USGS
science for a changing world

2009 Minerals Yearbook

SILICON

U.S. Department of the Interior
U.S. Geological Survey

August 2011

SILICON

By Lisa A. Corathers

Domestic survey data and tables were prepared by Maria Arguelles, statistical assistant.

In 2009, domestic ferrosilicon production decreased 23% from that of 2008 to 139,000 metric tons (t) of contained silicon (table 1). On a gross-weight basis, ferrosilicon production decreased by 25% from the revised amount of 307,000 t produced in 2008 (table 2). Domestic statistics for silicon metal were withheld to avoid disclosing company proprietary data. On the basis of contained silicon, U.S. exports of silicon products increased by 3%, and imports decreased by 49%. The increase in exports was primarily associated with an increase in the "more than 99.99% silicon" metal trade category (table 5). The decrease in imports was primarily attributable to decreases in the "55% to 80%, other" ferrosilicon and the "99.00% to 99.99%" and "other" silicon metal trade categories (table 6). Apparent consumption for ferrosilicon decreased by 38% compared with that in 2008. Year-average import prices for the 50% and 75% ferrosilicon grades each decreased by 34% and 37%, respectively, and those for silicon metal decreased by 28% compared with that in 2008 (table 1).

Silicon is a light chemical element with metallic and nonmetallic characteristics. Silicon is rarely found free in nature. Silicon combines with oxygen and other elements to form silicates, which comprise more than 25% of the Earth's crust. Silica (SiO_2) as quartz or quartzite is used to produce silicon ferroalloys for the iron and steel industries and silicon metal for the aluminum and chemical industries. Silicon metal that is refined into semiconductor-grade metal for use in making computer chips is crucial to modern technology, but the quantity is less than 5% of total silicon metal demand (Roskill's Letter from Japan, 2000). Silicon metal may either be used directly in an upgraded metallurgical form or refined into wafers to power solar batteries. In order of amounts consumed, world consumption of silicon metal used to produce monocrystalline and polycrystalline silicon, amorphous monocrystalline silicon, and ribbon silicon solar cells in 2009 was estimated to be 74,000 t, which was about 5.7% of the total amount of silicon metal consumed worldwide [1.3 million metric tons, (Mt)] (Roskill's Letters from Japan, 2010b; c, p. 11). The U.S. Geological Survey (USGS) does not survey the high-purity silicon industry for production and related data; therefore, the only information that this report contains about these high-purity grades is as it appears in the foreign trade statistics and from published sources.

Production

Silicon Ferroalloys.—Domestic production data for silicon ferroalloys are derived from monthly and annual voluntary surveys and estimates for nonrespondents by the USGS. The data in table 2 were obtained from all operations listed in table 3 that are canvassed by means of the USGS "Silicon Alloys" survey. In terms of gross weight and compared with that of 2008, domestic ferrosilicon gross production and net shipments decreased by 25% and 19%, respectively. Producer stocks of ferrosilicon at yearend 2009 had decreased by 78% compared with those at yearend 2008. Data for ferrosilicon reflected adjustments in inventory and in-plant consumption of ferrosilicon to produce magnesium ferrosilicon and other miscellaneous alloys.

Silicon Metal.—Production-related statistics for silicon metal were withheld to avoid disclosing company proprietary data. In November, Globe Specialty Metals, Inc. (GSM; owner of U.S.-based silicon producer Globe Metallurgical, Inc.) formed a joint venture with Dow Corning Corporation—WVA Manufacturing LLC—at its 67,000-metric-ton-per-year (t/yr) silicon metal facility in Alloy, WV. GSM retained 51% ownership in, and operational control of, the plant; production would be split proportionally between the two companies. Also in November, GSM reopened its 30,000-t/yr silicon metal plant in Niagara Falls, NY (Globe Specialty Metals, Inc., 2009a, b).

Upgraded-Metallurgical-Grade Silicon Metal.—Upgraded-metallurgical-grade silicon metal (UMG-Si) is used in silicon-based photovoltaic (solar) cells. UMG-Si does not require as much additional refinement as does polycrystalline silicon, which has been traditionally used in solar panel wafers. Sometime in 2009, GSM suspended operations at its 360-t/yr Solsil UMG-Si plant in Beverly, OH. This loss was to be more than offset by GSM's 4,000-t/yr UMG-Si production capacity planned at its Niagara Falls silicon plant (Globe Specialty Metals, Inc., 2009b; 2010, p. 22).

Semiconductor- and Solar-Battery-Grade Silicon.—U.S. production capacity for polycrystalline silicon used in semiconductor and solar cells was reported to be 48,000 t in 2009. Total annual domestic polycrystalline production capacity by company was as follows: Hemlock Semiconductor Corp., 27,500 t; REC Group (includes REC Advanced Silicon Materials LLC and REC Solar Grade Silicon LLC), 11,000 t; MEMC Electronic Materials, 8,000 t; and Mitsubishi Materials Group, 1,500 t (Roskill's Letters from Japan, 2010a, p. 8).

Consumption

Silicon Ferroalloys and Metal.—Most ferrosilicon (including miscellaneous silicon alloys) was used to produce steel (68%) (table 4). Silicon metal was used mainly to produce chemicals—silanes, silicones, and others—and silica fume (78%). Silicon metal production at one U.S. silicone producer, Dow Corning, was reported to be between 100,000 to 110,000 t/yr of silicon metal at its 260,000-t/yr plant in Carrollton, KY (Louisville & Jefferson County Riverport Authority, 2008, p. 45, 51).

Metallurgical-grade silicon carbide can substitute for ferrosilicon, especially in iron foundries. Data on North American production and U.S. imports of silicon carbide are

reported in the Manufactured Abrasives chapter of the 2009 USGS Minerals Yearbook, volume I, Metals and Minerals.

In 2009, apparent consumption of ferrosilicon and miscellaneous silicon alloys decreased 38% to 217,000 t compared with that of 2008 (table 1). Decreases in net imports for consumption contributed to the decline in ferrosilicon apparent consumption. Silicon metal apparent consumption was withheld to avoid disclosing company proprietary data.

Reported consumption of ferrosilicon, which includes miscellaneous silicon alloys, was 59% of apparent consumption (content basis). This percentage was derived based on the typical silicon content of these materials noted in table 4.

