do.	180,000	177,000	174,000	179,000	162,000
Imports:						
Chromite ore[2]	do.	55,300	49,500	52,900	53,800	46,400
Chromium chemicals	do.	10,300	6,040	11,400	12,100	10,600
Chromium ferroalloys	do.	243,000	261,000	278,000	265,000	259,000
Chromium metal	do.	8,570	9,630	11,000	10,900	11,700
Stainless steel mill products and scrap	do.	124,000	163,000	150,000	179,000	158,000
Stocks, January 1:						
Government	do.	643,000	560,000	466,000	375,000	253,000
Industry[6]	do.	8,390	9,870	7,900	8,600	9,700
Total	do.	1,270,000	1,240,000 r	1,150,000	1,080,000	910,000
Distribution of U.S. supply, contained chromium:						
Exports:						
Chromite ore[2]	do.	32,800	14,000	13,700	17,400	12,000
Chromium chemicals	do.	9,710	14,500	18,900	16,700	21,000
Chromium ferroalloys and metal	do.	3,770	6,250	24,700	22,300	27,000
Stainless steel mill products and scrap	do.	141,000	136,000	162,000	156,000	231,000
Stocks, December 31:						
Government[7]	do.	560,000	466,000	375,000	272,000	115,000
Industry[6]	do.	9,870	7,900	8,600	9,700 r	10,000
Total	do.	758,000	645,000	603,000	494,000	416,000
Production, reported:[8]						
Chromium ferroalloy and metal net production:						
Gross weight	do.	W	W	W	W	W
Chromium content	do.	W	W	W	W	W
Net shipments, contained chromium	do.	W	W	W	W	W
Consumption:						
Apparent, contained chromium	do.	514,000	591,000	548,000	589,000	493,000
Reported:						
Chromite ore and concentrates, gross weight	do.	W	W	W	W	W
Chromite ore, average Cr_2O_3[9]	percent	45.0	45.0	45.0	45.0	45.0
Chromium ferroalloys:[10]						
Gross weight	metric tons	411,000	449,000	431,000	429,000	469,000
Contained chromium	do.	240,000	262,000	250,000	252,000	275,000
Chromium metal, gross weight	do.	5,140	5,690	7,280	6,160 r	5,410
Stocks, December 31, gross weight:						
Government:[7]						
Chromite ore	do.	235,000	135,000	73,400	1,160	--
Chromium ferroalloys	do.	691,000	595,000	492,000	373,000	155,000
Chromium metal	do.	7,120	6,670	6,190	5,280 r	4,970
Industry:						
Producer[11]	do.	W	W	W	W	W
Consumer:						
Chromium ferroalloys[12]	do.	16,100 r	12,900 r	14,000 r	15,700 r	16,500
Chromium metal	do.	242	182	228	220 r	221
Other	do.	237	231	305	231	216

See footnotes at end of table.

TABLE 1—Continued

SALIENT CHROMIUM STATISTICS[1]

		2003	2004	2005	2006	2007
Prices, average annual:						
Chromite ore[13]	dollars per ton	--	--	--	119	244
Ferrochromium, chromium content[14]	dollars per pound	$0.433	$0.690	$0.684	$0.695	$1.048
Electrolytic chromium metal, gross weight[15]	dollars per pound	$4.50	$4.50	$4.50	$4.50	NA
Aluminothermic chromium metal, gross weight[16]	do.	$1.84	$2.27	$2.72	$2.94	$3.66
Value of trade:[17]						
Exports, contained chromium	thousands	$58,395	$80,749	$115,656	$121,316	$150,231
Imports, contained chromium	do.	$322,140	$477,377	$583,298	$528,839	$698,510
Net exports, contained chromium[18]	do.	-$263,745	-$396,628	-$467,642	-$407,523	-$548,279
Stainless steel:						
Production:						
Gross weight[19]	metric tons	2,220,000	2,400,000	2,240,000	2,460,000	2,170,000
Contained chromium[20]	do.	373,000	407,000	373,000	419,000	364,000
Average grade, dimensionless[21]		0.1683	0.1697	0.1667	0.1705	0.1676
Shipments, gross weight[22]	metric tons	1,790,000	1,880,000	1,730,000	1,890,000	1,700,000
Exports, gross weight	do.	327,000	323,000	371,000	410,000	476,000
Imports, gross weight	do.	639,000	811,000	770,000	872,000	809,000
Scrap, gross weight:						
Receipts	do.	1,060,000	1,040,000	1,030,000	1,050,000	953,000
Consumption	do.	1,430,000	1,480,000	1,480,000	1,500,000	1,430,000
Exports	do.	505,000	478,000	585,000	506,000	882,000
Imports	do.	89,200	146,000	111,000	180,000	118,000
Value of trade:						
Exports	thousands	$895,000	$1,030,000	$1,340,000	$1,580,000	$2,110,000
Imports	do.	$1,320,000	$2,230,000	$2,630,000	$3,210,000	$4,300,000
Scrap exports	do.	$382,000	$548,000	$670,000	$716,000	$1,620,000
Scrap imports	do.	$70,200	$160,000	$124,000	$209,000	$198,000
Net exports[18, 23]	do.	-$115,000	-$809,000	-$744,000	-$1,130,000	-$770,000

[r]Revised. do. Ditto. NA Not available. W Withheld to avoid disclosing company proprietary data. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Calculated assuming chromite ore to average 44% Cr_2O_3, which is 68.42% chromium.

[3]Calculated assuming chromium content of ferrochromium to average 57% chromium.

[4]Calculated from American Iron and Steel Institute reported stainless steel production assuming chromium content of stainless steel to average 16.7% chromium.

[5]Calculated assuming chromium content of stainless steel to average 17% chromium.

