

## SILICON

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

**Domestic Production and Use:** Six companies produced silicon materials at seven 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, also consumed silicon metal.

<b>Salient Statistics—United States:</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019<sup>e</sup></b>
Production:					
Ferrosilicon and silicon metal <sup>1,2</sup>	411	384	415	430	320
Imports for consumption:					
Ferrosilicon, all grades <sup>1</sup>	162	155	147	140	140
Silicon metal	140	122	136	116	130
Exports:					
Ferrosilicon, all grades <sup>1</sup>	9	7	11	12	10
Silicon metal	37	60	71	45	40
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	661	601	616	637	560
Price, average, cents per pound of silicon:					
Ferrosilicon, 50% Si <sup>4</sup>	101	83	94	104	100
Ferrosilicon, 75% Si <sup>5</sup>	88	71	87	108	93
Silicon metal <sup>2,5</sup>	127	91	117	134	110
Stocks, producer, yearend:					
Ferrosilicon and metal <sup>1,2</sup>	33	26	26	19	20
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	38	36	33	32	41

**Recycling:** Insignificant.

**Import Sources (2015–18):** Ferrosilicon: Russia, 38%; Canada, 13%; China, 13%; Brazil, 8%; and other, 28%. Silicon metal: Brazil, 28%; Canada, 18%; and other, 54%. Total: Russia, 20%; Brazil, 17%; Canada, 15%; and other, 48%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–19</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 2019, expressed in terms of contained silicon, decreased from that of 2018. One producer idled a silicon metal production facility at the end of 2018 to consolidate operations and respond to reduced demand. Domestic production during the first 9 months of 2019 was about 19% less, on a gross-weight basis, than that during the same period in 2018. By September 2019, average U.S. ferrosilicon spot market prices had decreased slightly for 50%-grade ferrosilicon and by 14% for 75%-grade ferrosilicon compared with the annual average spot price in 2018. The average silicon metal spot market price had decreased by 18% compared with the annual average spot price in 2018. Oversupply in the market combined with decreased demand from ferrosilicon and silicon metal consumers contributed to declining prices in 2019.

Excluding the United States, ferrosilicon accounted for about 55% of world silicon production on a silicon-content basis in 2019. Global production for 2018 was revised from the previous year's publication owing to increases in the estimates for production from China. 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 64% of total global estimated production of silicon materials in 2019.

### World Production and Reserves:

	Production <sup>e, 7</sup>		Reserves <sup>8</sup>
	2018	2019	
United States	430	320	The reserves in most major producing countries are ample in relation to demand. Quantitative estimates are not available.
Bhutan <sup>9</sup>	90	90	
Brazil	220	210	
Canada	57	60	
China	4,800	4,500	
France	140	140	
Iceland	83	80	
India <sup>9</sup>	57	60	
Malaysia <sup>9</sup>	140	150	
Norway	370	370	
Poland <sup>9</sup>	43	36	
Russia	600	600	
Spain	69	70	
Ukraine <sup>9</sup>	49	50	
Other countries	290	290	
World total (rounded)	7,400	7,000	

**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>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.