Consumption of ferrosilicon and silicon metal was estimated by CRU International Ltd. to have each decreased in 2009 throughout the Western World. In terms of contained silicon, ferrosilicon consumption decreased to 1.38 Mt in 2009 from 2.10 Mt (revised) in 2008, and silicon metal consumption decreased to 1.03 Mt from 1.48 Mt. Areas with the largest year-to-year decrease in consumption of ferrosilicon were Europe, Asian countries (excluding China, Japan, and North Korea), and the United States. Areas with the largest year-to-year decrease in consumption of silicon metal were the European Union (EU) and Asian countries (excluding China, Japan, and North Korea). In decreasing order of consumption, Europe, other Asian countries (excluding China, Japan, and North Korea), and Japan accounted for 70% of the ferrosilicon consumption in 2009. Also in decreasing order of consumption, the EU, the United States, and Japan accounted for 73% of the silicon metal consumed in 2009 (CRU Bulk Ferroalloys Monitor, 2010a, b).

Prices

Ferrosilicon and silicon metal prices (excluding those of ultra high-purity silicon) tend to vary in response to changes in supply and demand by the steel, ferrous foundry, chemical, and aluminum industries. There were significant decreases in silicon material prices in 2009 from those in 2008 because of continued effects of the economic downturn that began during the third quarter 2008. The year-average spot prices given by Platts Metals Week were 68.9 cents per pound for 75% ferrosilicon and 116.3 cents per pound for silicon metal; these prices were 37% and 28% lower, respectively, than those of 2008. The year-average North American transaction price for 50% ferrosilicon as calculated from Ryan's Notes listings was 76.9 cents per pound, a 34% decrease from that of 2008. Average monthly ferrosilicon spot prices were at their lowest in April 2009—62.5 cents per pound for 50% ferrosilicon and 53.8 cents per pound for 75% ferrosilicon—before trending upward throughout the rest of the year. The average monthly silicon metal price started the year at a high of 137.5 cents per pound, and hit a low of 104.5 cents per pound in early August before rising again. The range for spot market prices, in cents per pound, ended the year as follows: silicon metal, 112 to 117; 50% ferrosilicon, 87 to 90; and 75% ferrosilicon, 76 to 78.

Foreign Trade

Trade volumes discussed are based on gross weight. U.S. ferrosilicon exports decreased by 20% to 14,200 t, and their value decreased by 43% to $16.8 million from those of 2008. In decreasing order of quantity, Canada and Mexico accounted for 84% of the total 2009 ferrosilicon exports (table 5). Exports of silicon metal increased by 7% to 37,900 t, but their value decreased by 8% to $2.07 million from that of 2008. In decreasing order of quantity, Japan, China, and Germany accounted for 68% of silicon metal exports. Shipments of high-purity silicon containing more than 99.99% silicon accounted for 84% of total silicon metal exported and 99% of the total value of combined ferrosilicon and silicon metal exports.

U.S. ferrosilicon imports decreased by 63% to 103,000 t, and the value of those imports decreased by 68% to $126 million compared with that in 2008. These imports declined primarily because of a decrease in the "55% to 80% silicon, other" ferrosilicon trade category. Imports of standard 75% ferrosilicon (ferrosilicon category of "55% to 80% silicon, other") accounted for 78% of total ferrosilicon imports by gross weight and 75% of total ferrosilicon value (table 6). Russia was the leading source of ferrosilicon imports at 45%, followed by Canada (20%) and China (14%).

Silicon metal imports (116,000 t) decreased by 33% from those in 2008, and decreased by 30% in value to $477 million from $678 million in 2008. The decrease in silicon metal imports was attributable to decreases in the "99.00% to 99.99% silicon" (41,900 t) and "silicon, other" (14,900 t) trade categories. Brazil was the leading source of "99.00% to 99.99% silicon" silicon metal imports at 36%, followed by South Africa at 23% and Australia at 15%. Canada was the leading source of "silicon, other" silicon metal imports at 38%, followed by Brazil at 26% and Norway at 12%. Silicon metal in the "99.00% to 99.99% silicon" trade category accounted for 88% of the quantity, and 54% of the value, respectively, of all silicon metal imported in 2009. The quantity of silicon metal imports in this trade category decreased by 29% compared with that of 2008.

The estimated U.S. net import reliance for ferrosilicon in 2009 as a percentage of apparent consumption decreased to 38% from 49% (revised) in 2008. Silicon metal import reliance was withheld to avoid disclosing company proprietary data.

The general rates of duty that applied to U.S. imports during 2009 were the same as those in 2008. These were, on an ad valorem basis, 5.8% for ferrosilicon containing more than 90% silicon; 5.3% or 5.5% for metal containing 99.00% to 99.99% silicon or "other" silicon, respectively; 1.9% for ferrosilicon containing 80% to 90% silicon; 1.5% for standard 75% ferrosilicon; 1.1% for nominal 75% ferrosilicon that contains more than 3% calcium; and free for magnesium ferrosilicon, metal containing more than 99.99% silicon, and other ferrosilicon (U.S. International Trade Commission, 2009).

Antidumping Duty Administrative Reviews.—There were no final antidumping duty rates assessed in 2009 on imports of silicon materials to the United States. Results of appeals of import antidumping duty reviews made in 2009 are found in table 7.

Foreign-Trade Zone Designation.—The Foreign-Trade Zones Board of the U.S. Department of Commerce granted foreign-trade zone (FTZ) subzone status to Shin-Etsu Handotai America, Inc.'s semiconductor-grade silicon

wafer manufacturing plant in Vancouver, WA. With this FTZ status, Shin-Etsu Handotai would be allowed to import silicon metal duty free provided that all of it be reexported whether manufactured into a downstream product or not (U.S. Department of Commerce, Foreign-Trade Zones Board, 2009).

U.S.-World Trade Organization (WTO) Chinese Raw Material Export Dispute Settlement Proceedings.—On June 23, the United States requested consultations with China and the WTO Dispute Settlement Body (DSB) about curbs placed by China on exports of various materials, including silicon metal. In July, Canada, the EU, Mexico, and Turkey requested to join the consultations. On November 4, the Office of the United States Trade Representative requested that the DSB establish a dispute settlement panel to review the U.S. claims. (The European Union and Mexico also requested the establishment of a dispute settlement panel.) The DSB established a single panel on December 21 and appointed panel representatives on March 29, 2010. The panel was expected to finalize the proceedings in April 2011 (Office of the United States Trade Representative, 2009; World Trade Organization Dispute Settlement Body, 2010).