[6]Includes consumer stocks of chromium ferroalloys and metal and other chromium-containing materials.

[7]"Summary of Commodities" as reported by the Defense National Stockpile Center (DNSC) through 2006. "Inventory of Stockpile Material" as reported by DNSC starting in 2007.

[8]Includes chromium ferroalloys and metal and other chromium materials in the United States.

[9]Chromium oxide: Cr_2O_3

[10]Chromium ferroalloy, chromite ore, and other chromium-containing materials excluding chromium metal.

[11]Chromium ferroalloy and metal producer stocks of chromium ferroalloys and metal.

[12]Consumer stocks of high- and low-carbon ferrochromium and ferrochromium silicon.

[13]Time-weighted average price of South African chromite ore that contains 44% Cr_2O_3 f.o.b. South Africa started in June 2006.

[14]Time-weighted average U.S. price of imported high-carbon chromium that contains 50% to 55% chromium as reported in Platts Metals Week.

[15]Time-weighted average U.S. price of domestically produced electrolytic chromium metal as reported by Ryan's Notes.

[16]Time-weighted average U.S. price of imported aluminothermic chromium metal as reported by Ryan's Notes.

[17]Includes chromite ore and chromium ferroalloys, metal, and chemicals.

[18]Negative data indicate that imports are greater than exports.

[19]Source: American Iron and Steel Institute annual report of stainless and heat-resisting raw steel production and shipments.

TABLE 1—Continued

SALIENT CHROMIUM STATISTICS[1]

[20]Estimated mass-weighted average of the mean chromium content of stainless steel production by grade. Uncertainty is approximately ± 0.01, owing to the range of chromium chemical specification limits by stainless steel grade.

[21]Ratio of estimated mass-weighted average chromium content of stainless steel production by grade to production. Expressed as a fraction.

Source: American Iron and Steel Institute quarterly reports of stainless and heat-resisting raw steel production by grade.

[22]Source: American Iron and Steel Institute annual report of stainless and heat-resisting raw steel shipments.

[23]Includes stainless steel and stainless steel scrap.

TABLE 2

U.S. REPORTED CONSUMPTION AND STOCKS OF CHROMIUM PRODUCTS[1]

(Metric tons)

	2006		2007		Change[2]	
	Gross weight	Chromium content	Gross weight	Chromium content	Quantity	Percentage
Consumption by end use:						
Alloy uses:						
Steel:						
Carbon steel	6,060	3,660	6,570	4,010	513	8
High-strength low-alloy steel	9,610	5,210 r	3,360	2,210	-6,250	-65
Stainless and heat-resisting steel	352,000 r	205,000	376,000	218,000	24,300	7
Full alloy steel	21,400	12,800	21,000	12,800	-369	-2
Tool steel	5,020	3,030	5,240	3,030	214	4
Steel end use, not reported by grade	4,400	2,800	26,700	16,600	22,300	508
Superalloys	16,200 r	12,400 r	13,500	10,400	-2,670	-17
Other alloys and uses[3]	21,400	12,600	21,800	12,600	371	2
Total	436,000	258,000	474,000	280,000	38,400	9
Consumption by material:						
Low-carbon ferrochromium	36,600	25,000	43,300	29,300	6,710	18
High-carbon ferrochromium	351,000	210,000	390,000	232,000	38,600	11
Ferrochromium silicon	36,600 r	14,300	33,100	12,900	-3,410	-9
Chromium metal	6,160 r	6,150 r	5,410	5,140	-753	-12
Chromium ore	3,960	1,290	1,160	378	-2,790	-71
Chromium-aluminum alloy	480 r	361 r	464	302	-16	-3
Other chromium materials	435 r	187 r	446	211	11	3
Total	436,000	258,000	474,000	280,000	38,400	9
Consumer stocks:						
Low-carbon ferrochromium	2,140	1,460	1,970	1,330	-174	-8
High-carbon ferrochromium	12,400	7,440	13,300	7,910	896	7
Ferrochromium silicon	1,150	451	1,160	451	9	1
Chromium metal	220 r	220 r	221	210	1	1
Chromium-aluminum alloy	97 r	73 r	79	52	-18	-19
Other chromium materials	134 r	51 r	137	53	3	2
Total	16,200 r	9,700 r	16,900	10,000	717	4
National Defense Stockpile stocks:[4, 5]						
Chromium ferroalloys:[6]						
High-carbon ferrochromium[7]	229,000 r	163,000 r	99,400	71,000	-129,000	-56
Low-carbon ferrochromium[7]	118,000 r	84,300 r	55,400	39,500	-62,800	-53
Chromium metal[8]	5,280 r	5,280 r	4,970	4,970	-312	-6

rRevised.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Change based on gross weight quantity of current year compared with that of previous year.

[3]Includes cast irons, welding and alloy hard-facing rods and materials, wear- and corrosion-resistant alloys, and aluminum, copper, magnetic, nickel, and other alloys.

[4]The source for stockpile materials is the Defense Logistics Agency, Defense National Stockpile Center (DNSC).

[5]The DNSC data is based on the "Total Uncommitted Inventory" of stockpile material D–1 report.

[6]Ferrochromium silicon was used up in 2002.

[7]Chromium content estimated using 71.4% chromium.

[8]Chromium content estimated using 100% chromium.

