

## SILICON

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

**Domestic Production and Use:** Six companies produced silicon materials at eight plants, all east of the Mississippi River. Most ferrosilicon was consumed in the ferrous foundry and steel industries, predominantly in the Eastern United States, and was sourced primarily from domestic quartzite (silica). The main consumers of silicon metal were producers of aluminum alloys and the chemical industry. The semiconductor and solar energy 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>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018<sup>e</sup></b>
Production:					
Ferrosilicon and silicon metal <sup>1,2</sup>	401	411	384	415	430
Imports for consumption:					
Ferrosilicon, all grades <sup>1</sup>	186	162	155	147	158
Silicon metal	139	140	122	136	118
Exports:					
Ferrosilicon, all grades <sup>1</sup>	9	9	7	11	12
Silicon metal	45	37	60	71	41
Consumption, apparent: <sup>3</sup>					
Ferrosilicon, all grades <sup>1</sup>	W	W	W	W	W
Silicon metal <sup>2</sup>	W	W	W	W	W
Total	670	661	601	616	660
Price, average, cents per pound of silicon:					
Ferrosilicon, 50% Si <sup>4</sup>	108	101	83	94	104
Ferrosilicon, 75% Si <sup>5</sup>	98	88	71	87	108
Silicon metal <sup>2,5</sup>	140	127	91	117	138
Stocks, producer, yearend:					
Ferrosilicon and metal <sup>1,2</sup>	27	33	26	26	25
Net import reliance <sup>6</sup> as a percentage of apparent consumption:					
Ferrosilicon, all grades <sup>1</sup>	<50	>50	>50	<50	<50
Silicon metal <sup>2</sup>	<50	<50	<50	<50	<50
Total	42	38	36	33	34

**Recycling:** Insignificant.

**Import Sources (2014–17):** Ferrosilicon: Russia, 35%; China, 20%; Canada, 12%; Iceland, 7%; and other, 26%. Silicon metal: Brazil, 28%; South Africa, 18%; Canada, 15%; Australia, 14%; and other, 25%. Total: Russia, 19%; Brazil, 16%; Canada, 14%; China, 11%; and other, 40%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–18</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:** Combined domestic ferrosilicon and silicon metal production in 2018, expressed in terms of contained silicon, increased from that of 2017. Domestic production during the first 9 months of 2018 was about 7% greater than that during the same period in 2017. By September 2018, average U.S. ferrosilicon spot market prices had increased by 11% and 25% for 50%-grade and 75%-grade ferrosilicon, respectively, and the average silicon metal spot market price had increased by 19% compared with the annual average spot price in 2017.

Excluding the United States, ferrosilicon accounted for about 62% of world silicon production on a silicon-content basis. The leading countries for ferrosilicon production were, in descending order and on a contained-weight basis, China, Russia, and Norway. For silicon metal, the leading producers were China, Norway, and Brazil. China accounted for approximately 60% of total global estimated production of silicon materials in 2018.

### World Production and Reserves:

	Production <sup>6, 7</sup>		Reserves <sup>8</sup>
	2017	2018	
United States	415	430	The reserves in most major producing countries are ample in relation to demand. Quantitative estimates are not available.
Bhutan <sup>9</sup>	55	65	
Brazil	170	190	
Canada	54	54	
China	4,000	4,000	
France	126	130	
Iceland <sup>9</sup>	76	76	
India <sup>9</sup>	59	62	
Malaysia <sup>9</sup>	113	140	
Norway	375	380	
Russia	670	670	
South Africa	65	65	
Spain	69	69	
Ukraine <sup>9</sup>	60	52	
Other countries	274	300	
World total (rounded)	6,580	6,700	

**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>6</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>Defined as production + imports – exports + adjustments for industry stock changes.

<sup>4</sup>CRU Group transaction prices based on weekly averages.

<sup>5</sup>S&P Global Platts mean import prices based on monthly averages.

<sup>6</sup>Defined as imports – exports + adjustments for industry stock changes.

<sup>7</sup>Production quantities are the silicon content of combined totals for ferrosilicon and silicon metal, except as noted.

<sup>8</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>9</sup>Silicon content of ferrosilicon only.