World Industry Structure

Data on annual world production of ferrosilicon and silicon metal by country from 2005 through 2009 are provided in the Ferroalloys chapter of the 2009 USGS Minerals Yearbook, volume I, Metals and Minerals. World production of ferrosilicon, on a gross-weight basis, was estimated to have been 7.43 Mt in 2009 compared with 7.37 Mt (revised) in 2008. The major ferrosilicon producers in 2009 were, in decreasing order, China, Russia, Norway, the United States, and Ukraine; they accounted for 87% of total world production listed in table 1.

World production of silicon metal, excluding that from the United States, was estimated to have been 1.49 Mt in 2009 compared with 1.63 Mt (revised) in 2008 (table 1). China was by far the leading producer of silicon metal in the world in 2009 with an estimated 950,000 t; this was 64% of the world total. Other major producers of silicon metal in 2009 were, excluding the United States and in decreasing order, Norway and Brazil; they accounted for 20% of world production reported in table 1. New ferrosilicon and silicon metal projects scheduled for completion around the world from 2009 through 2013 are listed in table 8.

World Review

European Union.—In December, the Council of the European Union repealed the 5.4% antidumping duty on ferrosilicon imports from Macedonian producer Silmak dooel that was imposed in February 2008 (Official Journal of the European Union, 2009).

Brazil.—GSM sold its Globe Metais SA silicon metal plant in Brue Branco to Dow Corning in November. The plant production capacity was 43,600 t/yr (Globe Specialty Metals, Inc., 2009a).

Canada.—Timminco Limited reported UMG-Si production was negatively impacted in 2009 because of low demand from customers, higher overheads related to expanded production capacity, and UMG-Si byproduct recycling during the first half of the year. As a result, four of seven purification lines were shut down in May and two more lines were closed in July. The seventh line was shut down in January 2010 pending recovery in the solar market.

Timminco also reported that its Becancour Silicon Inc. plant in Becancour, Quebec, had a nominal silicon metal production capacity of about 50,000 t/yr using three electric arc furnaces. During the first and second quarters of 2009, the plant produced silicon metal for both internal (UMG-Si production) and external consumption. The plant was shut down in May owing to low demand by the aluminum and chemical industries. However, between June and November, all three furnaces were restarted based on improving market conditions (Timminco Limited, 2010, p. 26).

China.—China's exports of silicon materials in 2009 were affected by the global economic downturn that started in the third quarter of 2008, continued high export tariffs, and increased electricity fees imposed by the Central Government of China in late November 2009. China's exports of ferrosilicon fell 65% from those of 2008 to about 447,000 t (TEX Report, The, 2010c). China's exports of silicon metal were also significantly less in 2009 compared with those in 2008; they were down 39% to 421,669 t from 692,711 t (Metal Pages, 2010).

The Chinese export tariffs in 2009 for ferrosilicon and silicon metal remained at 25% and 15%, respectively (Metal Pages, 2009a). With these duties, the Chinese Government aimed to reduce exports of these materials from the country so more material would be available for the domestic market.

The Central Government of China raised the country's electricity fees on average by USD0.004 (CNY0.028) per kilowatthour (kwh) effective November 20. However, the increase in electricity fees was higher at USD 0.013 (CNY0.088) per kwh in the so-called Silicon Land—the area comprised of the Gansu Province, Inner Mongolia Autonomous Region, and Ningxia Hui Autonomous Region (TEX Report, The, 2010b).

China's largest ferroalloys producer, Erdos Group, produced 490,000 t of ferrosilicon, 20,000 t of silicon metal, and 1.3 Mt of silicon carbide in 2009 (TEX Report, The, 2010a).

France.—After operating its French silicon smelters from April through October, Grupo FerroAtlántica S.L. (Ferroatlantica) suspended operations again in November for 5 months citing a slow recovery in demand from the aluminum and chemical markets. As a result, French silicon metal production was 40% lower in 2009 than in 2008. The plants that were affected included the following with their associated products and capacities: Anglefort, silicon metal (36,000 t/yr); Château Feuillet, silicon metal (12,000 t/yr); Laudun, ferrosilicon (25,000 t/yr) and silicon (14,000 t/yr); Les Clavaux, silicon metal (35,000 t/yr); and Montricher, silicon metal (30,000 t/yr) (Grupo FerroAtlántica, S.L., 2010; Metal Pages, 2009b, c).

Japan.—Japan relied on imports of ferrosilicon and nonsemiconductor and solar-battery-grade silicon metal (< 99.999 silicon content) to meet its silicon material requirements in 2009. Japan imported 294,000 t of ferrosilicon,

which was one-half that of 2008. This was a result of decreased demand by the Japanese steel industry and a surplus of ferrosilicon stocks from 2008 imports. According to United Nations trade statistics, Japan imported about 165,000 t of silicon metal in 2009. This was 36% less than in 2008 and was attributed to decreased consumption by the aluminum, chemical, and electronics industries (TEX Report, The, 2010d).

Kazakhstan.—Eurasian Natural Resources Corporation PLC produced 43,000 t of ferrosilicon in 2009. Most of the production was at its Aksu plant in Kazakhstan supplemented by some from its recently acquired Serov plant in Russia (Eurasian Natural Resources Corporation PLC, 2008, 2009, and 2010).

Macedonia.—Silmak dooel resumed production at its ferrosilicon plant in Jegunovce after a 4-month shutdown in early 2009 before shutting down again in early November. The plant has seven EAFs capable of producing 80,000 t/yr (Ryan's Notes, 2009a; Thefreelibrary.com, 2009).

Norway.—Elkem AS (2009a, b) announced it would restart two furnaces in the third quarter of 2009—one furnace at its Bremanger ferrosilicon plant and one at its Salten silicon metal plant—because of improved market conditions. Elkem had total ferrosilicon production capacity of 76,000 t/yr; 40,000 t/yr at the Bjolvefossen plant and 36,000 t/yr in Bremanger. Elkem's silicon metal capacity was as follows: Bremanger, 28,000 t/yr; Salten, 65,000 t/yr; and Thamshavn, 40,000 t/yr.