TABLE 3

VALUE OF IMPORTS AND U.S. PRICE QUOTATIONS FOR CHROMIUM MATERIALS[1]

Material		2006 Contained chromium	2006 Gross weight	2007 Contained chromium	2007 Gross weight
Value:[2, 3]					
Chromite ore:					
Not more than 40% chromic oxide	dollars per metric ton	624	158	2,030	507
More than 40% but less than 46% chromic oxide	do.	564	177	263	83
46% or more chromic oxide	do.	434	141	537	172
Average	do.	437	141	488	156
Ferrochromium:					
Not more than 0.5% carbon	do.	2,490	1,710	3,130	2,080
More than 0.5% but not more than 3% carbon	do.	1,570	1,220	2,140	1,210
More than 3% but not more than 4% carbon	do.	(4)	(4)	992	534
Average (not more than 4%)	do.	2,490	1,710	2,960	1,910
More than 4% carbon	do.	1,190	694	1,830	1,040
Average (all grades)	do.	1,290	762	1,950	1,120
Chromium metal[5]	do.	XX	8,180	XX	8,330
Price:[6]					
Chromite ore:[7]					
Turkey[8]					
40% to 42% Cr_2O_3	do.	613	172	1,280	360
44% Cr_2O_3	do.	601	181	1,270	382
South Africa[9]					
39% Cr_2O_3	do.	453	121	914	244
44% Cr_2O_3	do.	395	119	811	244
High-carbon ferrochromium:[10]					
50% to 55% chromium	cents per pound	69.54	XX	104.85	XX
60% to 65% chromium	do.	63.32	XX	119.59	XX
Low-carbon ferrochromium:[10]					
0.05% carbon	do.	116	XX	175	XX
0.10% carbon	do.	100	XX	156	XX
0.15% carbon	do.	99	XX	155	XX
Chromium metal:					
Domestic, electrolytic[11]	do.	XX	450	XX	450
Imported, aluminothermic[11]	do.	XX	294	XX	366

do. Ditto. XX Not applicable.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Mass-weighted average based on customs value and weight of imported material.

[3]Reported by the U.S. Census Bureau.

[4]No imports of more that 3% but not more than 4% carbon ferrochromium were reported in 2006.

[5]Average over all grades.

[6]Time-weighted average based on prices reported by material in trade journals.

[7]Source: Ryan's Notes.

[8]Price is cfr China.

[9]Price started in June 2006 and is f.o.b. South Africa.

[10]Source: Platts Metals Week.

[11]Source: Ryan's Notes. Price discontinued in February 2007.

TABLE 4

U.S. EXPORTS OF CHROMIUM MATERIALS, BY TYPE[1]

HTS[2] code	Type	2006 Quantity (kilograms)	2006 Value (thousands)	2007 Quantity (kilograms)	2007 Value (thousands)	Principal destinations in 2007
2610.00.0000	Chromite ore and concentrate, gross weight	53,900,000	$10,200	37,600,000	$5,560	Sweden (76.3%); Canada (18.7%); Mexico (4.3%).
	Metal and alloys, gross weight:					
8112.21.0000	Unwrought chromium powders	262,000	4,200	402,000	6,670	Japan (50.7%); China (14.0%); United Kingdom (9.8%); Canada (7.6%); Germany (3.8%); Mexico (3.3%); Netherlands (1.9%); Republic of Korea (1.4%); Singapore (1.4%); Brazil (1.1%); Belgium (1.0%); France (0.8%); India (0.6%).
8112.22.0000	Chromium metal waste and scrap	208,000	3,730	132,000	1,930	Japan (52.5%); Germany (17.7%); Austria (11.4%); Taiwan (6.4%); United Kingdom (6.4%); Netherlands (5.1%).
8112.29.0000	Chromium metal other than unwrought powders and waste and scrap	545,000	13,300	674,000	14,600	Japan (66.0%); Saudi Arabia (13.3%); Germany (5.9%); Belgium (2.6%); Taiwan (2.6%); China (2.1%); Singapore (1.4%); Hong Kong (1.2%); United Kingdom (1.2%); Canada (0.7%); Ireland (0.6%); Russia (0.5%).
	Total chromium metal	1,020,000	21,300	1,210,000	23,200	
	Chromium ferroalloys:					
7202.41.0000	High-carbon ferrochromium:[3]					
	Gross weight	18,800,000	15,600	24,700,000	25,100	Netherlands (51.0%); Mexico (20.5%); Canada (15.4%); Switzerland (7.2%); Italy (1.5%); Japan (1.3%); Argentina (0.7%).
	Contained weight	11,200,000	XX	15,500,000	XX	
7202.49.0000	Low-carbon ferrochromium:[4]					
	Gross weight	16,600,000	22,000	16,200,000	25,700	Netherlands (67.3%); Canada (6.7%); Brazil (6.5%); Mexico (4.7%); Italy (2.5%); Switzerland (2.4%); Japan (2.2%); United Kingdom (1.9%); India (1.6%); Republic of Korea (1.3%); South Africa (0.8%); Sweden (0.7%).
	Contained weight	9,960,000	XX	10,200,000	XX	
7202.50.0000	Ferrochromium-silicon:					
	Gross weight	248,000	480	328,000	434	Argentina (57.1%); Canada (15.6%); Mexico (10.9%); Venezuela (6.1%); United Kingdom (3.8%); Morocco (2.1%); Singapore (1.6%); Taiwan (1.4%); South Africa (0.8%); Turkey (0.8%).
	Contained weight	96,500	XX	94,400	XX	
	Total chromium ferroalloys:					
	Gross weight	35,700,000	38,100	41,100,000	51,200	
	Contained weight	21,300,000	XX	25,800,000	XX	
	Chemicals, gross weight:					
	Chromium oxides:					
2819.10.0000	Chromium trioxide	9,560,000	11,800	15,900,000	21,400	China (17.1%); United Kingdom (14.2%); Brazil (13.9%); India (13.1%); Chile (6.9%); Republic of Korea (4.5%); Belgium (4.0%); France (3.5%); Taiwan (3.1%); Mexico (2.7%); South Africa (2.4%); Spain (1.8%); Indonesia (1.6%); Vietnam (1.6%); Canada (1.3%); Columbia (1.1%); Thailand (1.1%); Japan (0.8%); Turkey (0.8%); Pakistan (0.7%); Singapore (0.7%); Argentina (0.6%); Malaysia (0.5%).

