

## SILICON

(Data in thousand metric tons of silicon content unless otherwise noted)

**Domestic Production and Use:** Estimated value of silicon alloys and metal produced in the United States in 2011 was \$1,400 million. Two companies produced silicon materials in seven plants east of the Mississippi River. Ferrosilicon and metallurgical-grade silicon metal were each produced in four plants. One company produced both products at two plants. Most ferrosilicon was consumed in the ferrous foundry and steel industries, predominantly in the eastern United States. The main consumers of silicon metal were producers of aluminum and aluminum alloys and the chemical industry. The semiconductor and solar industries, which manufacture chips for computers and photovoltaic cells from high-purity silicon, respectively, accounted for only a small percentage of silicon demand.

<b>Salient Statistics—United States:</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011<sup>e</sup></b>
Production:					
Ferrosilicon, all grades <sup>1</sup>	155	180	139	176	W
Silicon metal <sup>2</sup>	W	W	W	W	W
Total	W	W	W	W	350
Imports for consumption:					
Ferrosilicon, all grades <sup>1</sup>	208	190	70	157	150
Silicon metal	147	168	113	171	200
Exports:					
Ferrosilicon, all grades <sup>1</sup>	7	10	9	15	20
Silicon metal	28	35	38	65	82
Consumption, apparent:					
Ferrosilicon, all grades <sup>1</sup>	359	352	207	312	W
Silicon metal <sup>2</sup>	W	W	W	W	W
Total	W	W	W	W	600
Price, <sup>3</sup> average, cents per pound Si:					
Ferrosilicon, 50% Si	74.0	116	76.9	109	110
Ferrosilicon, 75% Si	65.6	109	68.9	97.2	100
Silicon metal <sup>2</sup>	113	162	116	140	150
Stocks, producer, yearend:					
Ferrosilicon, all grades <sup>1</sup>	14	21	14	20	W
Silicon metal <sup>2</sup>	W	W	W	W	W
Total	W	W	W	W	23
Net import reliance <sup>4</sup> as a percentage of apparent consumption:					
Ferrosilicon, all grades <sup>1</sup>	58	49	33	44	<50
Silicon metal <sup>2</sup>	<50	<50	<50	<50	<50
Total	W	W	W	W	42

**Recycling:** Insignificant.

**Import Sources (2007–10):** Ferrosilicon: China, 41%; Russia, 33%; Venezuela, 13%; Canada, 9%; and other, 4%. Silicon metal: Brazil, 39%; South Africa, 22%; Canada, 13%; Australia, 10%; and other, 16%. Total: China, 22%; Brazil, 20%; Russia, 17%; Canada, 11%; and other, 30%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12-31-11</b>
Silicon, more than 99.99% Si	2804.61.0000	Free.
Silicon, 99.00%–99.99% Si	2804.69.1000	5.3% ad val.
Silicon, other	2804.69.5000	5.5% ad val.
Ferrosilicon, 55%–80% Si:		
More than 3% Ca	7202.21.1000	1.1% ad val.
Other	7202.21.5000	1.5% ad val.
Ferrosilicon, 80%–90% Si	7202.21.7500	1.9% ad val.
Ferrosilicon, more than 90% Si	7202.21.9000	5.8% ad val.
Ferrosilicon, other:		
More than 2% Mg	7202.29.0010	Free.
Other	7202.29.0050	Free.

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**Depletion Allowance:** Quartzite, 14% (Domestic and foreign); gravel, 5% (Domestic and foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** The number of ferrosilicon producers in the United States fell from three to two during 2011, as one of the existing companies acquired another. As a result, U.S. ferrosilicon statistics have been withheld to avoid disclosing company proprietary data, and domestic ferrosilicon and silicon metal statistics have been aggregated. Annual average U.S. ferrosilicon spot market prices increased only slightly in 2011 from those of 2010 despite increased domestic steel production, as competition for ferrosilicon business increased and costs for replacing Chinese ferrosilicon decreased.

Demand for silicon metal comes primarily from the aluminum and chemical industries. Domestic secondary aluminum production—the primary materials source for aluminum-silicon alloys—was projected to increase by 12% in 2011 compared with that in 2010. Domestic chemical production was projected to increase by 3% in 2011.

World production of silicon materials increased in 2011 compared with that in 2011, mainly as a result of ferrosilicon and silicon smelter expansions, particularly in China. One ferrosilicon plant in the Inner Mongolia Autonomous Region of China added about 350,000 tons of production capacity in 2011, making it the largest plant of its kind at 1,000,000 tons of capacity (gross weight). About 180,000 tons of production capacity (gross weight) was added to the global silicon industry via plant expansions in Australia, China, Kazakhstan, Russia, and Thailand.

### World Production and Reserves:

	Production <sup>e, 5</sup>		Reserves <sup>6</sup>
	2010	2011	
United States	<sup>7</sup> 176	350	The reserves in most major producing countries are ample in relation to demand. Quantitative estimates are not available.
Brazil	224	230	
Canada	52	52	
China	4,920	5,400	
France	127	140	
Iceland	74	75	
India <sup>7</sup>	66	68	
Norway	303	320	
Russia	643	670	
South Africa	137	130	
Ukraine <sup>7</sup>	127	100	
Venezuela <sup>7</sup>	50	62	
Other countries	<u>394</u>	<u>400</u>	
World total (rounded)	7,290	8,000	

Ferrosilicon accounts for about four-fifths of world silicon production (gross-weight basis). The leading countries for ferrosilicon production, in descending order, were China, Russia, the United States, Norway, and Ukraine, and for silicon metal production were China, the United States, Norway, Brazil, and France. China was by far the leading producer of both ferrosilicon (5,800,000 tons) and silicon metal (1,650,000 tons) in 2011.

**World Resources:** World and domestic resources for making silicon metal and alloys are abundant and, in most producing countries, adequate to supply world requirements for many decades. The source of the silicon is silica in various natural forms, such as quartzite.

**Substitutes:** Aluminum, silicon carbide, and silicomanganese can be substituted for ferrosilicon in some applications. Gallium arsenide and germanium are the principal substitutes for silicon in semiconductor and infrared applications.

<sup>e</sup>Estimated. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Ferrosilicon grades include the two standard grades of ferrosilicon—50% and 75% silicon—plus miscellaneous silicon alloys.

<sup>2</sup>Metallurgical-grade silicon metal.

<sup>3</sup>Based on U.S. dealer import price.

<sup>4</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

<sup>5</sup>Production quantities are combined totals of estimated silicon content for ferrosilicon and silicon metal, as applicable, except as noted.

<sup>6</sup>See Appendix C for resource/reserve definitions and information concerning data sources.

<sup>7</sup>Ferrosilicon only.