Fesil AS' production of silicon materials was impacted in 2009 by the global economic downturn. The company reported full capacity utilization at its 2-furnace Rana Metall ferrosilicon plant until May, when capacity utilization dropped to about 50% for the rest of the year. At its Holla Metall silicon metal plant, three of four furnaces were closed in the first quarter of 2009, and only two furnaces produced intermittently thereafter. The Rana Metall ferrosilicon plant production capacity was 90,000 t/yr, and the Holla Metall silicon metal plant production capacity was 50,000 t/yr (Fesil AS, 2010, p. 11–12, 15–16).

Russia.—Mechel OAO reported a 6% decrease in ferrosilicon production at its Bratsk ferroalloys plant to 86,010 t in 2009 from 91,900 t in 2008. The company planned to increase the plant's annual ferrosilicon production capacity to about 96,000 t by 2012 (Mechel OAO, 2010, p. 101–102, and 104).

South Africa.—Silicon Smelters (a subsidiary of Spanish ferroalloy producer Ferroatlantica's FerroPem division) operated two of three silicon metal furnaces. As a result, silicon metal production in 2009 was 25% less than that of 2008 (Ryan's Notes, 2009b).

Spain.—During the year, Ferroatlantica operated only one furnace intermittently at its Sabon silicon metal plant. As a result, the company was expected to produce no more than 20% of its total production capacity (40,000 t/yr) (Metal Pages, 2009b; Grupo FerroAtlántica, S.L., 2010).

Ukraine.—Ferrosilicon production in the Ukraine decreased slightly to 150,300 t from 152,800 t in 2008. Stakhanov Ferroalloy Works produced 111,000 t of ferrosilicon, up 35.4% from that of 2008, and Zaporizhiya Ferroalloy Works produced 39,300 t of ferrosilicon, down 32.2% from that of 2008 (Interfax Russia & CIS Metals & Mining Weekly, 2010).

Outlook

Consumption of ferrosilicon follows trends in the iron and steel industries, for which the combined annual growth rates (CAGRs) have been typically in the range of 1% to 2% in the United States. Details of the outlook for the steel industry are discussed in the Outlook section of the Iron and Steel chapter of the 2009 USGS Minerals Yearbook, volume I, Metals and Minerals. According to the World Steel Association (2009), raw steel production, compared with that in 2008, decreased by 36.4% to 58.1 Mt in the United States while decreasing 8% worldwide to 1,220 Mt. However, raw steel production in China, the leading world producer of raw steel, increased by 13.5% to about 568 Mt. MEPS (International) Ltd. (2010) forecast world raw steel production would increase to 1.4 billion metric tons in 2010 from that in 2009, with a 21% increase in North American raw steel production to 100.5 Mt.

Demand for silicon metal comes primarily from the aluminum and chemical industries. Consumption of silicon metal by the U.S. aluminum castings industry was expected to mirror the short-term growth rate of 29% from 2009 (1.313 Mt) through 2011 (1.695 Mt) in aluminum casting shipments, and the long-term growth rate of 6.1% annually from 2011 through 2019 (2.37 Mt) (Kirgin, 2010). U.S. chemical production was expected to increase by 3.1% in 2010 (by 5.2% when excluding pharmaceuticals) compared with that in 2009. Domestic chemical production was expected to rise by 3% in 2011 (by 2.7% if pharmaceuticals are excluded) compared with 2010 (Bomgardner, 2011).

World production capacity for polycrystalline silicon can be used as a rough indicator of high-purity silicon consumption. Compared with that of 2008, world polycrystalline silicon output increased by 40% to 80,000 t in 2009. Of that amount, consumption in solar cells rose by 76% to 60,000 t in 2009 compared with that of 2008, while use in semiconductors declined by 13% to 20,000 t. World production capacity for polycrystalline silicon was forecast to increase by 54% to 141,800 t in 2010 from 92,100 t in 2009; by 2013, world polycrystalline silicon production capacity would increase to 195,500 t (Roskill's Letters from Japan, 2010a, p. 6, 8).

References Cited

Bomgardner, M.M., 2011, U.S. weak domestic demand will be offset by strong exports, low natural gas prices: Washington, DC, Chemical & Engineering News, v. 89, no. 2, January, p. 10. (Accessed January 10, 2011, at http://pubs.acs.org/cen/coverstory/89/8902cover17.html.)

CRU Bulk Ferroalloys Monitor, 2010a, Ferrosilicon—Ferrosilicon supply/demand balance: CRU Bulk Ferroalloys Monitor, March, p. 6.

CRU Bulk Ferroalloys Monitor, 2010b, Silicon metal—Silicon metal supply/demand balance: CRU Bulk Ferroalloys Monitor, March, p. 10.

Elkem AS, 2009a, Elkem Salten planning to start silicon furnace: Oslo, Norway, Elkem AS press release, September 17. (Accessed January 6, 2011, at http://www.elkem.com/eway/default.aspx?pid=242&oid=6531&trg=_6531&_6531=0:33383.)

Elkem AS, 2009b, Furnace at Elkem Bremanger to start end of November: Oslo, Norway, Elkem AS press release, November 16. (Accessed January 6, 2011, at http://www.elkem.com/eway/default.aspx?pid=242&oid=6531&trg=_6531&_6531=0:33427.)