See footnotes at end of table.

TABLE 4—Continued

U.S. EXPORTS OF CHROMIUM MATERIALS, BY TYPE[1]

HTS[2] code	Type	2006 Quantity (kilograms)	2006 Value (thousands)	2007 Quantity (kilograms)	2007 Value (thousands)	Principal destinations in 2007
	Chemicals, gross weight—Continued:					
2819.90.0000	Other	2,180,000	8,730	2,680,000	10,300	Canada (19.7%); Brazil (15.2%); Chile (15.0%); France (8.3%); Republic of Korea (5.7%); United Kingdom (5.0%); Philippines (4.3%); Australia (4.0%); Germany (2.6%); Taiwan (2.4%); Mexico (2.1%); Japan (2.0%); Malaysia (1.7%); China (1.6%); Columbia (1.4%); Costa Rica (1.3%); Netherlands (1.3%); Argentina (1.0%); India (1.0%); Indonesia (1.0%); Spain (0.7%); Switzerland (0.5%); Thailand (0.5%).
	Total chromium oxides	11,700,000	20,500	18,600,000	31,700	
2833.23.0000	Chromium sulfates	34,600	145	--	--	
2833.29.4000	Chromium sulfates	--	--	23,400	$250	United Kingdom (31.5%); Mexico (29.9%); Columbia (14.1%); Venezuela (12.4%); Australia (5.2%); Singapore (4.2%); India (2.7%).
	Salts of oxometallic or peroxometallic acids:					
2841.20.0000	Zinc and lead chromate	73,800	$703	--	--	
2841.90.4500	Zinc and lead chromate	--	--	18,100	82	Dominican Republic (38.8%); Germany (11.6%); New Zealand (11.4%); Republic of Suriname (9.7%); China (7.6%); Trinidad (7.6%); Columbia (6.6%); Jamaica (5.4%); Costa Rica (1.1%).
2841.30.0000	Sodium dichromate	28,900,000	20,700	30,800,000	24,600	Japan (62.5%); Mexico (16.7%); Canada (10.7%); Peru (2.8%); Germany (2.0%); Taiwan (1.0%); Republic of Korea (0.9%); Belgium (0.6%).
2841.50.1000	Potassium dichromate	181,000	497	288,000	758	Canada (86.9%); Spain (4.6%); India (3.9%); Republic of Korea (2.6%); China (1.1%); Brazil (1.0%).
2841.50.9000	Other	667,000	2,570	--	--	
2841.50.9100	Other	--	--	795,000	2,950	Canada (23.7%); China (22.6%); Hong Kong (9.4%); Republic of Korea (6.9%); United Kingdom (4.4%); Belgium (4.2%); Vietnam (4.2%); Russia (4.1%); Indonesia (2.6%); Turkey (2.4%); Spain (2.1%); Taiwan (2.1%); India (2.0%); Thailand (2.0%); Mexico (1.8%); India (1.5%); Jamaica (1.0%); Germany (1.0%); Brazil (0.8%); Republic of Lithuania (0.8%); Singapore (0.6%); Ukraine (0.6%); Italy (0.5%); State of Qatar (0.5%).
	Total salts	29,900,000	24,400	31,900,000	28,400	
3206.20.0000	Pigments and preparations, gross weight	1,330,000	6,620	1,410,000	9,930	Canada (31.8%); Mexico (13.9%); Australia (9.5%); China (9.3%); Hong Kong (8.3%); Japan (6.7%); Colombia (3.7%); Germany (2.1%); Brazil (1.9%); Republic of Korea (1.4%); Guatemala (1.1%); Peru (1.1%); Singapore (0.9%); Taiwan (0.9%); Barbados (0.7%); Trinidad (0.7%); Belgium (0.6%); Italy (0.6%); Thailand (0.6%).

XX Not applicable. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 4—Continued

U.S. EXPORTS OF CHROMIUM MATERIALS, BY TYPE[1]

[2]Harmonized Tariff Schedule of the United States of America.

[3]More than 4% carbon.

[4]Not more than 4% carbon.

Source: U.S. Census Bureau.

TABLE 5

U.S. IMPORTS FOR CONSUMPTION OF FERROCHROMIUM, BY COUNTRY[1]

	Not more than 0.5% carbon (HTS[2] code 7202.49.5090)			More than 0.5% carbon, but not more than 3% carbon (HTS[2] code 7202.49.5010)			More than 3% carbon, but not more than 4% carbon (HTS[2] code 7202.49.1000)			More than 4% carbon (HTS[2] code 7202.41.0000)			Total all grades		
Country	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)	Gross weight (metric tons)	Cr content (metric tons)	Value (thousands)
2006:															
Brazil	19	14	$47	--	--	--	--	--	--	--	--	--	19	14	$47
China	710	475	1,220	10	7	$16	--	--	--	--	--	--	720	481	1,240
Germany	5,910	4,140	12,700	--	--	--	--	--	--	--	--	--	5,910	4,140	12,700
India	--	--	--	--	--	--	--	--	--	70	51	$51	70	51	51
Japan	2,770	1,920	8,800	--	--	--	--	--	--	--	--	--	2,770	1,920	8,800
Kazakhstan	3,330	2,310	4,730	--	--	--	--	--	--	98,800	68,800	85,300	102,000	71,100	90,000
Mexico	20	13	65	--	--	--	--	--	--	--	--	--	20	13	65
Russia	13,400	9,300	18,700	--	--	--	--	--	--	44,400	28,600	30,000	57,700	37,900	48,600
South Africa	1,800	1,060	1,410	19	16	20	--	--	--	190,000	97,000	114,000	192,000	98,100	115,000
Sweden	35	25	121	--	--	--	--	--	--	557	374	633	592	399	754
Tajikistan	--	--	--	--	--	--	--	--	--	101	69	140	101	69	140
Turkey	102	65	276	--	--	--	--	--	--	--	--	--	102	65	276
Zimbabwe	--	--	--	--	--	--	--	--	--	59,000	34,600	43,000	59,000	34,600	43,000
Total	28,100	19,300	48,000	29	23	35	--	--	--	393,000	230,000	273,000	421,000	249,000	321,000
2007:															
Brazil	5	3	10	--	--	--	--	--	--	--	--	--	5	3	10
China	225	148	479	--	--	--	--	--	--	--	--	--	225	148	479
France	6	4	21	--	--	--	--	--	--	--	--	--	6	4	21
Germany	5,720	4,020	12,900	--	--	--	--	--	--	--	--	--	5,720	4,020	12,900
India	--	--	--	--	--	--	--	--	--	4,300	2,710	7,590	4,300	2,710	7,590
Japan	5,620	3,760	10,100	--	--	--	--	--	--	--	--	--	5,620	3,760	10,100
Kazakhstan	3,600	2,500	7,930	1,110	777	2,090	--	--	--	107,000	74,400	162,000	111,000	77,700	172,000
Mexico	14	9	41	--	--	--	--	--	--	40	28	71	53	37	112
Netherlands	--	--	--	--	--	--	--	--	--	1,140	719	2,070	1,140	719	2,070
Russia	15,500	10,000	32,600	--	--	--	267	144	$143	18,500	11,600	22,600	34,300	21,800	55,300
South Africa	718	427	1,050	6,000	3,250	6,520	--	--	--	233,000	116,000	178,000	239,000	119,000	185,000
Sweden	218	153	622	--	--	--	--	--	--	41	28	105	258	181	728
Switzerland	--	--	--	--	--	--	--	--	--	3,500	1,680	2,130	3,500	1,680	2,130
Tajikistan	--	--	--	--	--	--	--	--	--	5	3	9	5	3	9
Turkey	13	8	40	--	--	--	--	--	--	255	158	157	268	166	197
United Kingdom	--	--	--	--	--	--	--	--	--	1	(3)	3	1	(3)	3
Zimbabwe	--	--	--	--	--	--	--	--	--	17,100	10,200	23,700	17,100	10,200	23,700
Total	31,700	21,000	65,800	7,110	4,020	8,610	267	144	143	384,000	217,000	398,000	423,000	242,000	473,000

See footnotes at end of table.

TABLE 5--Continued

U.S. IMPORTS FOR CONSUMPTION OF FERROCHROMIUM, BY COUNTRY[1]

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Harmonized Tariff Schedule of the United States of America.

[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 6

U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE[1]

HTS[2] code	Type	2006 Quantity (kilograms)	2006 Value[3] (thousands)	2007 Quantity (kilograms)	2007 Value[3] (thousands)	Principal sources in 2007
	Chromite ore:					
2610.00.0020	Not more than 40% Cr_2O_3:					
	Gross weight	54,000 r	$9	52,000	$26	Canada (90.4%); China (9.6%).
	Cr_2O_3 content	20,000 r	XX	19,000	XX	
2610.00.0040	More than 40%, but less than 46% Cr_2O_3:					
	Gross weight	3,810,000	674	26,400,000	2,180	South Africa (100%).
	Cr_2O_3 content	1,750,000	XX	12,100,000	XX	
2610.00.0060	46% or more Cr_2O_3:					
	Gross weight	162,000,000 r	22,800	119,000,000	20,400	South Africa (100%).
	Cr_2O_3 content	76,900,000 r	XX	55,600,000	XX	
	Total chromite ore:					
	Gross weight	166,000,000 r	23,500	145,000,000	22,700	
	Cr_2O_3 content	78,600,000 r	XX	67,800,000	XX	
	Chromium ferroalloys:					
7202.49.5090	Not more than 0.5% carbon:					
	Gross weight	28,100,000	48,000	31,700,000	65,800	Russia (49.0%); Germany (18.1%); Japan (17.8%); Kazakhstan (11.4%);
	Cr content	19,300,000	XX	21,000,000	XX	South Africa (2.3%); China (0.7%); Sweden (0.7%).
7202.49.5010	More than 0.5%, but less than 3% carbon:					
	Gross weight	29,000	35 r	7,110,000	8,610	South Africa (84.3%); Kazakhstan (15.7%).
	Cr content	22,700	XX	4,020,000	XX	
7202.49.1000	More than 3%, but less than 4% carbon:					
	Gross weight	--	--	267,000	143	Russia (100%).
	Cr content	--	XX	144,000	XX	
7202.41.0000	More than 4% carbon:					
	Gross weight	393,000,000	273,000	384,000,000	398,000	South Africa (60.6%); Kazakhstan (27.8%); Russia (4.8%); Zimbabwe
	Cr content	230,000,000	XX	217,000,000	XX	(4.5%); India (1.1%); Switzerland (0.9%).
7202.50.0000	Ferrochromium-silicon:					
	Gross weight	38,300,000	32,200	42,700,000	42,700	Kazakhstan (59.9%); Russia (40.1%).
	Cr content	15,900,000	XX	16,700,000	XX	
	Total chromium ferroalloys:					
	Gross weight	459,000,000	353,000 r	466,000,000	515,000	
	Cr content	265,000,000	XX	259,000,000	XX	
	Chromium metal, gross weight:					
8112.21.1000	Unwrought chromium powders	1,250,000	17,000	822,000	10,500	Russia (34.9%); United Kingdom (31.4%); China (17.3%); Japan (6.3%); Germany (5.1%); Spain (3.8%); France (1.0%).
8112.22.0000	Waste and scrap	90,400	864	357,000	2,200	Mexico (75.9%); Japan (9.7%); Germany (5.1%); Taiwan (4.5%); Malaysia (3.0%); Singapore (1.9%).