Eurasian Natural Resources Corporation PLC, 2008, Completion of US$210 million acquisition of a controlling interest in Serov: London, United Kingdom, Eurasian Natural Resources Corporation PLC press release, April 4. (Accessed January 7, 2011, at http://enrc.com/files/04April2008CompletionofUS$210millionacquisitionofSerov.pdf.)
Eurasian Natural Resources Corporation PLC, 2009, Production report for the second quarter ended 30 June 2009: London, United Kingdom, Eurasian Natural Resources Corporation PLC press release, August 19, 17 p. (Accessed January 7, 2011, at http://enrc.com/files/Q2ProdRpt09Ann.pdf.)
Eurasian Natural Resources Corporation PLC, 2010, Production report for the fourth quarter ended 31 December 2009: London, United Kingdom, Eurasian Natural Resources Corporation PLC press release, February 3. (Accessed January 7, 2011, at http://enrc.com/files/IMS09Q4_Ann.pdf.)
Fesil ASA, 2010, Fesil annual report 2009: Trondheim, Norway, Fesil ASA, March 17, 90 p. (Accessed January 6, 2011, at http://www.fesil.no/images/pdf/fesil_09.pdf.)
Globe Specialty Metals, Inc., 2009a, Globe Specialty Metals closes two major transactions with Dow Corning: New York, NY, Globe Specialty Metals, Inc. press release, November 5. (Accessed July 23, 2010, at http://investor.glbsm.com/releasedetail.cfm?ReleaseID=422175.)
Globe Specialty Metals, Inc., 2009b, Governor Paterson announces Globe Specialty Metals has reopened in Niagara Falls: New York, NY, Globe Specialty Metals, Inc. press release, November 23. (Accessed July 23, 2010, at http://investor.glbsm.com/releasedetail.cfm?ReleaseID=426119.)
Globe Specialty Metals, Inc., 2010, U.S. Securities and Exchange Commission (SEC) quarterly report for period ended March 31, 2010: New York, NY, Globe Specialty Metals, Inc. SEC Form 10–Q, May 17, 29 p. (Accessed July 23, 2010, via http://investor.glbsm.com/sec.cfm?DocType=&Year=2010&FormatFilter=.)
Grupo FerroAtlántica, 2010, Grupo FerroAtlántica operations: Madrid, Spain, Grupo FerroAtlántica. (Accessed January 6, 2011, via http://www.ferroatlantica.es/grupo_ferroatlantica/html/english/index_english.html.)
Interfax Russia & CIS Metals & Mining Weekly, 2010, Ukraine cuts ferroalloy output in 2009: Interfax Russia & CIS Metals & Mining Weekly, v. XX, issue 2, January 15, 2010–January 21, 2010, p. 37.
Kirgin, K.H., 2010, Industry to recover after weak 2009: Schaumberg, IL, Modern Casting, January. (Accessed January 8, 2011, via http://www.moderncasting.com/.)
Louisville & Jefferson County Riverport Authority, 2008, Subzone application with manufacturing authority for Dow Corning Corporation—Foreign-trade zone #29: Louisville, KY, December 12, 216 p. (Accessed October 5, 2010, at http://web.ita.doc.gov/ia/foreignT.nsf/viewall?OpenView&Start=1&Count=1000&Expand=326#326.)
Mechel OAO, 2010, United States Securities and Exchange Commission Form 20–F: Moscow, Russia, Mechel OAO, April 26, 368 p. (Accessed January 7, 2011, at http://www.mechel.com/media/for_investors/20f/form_20f.pdf.)
MEPS (International) Ltd., 2010, Record high global steel production in 2010 despite second half weakness: Sheffield, United Kingdom, MEPS Steel News, October 27. (Accessed November 2, 2010, at http://www.meps.co.uk/GlobalSteelProduction2010.htm.)
Metal Pages, 2009a, Duties & taxes—Chinese export tariffs 2009: London, United Kingdom, Metal Pages, undated. (Accessed January 6, 2011, via http://www.metal-pages.com/.)
Metal Pages, 2009b, Ferroatlantica cuts more silicon production: London, United Kingdom, Metal Pages, June 22. (Accessed January 6, 2011, via http://www.metal-pages.com/.)
Metal Pages, 2009c, Silicon metal in the U.S. lifted on supply crimp: London, United Kingdom, Metal Pages, October 1. (Accessed January 6, 2011, via http://www.metal-pages.com/.)
Metal Pages, 2010, Chinese silicon exports fall 39% in 2009—Recovery seen in 2010: London, United Kingdom, Metal Pages, February 3. (Accessed January 6, 2011, via http://www.metal-pages.com/.)
Office of the United States Trade Representative, 2009, WTO dispute settlement proceeding regarding China—Measures related to the exportation of various raw materials: Federal Register, v. 74, no. 232, December, p. 63812–63814.
Official Journal of the European Union, 2009, Council implementing regulation (EU) No. 1297/2009 of 22 December 2009, repealing the anti-dumping duty imposed by Regulation (EC) No. 172/2008 on imports of ferro-silicon originating in the former Yugoslav Republic of Macedonia: Official Journal of the European Union, L 351, v. 52, December 30, p. 1–3.
Roskill's Letter from Japan, 2000, Silicon metal—Japanese consumption forecast to rise by 9% in 2000: Roskill's Letter from Japan, no. 286, June, p. 15–17.
Roskill's Letters from Japan, 2010a, Multi-crystalline silicon—World production rises by 40% in 2009: Roskill's Letters from Japan, no. 401, January, p. 6–9.
Roskill's Letters from Japan, 2010b, Silicon—Japanese producers suspend production of multi-crystalline silicon: Roskill's Letters from Japan, no. 406, June, p. 9.
Roskill's Letters from Japan, 2010c, Solar cells—World output increases by 54%: Roskill's Letters from Japan, no. 407, July, p. 11–14.
Ryan's Notes, 2009a, The pros and cons of restarting production—US imports fall to record low levels: Ryan's Notes, v. 15, no. 29, July 20, p. 1–2.
Ryan's Notes, 2009b, What were they thinking? EU and US attack Chinese Si export tax: Ryan's Notes, v. 15, no. 26, June 29, p. 2–3.
TEX Report, The, 2010a, Erdos/China explains about present situation on production of ferro-alloys and outlook for future: The TEX Report, v. 42, no. 9946, p. 6–7.
TEX Report, The, 2010b, General review of ferro-silicon in 2009 and its outlook for new year: The TEX Report, v. 42, no. 9883, p. 2–3.
TEX Report, The, 2010c, Quantities of ferro-alloys imported by China in CY 2009 exceeded those exported in same year: The TEX Report, v. 42, no. 9897, January 29, p. 3.
TEX Report, The, 2010d, Supply and demand of ferrro-silicon in Japan for CY 2009: The TEX Report, v. 42, no. 9936, p. 6–7.
Thefreelibrary.com, 2009, Silmak turns off furnaces: Huntingdon Valley, PA, Thefreelibrary.com, November 5, 1 p. (Accessed January 6, 2011, at http://www.thefreelibrary.com/Silmak+turns+off+furnaces.-a0212106712.)
Timminco Limited, 2010, Annual report 2009: Toronto, Ontario, Canada, Timminco Limited, March 26, 96 p.
U.S. Department of Commerce, Foreign-Trade Zones Board, 2009, Grant of authority for subzone status, Shin-Etsu Handotai America, Inc. (semiconductor-grade silicon wafers)—Vancouver, WA: Federal Register, v. 74, no. 95, May 19, p. 23395.
U.S. International Trade Commission, 2009, Harmonized tariff schedule of the United States—2009 (supplement 1, revision 1): U.S. International Trade Commission on-line update, effective September 3, [variously paginated and unpaginated].
World Steel Association, 2010, World crude steel production decreases by -8.0% in 2009: Brussels, Belgium, World Steel Association, January 22. (Accessed January 10, 2011, at http://www.worldsteel.org/?action=newsdetail&jaar=2010&id=285.)
World Trade Organization Dispute Settlement Body, 2010, China—Measures related to the exportation of various raw materials: Geneva, Switzerland, World Trade Organization Dispute Settlement Body summary, November 8. (Accessed January 6, 2011, at http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds394_e.htm.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Silicon. Ch. In Metal Prices in the United States Through 1998, 1999.
Silicon. Ch. in Mineral Commodity Summaries, annual.
Silicon. Mineral Industry Surveys, monthly.