See footnotes at end of table.

TABLE 6—Continued

U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE[1]

HTS[2] code	Type	2006 Quantity (kilograms)	2006 Value[3] (thousands)	2007 Quantity (kilograms)	2007 Value[3] (thousands)	Principal sources in 2007
	Chemicals, gross weight:					
	Chromium oxides and hydroxides:					
	Total chromium metal:	10,900,000	$89,000	11,700,000	$97,400	
8112.29.0000	Other than waste and scrap	9,540,000	71,100	10,500,000	84,700	Russia (38.7%); France (24.8%); China (17.7%); United Kingdom (17.2%); Germany (1.4%).
2819.10.0000	Chromium trioxide	9,090,000	17,900	8,210,000	17,100	Turkey (48.1%); Kazakhstan (38.1%); China (6.1%); South Africa (4.3%); Colombia (1.3%); United Kingdom (0.7%).
2819.90.0000	Other	2,300,000	8,080	2,280,000	9,070	China (69.6%); Germany (14.9%); United Kingdom (7.9%); Colombia (2.0%); Finland (1.9%); Japan (1.0%); Canada (0.9%); Poland (0.8%); South Africa (0.6%).
	Total oxides	11,400,000	26,000	10,500,000	26,200	
2833.23.0000	Sulfates of chromium	422,000	823	--	--	
2833.29.4000	Sulfates of chromium	--	--	186,000	546	Turkey (39.4%); China (21.8%); Argentina (18.9%); India (9.7%); United Kingdom (9.7%); Canada (0.5%).
	Salts of oxometallic or peroxometallic acids:					
2841.20.0000	Chromates of lead and zinc	416,000	1,060	--	--	
2841.90.4500	Chromates of lead and zinc	--	--	1,130,000	3,320	Republic of Korea (78.1%); China (10.3%); Japan (6.6%); Austria (3.0%); Colombia (2.1%).
2841.30.0000	Sodium dichromate	16,100,000	11,000	13,100,000	15,600	United Kingdom (98.4%); China (1.0%).
	Other chromates and dichromates; Peroxochromates:					
2841.50.1000	Potassium dichromate	4,450	32	34,600	110	Colombia (88.8%); India (7.7%); Mexico (2.8%); Japan (0.6%).
2841.50.9000	Other	299,000	676	--	--	
2841.50.9100	Other	--	--	343,000	812	Austria (78.6%); Colombia (11.9%); China (5.9%); United Kingdom (2.9%).
	Total salts	16,800,000	12,700	14,600,000	19,900	
2849.90.2000	Chromium carbide	126,000	2,010 r	143,000	1,800	Japan (39.1%); United Kingdom (28.9%); Canada (17.2%); China (7.7%); Germany (4.2%); Austria (1.6%); Hong Kong (1.4%).
	Pigments and preparations based on chromium, gross weight:					
3206.20.0010	Chrome yellow	4,080,000	12,600	2,250,000	8,710	Canada (47.1%); Republic of Korea (23.9%); Mexico (17.2%); China (7.6%); Germany (2.6%); Taiwan (1.3%).
3206.20.0020	Molybdenum orange	822,000	5,110	600,000	4,040	Canada (86.5%); Mexico (9.5%); France (3.7%).
3206.20.0030	Zinc yellow	31,000	78	92,700	242	China (94.9%); Mexico (5.1%).
3206.20.0050	Other	1,620,000	3,880	487,000	1,760	France (57.7%); Poland (11.7%); China (8.2%); Canada (7.4%); Japan (5.5%); Germany (3.8%); Saudi Arabia (1.7%); Italy (1.3%); Taiwan (0.8%); Mexico (0.7%); Brazil (0.5%).
	Total pigments	6,550,000	21,700 r	3,430,000	14,700	

See footnotes at end of table.

TABLE 6—Continued

U.S. IMPORTS FOR CONSUMPTION OF CHROMIUM MATERIALS, BY TYPE[1]

[r]Revised. XX Not applicable. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Harmonized Tariff Schedule of the United States of America.

[3]Customs import value generally represents a value in the foreign country and therefore excludes U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise into the United States.

TABLE 7
WORLD PRODUCTION CAPACITY OF CHROMITE ORE, FERROCHROMIUM, CHROMIUM METAL, CHROMIUM CHEMICALS, AND STAINLESS STEEL, AND APPARENT CONSUMPTION IN 2007[1]

(Thousand metric tons of contained chromium)

	Production capacity					
Country	Ore	Ferrochromium	Metal	Chemicals	Stainless steel	Apparent consumption[2]
Afghanistan	2	--	--	--	--	--
Albania	30	24	--	--	--	22
Argentina	--	--	--	13	--	16
Australia	80	--	--	--	--	-53
Austria	--	--	--	--	8	113
Belgium	--	--	--	--	260	227
Brazil	190	113	--	--	99	170
Canada	--	--	--	--	--	21
China	60	468	6	70	1,260	2,530
Cuba	13	--	--	--	--	--
Czech Republic	--	--	--	--	2	17
Finland	174	138	--	--	222	124
France	--	--	7	--	51	53
Germany	--	18	1	--	294	271
Greece	1	--	--	--	--	(3)
India	1,090	421	(3)	4	386	437
Indonesia	--	--	--	--	--	-1
Iran	74	12	--	2	--	(3)
Italy	--	--	--	--	310	230
Japan	1	8	1	17	712	554
Kazakhstan	1,110	746	2	37	--	43
Korea, Republic of	--	--	--	--	425	220
Madagascar	42	--	--	--	--	19
Oman	102	--	--	--	--	-2
Pakistan	98	--	--	3	--	5
Philippines	21	--	--	--	--	-5
Poland	--	--	--	--	1	17
Russia	291	350	16	31	43	347
Slovakia	--	1	--	--	--	-2
Slovenia	--	--	--	--	17	12
South Africa	2,910	1,900	--	23	128	119
Spain	--	--	--	--	218	118
Sudan	11	--	--	--	--	--
Sweden	--	89	--	--	122	126
Taiwan	--	--	--	--	293	235
Turkey	208	45	--	17	--	70
Ukraine	--	--	--	--	24	--
United Arab Emirates	6	--	--	--	--	5
United Kingdom	--	--	7	17	82	50
United States	--	20	3	38	430	245
Vietnam	59	--	--	--	--	(3)
Yugoslavia	--	--	--	--	17	--
Zimbabwe	215	165	--	--	--	89
Total	6,780	4,520	43	272	5,400	XX

XX Not applicable. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Apparent consumption is chromite ore production plus chromite ore, ferrochromium, and chromium metal net imports. Net imports are imports minus exports. Based on data reported by the International Chromium Development Association. A negative apparent consumption indicates that exports are greater than production plus imports.

[3]Less than ½ unit.

TABLE 8

CHROMITE: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	2003	2004	2005	2006	2007
Afghanistan[4]	6,400 r	6,600 r	6,800 r	7,300 r	7,300 e
Albania[5]	98,000	54,430	66,270	82,000 r	85,000 e
Australia	248,969	265,987	241,865	252,867	234,083
Brazil[6]	376,862	593,476	616,534 r	562,739 r	627,772
Burma[4]	340 r	360 r	410 r	390 r	400 e
China[e]	200,000	200,000	200,000	200,000	200,000
Cuba	33,300	40,300	34,000	27,900 r	25,000
Finland	549,040	579,780	571,103 r	548,713	556,100
Greece[4]	1,600	1,600	1,500	1,500	1,400
India	2,210,000	2,948,944	3,255,162	3,600,400	3,320,000
Iran	97,238	138,775	223,563	244,603 r	185,760
Kazakhstan	2,927,800 r	3,287,100 r	3,581,242 r	3,366,078 r	3,687,200
Madagascar	45,040	77,386	140,847	132,335	122,160
Oman	13,000	18,585	18,368	70,500	337,970
Pakistan	98,235	129,500	148,432	199,000	323,100
Philippines	33,780	42,140	38,081	46,728	47,000 e
Russia	116,455	320,200	772,000	966,065	776,681
South Africa	7,405,391	7,677,000 r	7,552,000 r	7,418,326	9,646,958 p
Sudan	37,000	26,000	21,654	28,772 r	15,476
Turkey	229,294	506,421	688,377 r	457,893 r	500,000 e
United Arab Emirates	--	7,089	--	--	19,000
Vietnam	143,518 r	194,909 r	78,915 r	73,037 r	103,830
Zimbabwe	637,099	668,391	614,720	712,908 r	663,593
Total	15,500,000	17,800,000 r	18,900,000 r	19,000,000 r	21,500,000

[e]Estimated. [p]Preliminary. [r]Revised. -- Zero.

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through August 8, 2008.

[3]Figures for all countries represent marketable output unless otherwise noted.

[4]Gross weight estimated assuming an average grade of 44% chromic oxide (Cr_2O_3).

[5]Direct shipping plus concentrate production.

[6]Average chromic oxide (Cr_2O_3) content was as follows: 2003—41.1%; 2004–05—42.6%; 2006—45.2% (revised); ar
2007—45.2%.

TABLE 9

FERROCHROMIUM: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country	2003	2004	2005	2006	2007[e]
Albania	37,800	34,650 [r]	34,400 [r]	17,040 [r]	17,000
Brazil[3]	204,339	216,277	197,653	166,577 [r]	170,000
China[e]	500,000	640,000	850,000	1,000,000	1,400,000
Finland	250,490	264,492	234,881	243,350	241,760 [4]
Germany	18,318	24,857	22,672	26,710	22,030 [4]
India[5]	468,677	527,100	611,373	634,200	820,000
Iran[e]	10,000	7,750 [4]	8,000	7,000 [r]	8,000
Japan[3]	19,427	13,472	12,367	13,056	12,000
Kazakhstan	993,000	1,080,993	1,156,168	1,200,000 [e]	1,200,000
Russia[e]	357,000 [4]	454,000	578,000 [4]	600,000	570,000
Slovakia	1,924	1,784	867	19	20
South Africa[6]	2,813,000	2,965,000	2,812,000	3,030,000	3,561,491 [4]
Sweden	110,529	128,191	127,451	136,374	124,403 [4]
Turkey	35,393	33,686	26,043	67,975	69,730 [4]
United States[7]	W	W	W	W	W
Zimbabwe	245,200	193,077	235,000 [e]	200,000 [e]	150,000
Total	6,070,000	6,590,000 [r]	6,910,000	7,340,000 [r]	8,370,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total."

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table inculdes data available through August 8, 2008.

[3]Includes high- and low-carbon ferrochromium.

[4]Reported figure.