Other

Company news releases and reports.
Roskill Information Services Ltd. (London; last reported on silicon and ferrosilicon in 2004).
Silicon. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
United Nations commodity trade statistics.

TABLE 1

SALIENT SILICON STATISTICS[1]

(Contained silicon, unless otherwise noted)

		2005	2006	2007	2008	2009
United States production:						
Ferrosilicon	thousand metric tons	125	146	155	180 [r]	139
Silicon metal	do.	145	W	W	W	W
Exports:						
Ferrosilicon	do.	8	5	7	10	9
Silicon metal	do.	23	27	28	35	38
Imports for consumption:						
Ferrosilicon	do.	197	223	208	190	70
Silicon metal	do.	152	146	147	168	113
Apparent consumption:						
Ferrosilicon	do.	317	363	359	352 [r]	217
Silicon metal	do.	275	W	W	W	W
Price, average:						
Ferrosilicon, 50% Si[2]	cents per pound	55.00	62.93	73.96	115.86	76.93
Ferrosilicon, 75% Si[3]	do.	48.03	54.87	65.62	108.71	68.91
Silicon metal[4]	do.	76.18	79.29	112.69	162.29	116.37
World production, gross weight:						
Ferrosilicon	thousand metric tons	5,810 [r]	6,490 [r]	7,330 [r]	7,370 [r]	7,430
Silicon metal	do.	1,540 [r]	1,470 [r, 5]	1,560 [r, 5]	1,630 [r, 5]	1,500 [5]

[r]Revised. do. Ditto. W Withheld to avoid disclosing company proprietary data.

[1]Data are rounded to no more than three significant digits.

[2]Ryan's Notes North American transaction prices based on weekly averages.

[3]Platts Metals Week mean import prices based on monthly averages.

[4]Platts Metals Week dealer import prices based on monthly averages.

[5]Excluding the United States.

TABLE 2

PRODUCTION, SHIPMENTS, AND STOCKS OF SILICON ALLOYS AND METAL IN THE UNITED STATES[1, 2]

(Metric tons)

	Silicon content (percent)		2008	2009		
Material	Range	Typical	producers' stocks, December 31 (gross weight)	Gross production[3] (gross weight)	Net shipments (gross weight)	Producers' stocks, December 31 (gross weight)
Ferrosilicon[4]	25–65 [5]	48	15,200 [r]	124,000	98,000	5,180
Do.	56–95	76	18,400 [r]	105,000	96,800	2,190
Silicon metal, excluding semiconductor grades	96–99	98	W	W	W	W

[r]Revised. Do. Ditto. W Withheld to avoid disclosing company proprietary data.

[1]Data are rounded to no more than three significant digits.

[2]Data for silvery pig iron (less than 25% silicon) withheld to avoid disclosing company proprietary data.

[3]Ferrosilicon production includes material consumed in the production of miscellaneous silicon alloys.

[4]Includes miscellaneous silicon alloys, which were listed separately prior to 1999.

[5]25% to 55% for ferrosilicon; 32% to 65% for miscellaneous silicon alloys.

TABLE 3
PRINCIPAL PRODUCERS OF SILICON ALLOYS AND (OR) SILICON METAL IN THE UNITED STATES IN 2009

Producer	Plant location	Product
CC Metals and Alloys, Inc.	Calvert City, KY	Ferrosilicon.
Globe Metallurgical, Inc.[1]	Alloy, WV	Ferrosilicon and silicon metal.
Do.	Beverly, OH	Do.
Do.	Niagara Falls, NY[2]	Silicon metal.
Do.	Selma, AL	Do.
Core Metals Group[1]	Bridgeport, AL	Do.
Simcala, Inc.	Mt. Meigs, AL	Silicon metal.

Do. Ditto.

[1]Owned by Globe Specialty Metals.

[2]The Niagara Falls plant reopened in November 2009.

TABLE 4
REPORTED CONSUMPTION, BY END USE, AND STOCKS OF SILICON FERROALLOYS AND METAL IN THE UNITED STATES IN 2009[1, 2]

(Metric tons, gross weight)

End use	Silvery pig iron[3]	Ferrosilicon, 50%[4]	Ferrosilicon, 75%[5]	Silicon metal[6]	Miscellaneous silicon alloys[7]	Silicon carbide[8]
Steel:						
Carbon and high-strength, low-alloy	(9)	(10)	27,600	(11)	828	(10)
Stainless and heat-resisting	--	(10)	40,800	294	(10)	(10)
Full alloy	--	5,050	6,290	(11)	(10)	--
Electric and tool	--	--	(10)	--	--	(10)
Unspecified	--	24,400	26,400	(11)	277	5,860
Total	--	29,500	101,000	294	1,110	5,860
Cast irons	3,870	27,600	20,800	(11)	13,000	22,900
Superalloys	--	(9)	(11)	(11)	(11)	--
Alloys, excluding superalloys and alloy steel	(9)	(9)	(11)	50,800 [12]	--	--
Miscellaneous and unspecified	--	(9)	651	179,000 [13]	(9)	(9)
Grand total	3,870	57,000	123,000	230,000	14,100	28,800
Consumers' stocks, December 31	371	1,480	7,620	2,320	657	1,160

-- Zero.

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

[2]Includes U.S. Geological Survey estimates.

[3]Typically 18% silicon content but ranges between 5% to 24% silicon content.

[4]Typically 48% silicon content but ranges between 25% to 55% silicon content; includes briquets.

[5]Typically 76% silicon content but ranges between 56% to 95% silicon content; includes briquets.

[6]Typically 98% silicon content but ranges between 96% to 99% silicon content.

[7]Typically 48% silicon content. Primarily magnesium-ferrosilicon but also includes other silicon alloys.

[8]Typically 64% silicon content but ranges between 63% to 70% silicon content. Does not include silicon carbide for abrasive or refractory uses.

[9]Included with "Cast irons," to avoid disclosing company proprietary data.

[10]Included with "Steel: Unspecified," to avoid disclosing company proprietary data.

[11]Included with "Miscellaneous and unspecified," to avoid disclosing company proprietary data.

[12]Primarily aluminum alloys.

[13]Primarily silicones, fumed silica, and other chemicals.

TABLE 5
U.S. EXPORTS OF FERROSILICON AND SILICON METAL, BY GRADE
AND COUNTRY, IN 2009[1]

Country	Gross weight (metric tons)	Contained weight (metric tons)	Value
Ferrosilicon:			
More than 55% silicon:			
Brazil	40	24	$60,800
Canada	7,750	5,070	6,190,000
Colombia	50	41	132,000
France	25	19	40,400
Germany	40	31	54,300
Japan	138	105	183,000
Malaysia	23	17	44,000
Mexico	2,190	1,440	3,560,000
Netherlands	83	63	122,000
United Kingdom	152	100	148,000
Others (7 countries)	64	47	120,000
Total	10,600	6,950	10,700,000
Other ferrosilicon:			
Belgium	319	160	592,000
Canada	1,100	550	1,740,000
Egypt	100	46	210,000
Germany	118	59	174,000
Japan	86	22	100,000
Korea, Republic of	342	152	243,000
Mexico	869	384	1,690,000
Portugal	80	37	152,000
Spain	200	99	391,000
Turkey	189	85	343,000
Other (8 countries)	247	122	568,000
Total	3,650	1,720	6,200,000
Grand total ferrosilicon	14,200	8,670	16,900,000
Metal			
More than 99.99% silicon:			
Canada	98	98	4,910,000
China	7,890	7,890	490,000,000
Germany	4,950	4,950	251,000,000
Hong Kong	249	249	15,300,000
Italy	99	99	6,970,000
Japan	10,500	10,500	717,000,000
Korea, Republic of	1,860	1,860	149,000,000
Malaysia	151	151	17,800,000
Norway	3,960	3,960	249,000,000
Taiwan	1,560	1,560	109,000,000
Other (41 countries)	509	509	46,900,000
Total	31,800	31,800 [2]	2,060,000,000
99.00%–99.99% silicon:			
Belgium	240	238	691,000
China	410	406	1,180,000
Germany	49	49	69,500
Italy	100	99	194,000
Japan	71	71	159,000
Mexico	52	52	117,000
Netherlands	242	241	466,000
Singapore	83	82	156,000
Taiwan	204	203	544,000
United Kingdom	167	166	329,000

See footnotes at end of table.

TABLE 5—Continued
U.S. EXPORTS OF FERROSILICON AND SILICON METAL, BY GRADE
AND COUNTRY, IN 2009[1]

Country	Gross weight (metric tons)	Contained weight (metric tons)	Value
Metal—Continued			
Other	224	222	$434,000
Total	1,840	1,830	4,340,000
Other silicon:			
Canada	98	95	235,000
China	309	300	653,000
Germany	298	290	515,000
Hong Kong	373	362	492,000
Japan	1,330	1,290	2,850,000
Korea, Republic of	223	216	160,000
Netherlands	220	214	247,000
Philippines	93	90	158,000
Taiwan	743	721	1,470,000
United Kingdom	200	196	403,000
Other	305	296	851,000
Total	4,200	4,070	8,030,000
Grand total silicon metal	37,900	37,700	2,070,000,000

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

[2]Contained weight estimated from gross weight.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF FERROSILICON AND SILICON METAL, BY GRADE AND COUNTRY, IN 2009[1]

Country	Gross weight (metric tons)	Contained weight (metric tons)	Value
Ferrosilicon:			
55%–80% silicon, more than 3% Ca:			
Argentina	116	70	$326,000
Brazil	449	274	611,000
Canada	21	13	32,100
China	817	567	1,040,000
France	225	137	704,000
Germany	18	12	46,800
Total	1,650	1,070	2,760,000
55%–80% silicon, other:			
Brazil	2,070	1,560	2,370,000
Canada	9,400	6,960	18,300,000
China	8,400	6,350	9,360,000
Egypt	518	383	580,000
France	1,140	803	3,170,000
Germany	250	177	1,450,000
India	55	41	169,000
Russia	46,300	35,500	44,600,000
South Africa, Republic of	320	230	378,000
Venezuela	12,200	9,150	14,300,000
Other (3 countries)	90	64	328,000
Total	80,800	61,200	95,000,000
80%–90% ferrosilicon:			
Germany	19	14	91,700
Norway	1	1	3,170
Total	20	15	94,800
Magnesium ferrosilicon:			
Argentina	468	188	1,460,000
Brazil	2,080	963	3,430,000
Canada	6,290	2,870	12,500,000
China	1,530	818	1,920,000
France	704	273	970,000
Germany	15	10	25,200
India	2	1	3,340
Japan	31	14	121,000
South Africa, Republic of	17	8	29,600
Total	11,100	5,150	20,500,000
Other ferrosilicon:			
Brazil	534	222	700,000
Canada	4,500	1,200	5,560,000
China	4,080	560	1,270,000
France	18	9	39,600
Norway	19	9	41,900
Poland	41	15	104,000
Russia	152	71	138,000
Total	9,340	2,090	7,850,000
Grand total ferrosilicon	103,000	69,600	126,000,000

See footnotes at end of table.