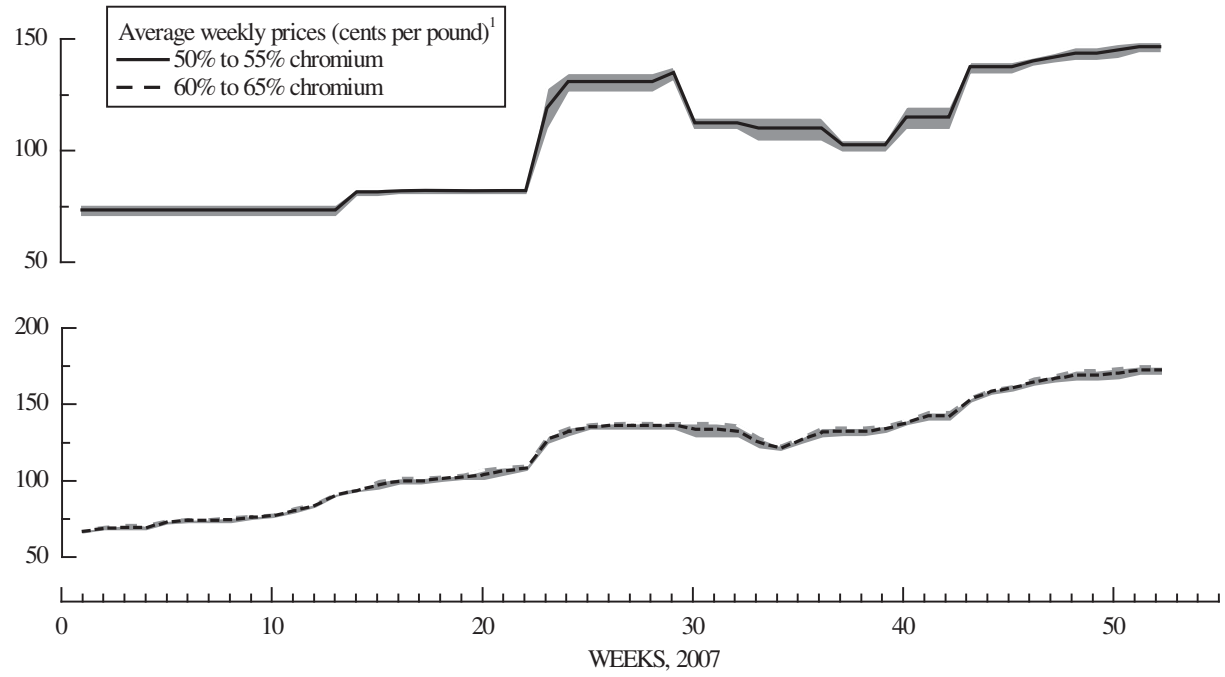
[5]Includes ferrochrome and charge chrome.

[6]Includes high- and low-carbon ferrochromium and ferrochromiumsilicon.

[7]Includes chromium metal, high- and low-carbon ferrochromium, ferrochromiumsilicon, and other chromium materials.

FIGURE 1

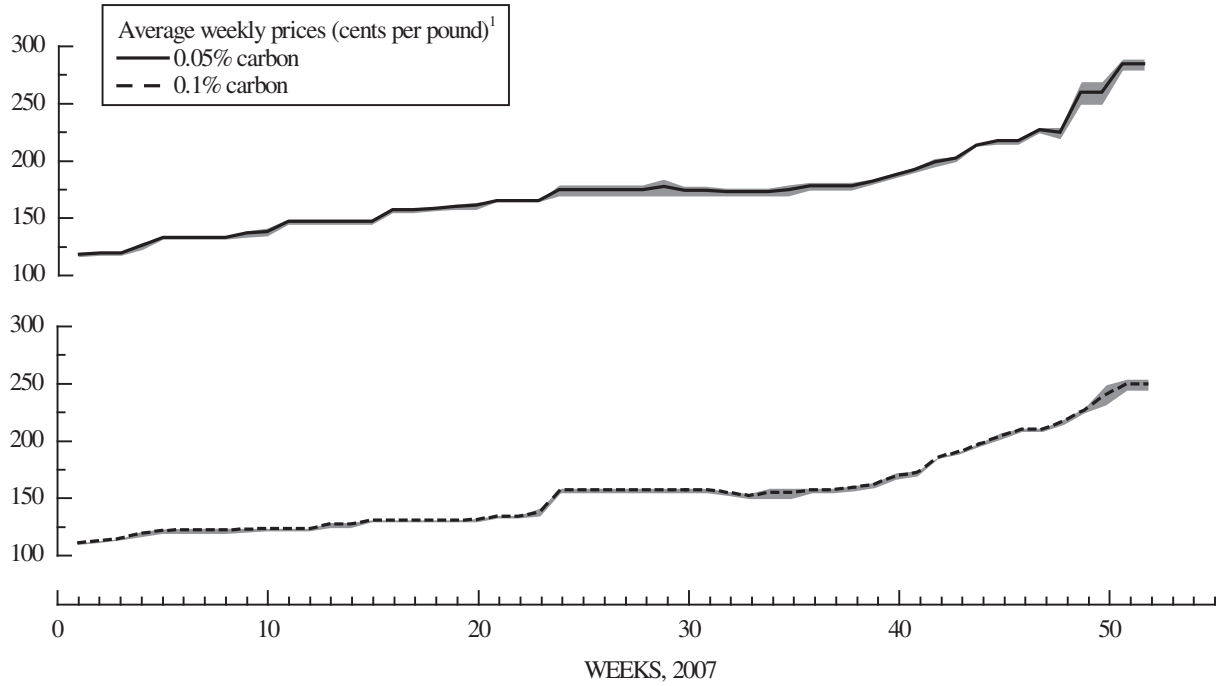
U.S. IMPORTED HIGH-CARBON FERROCHROMIUM IN 2007



[1]Average weekly price shown against price range background.

Source: Platts Metals Week

FIGURE 2
U.S. IMPORTED LOW-CARBON FERROCHROMIUM IN 2007



[1]Average weekly price shown against price range background.
Source: Platts Metals Week