TABLE 6—Continued
U.S. IMPORTS FOR CONSUMPTION OF FERROSILICON AND SILICON METAL,
BY GRADE AND COUNTRY, IN 2009[1]

Country	Gross weight (metric tons)	Contained weight (metric tons)	Value
Metal:			
More than 99.99% silicon:			
Canada	200	200	$7,650,000
China	85	85	2,380,000
Germany	1,690	1,690	118,000,000
Italy	224	224	12,700,000
Japan	252	252	28,100,000
Korea, Republic of	310	310	18,100,000
Norway	17	17	974,000
Russia	10	10	704,000
Spain	8	8	45,600
Taiwan	40	40	1,000,000
Other (12 countries)	19	19	5,990,000
Total	2,850	2,850 [2]	196,000,000
99.00%–99.99% silicon:			
Australia	15,500	15,500	38,700,000
Brazil	38,700	37,600	95,600,000
Canada	7,030	6,950	15,200,000
Japan	26	13	99,000
Laos	7,200	7,160	15,400,000
Norway	9,030	8,970	29,700,000
Philippines	525	521	1,090,000
South Africa, Republic of	23,500	23,300	59,000,000
Sweden	32	30	244,000
Ukraine	302	299	800,000
Other (1 country)	1	1	2,700
Total	102,000	100,000	256,000,000
Other silicon:			
Australia	969	951	2,750,000
Brazil	2,860	2,730	7,980,000
Canada	4,090	3,950	8,310,000
China	602	593	960,000
France	209	205	544,000
Japan	127	95	365,000
Norway	1,300	985	2,640,000
Philippines	134	131	220,000
South Africa, Republic of	117	96	234,000
Ukraine	318	314	801,000
Other (8 countries)	117	91	212,000
Total	10,800	10,100	25,000,000
Grand total silicon metal	116,000	113,000	477,000,000

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

[2]Contained weight estimated from gross weight.

Source: U.S. Census Bureau.

TABLE 7
SILICON MATERIALS: APPEALS OF IMPORT ANTIDUMPING DUTY ADMINISTRATIVE REVIEWS IN 2009, BY DECISION DATE

Imported material	Country of origin	Period of investigation	U.S. court	Decision	Decision date	Source
Silicon metal	China	6/1/05 – 05/31/06	CIT	Upheld ITA's use of Indian silicon dioxide import data as a surrogate value for silica fume in its remand determination to establish antidumping duties for two new Chinese shippers of silicon metal (Jiangxi Gangyuan Silicon Industry Co. Ltd. and Shanghai Jinneng International Trade Company Ltd.). As a result, ITA was expected to amend the antidumping duty rates of imports from the two companies.	May 5	Globe Metallurgical Inc. v. United States, et. al., Consol. Court No. 07–00386, CIT Slip Opinion 09–37.
Ferrosilicon	Brazil China Kazakhstan Russia Ukraine Venezuela	7/1/89 – 12/31/93	CAFC	Sustained the CIT's determination in September 2008 that U.S. ferrosilicon producers were not materially injured by these imports. As a result, no antidumping rates would be assessed.	May 11	CAFC Appeal No. 2009–1007, Elkem Metals Co., et. al., v. United States, et. al., Consol. Court No. 99–00628, CIT Slip Opinion 08–92.

CAFC, U.S. Court of Appeals for the Federal Circuit. CIT, Court of International Trade. ITA, the International Trade Administration of the U.S. Department of Commerce.

TABLE 8

SILICON MATERIALS: PROJECTS SCHEDULED FOR COMPLETION, BY YEAREND 2013[1, 2, 3]

(Metric tons, gross weight, unless otherwise specified)

Projected year of first production	Country	Project and company	Project type	Incremental annual production capacity	Total annual production capacity	Silicon product[4]
2009	Brazil	Ferbasa Plant Cia de Ferro Ligas da Bahia (Ferbasa)	ferroalloys plant expansion	18,000	81,000	FeSi.
2009	China	ERDOS Qipanjing Plant ERDOS Group	do.	220,000 [e]	550,000	Do.
2010	Do.	do.	do.	100,000	650,000	Do.
2010	Do.	Henan Sunshine Silicon Plant Henan Sunshine Silicon Technology Development	silicon plant expansion	80,000	120,000	Si.
2010	Do.	Qinghai Wutong Plant Qinghai Wutong (Group) Industry Co., Ltd.	ferroalloys plant expansion	25,000	400,000	FeSi.
2010	Russia	Yurga Plant JSC[5] Kuznetsk Ferroalloys	do.	19,500	41,400	Do.
2011	Australia	Simcoa Silicon Plant Simcoa Operations Pty., Ltd.	silicon plant expansion	16,000	48,000	Si.
2011	China	Ferroatlantica Sichuan Silicon Plant Grupo Ferroatlántica, S.L.	new smelter	NA	50,000	Do.
2011	Do.	Qinghai Wutong Plant Qinghai Wutong (Group) Industry Co., Ltd.	ferroalloys plant expansion	25,000	450,000	FeSi.
2011	Russia	Yurga Plant JSC[5] Kuznetsk Ferroalloys	do.	41,400	80,000	Do.
2012	Australia	Simcoa Silicon Plant Simcoa Operations Pty., Ltd.	silicon plant expansion	16,000	64,000	Si.
2012	Zambia	Kafue Ferroalloys Plant Universal Mining and Chemical Industries Ltd. (Umcil)	new ferroalloys plant[6, 7]	NA	80,000	FeSi.
2013	China	Ferroatlántica Sichuan Silicon Plant Grupo Ferroatlántica, S.L.	new silicon smelter	50,000	100,000 [r]	Si.

[e]Estimated. [r]Revised. Do., do. Ditto. NA Not available.

[1]Estimated data are rounded to no more than three significant digits.

[2]Excludes silicon metal containing more than 99.99% silicon.

[3]Projects in feasibility or later stages of development in 2009. Actual startup dates may be postponed, owing to economic or other factors. Additional projects might produce silicon materials by 2014, but not enough information was available to include them.

[4]FeSi Ferrosilicon. Si Si metal (containing 99.99% or less Si).

[5]JSC joint-stock company.

[6]Plant also scheduled to produce ferromanganese and silicomanganese.

[7]Plant may also produce ferronickel.

Sources: Company annual reports, presentations, and press releases; unpublished personal communications; and trade publications.