

IRON AND STEEL SLAG

(Data in million metric tons unless otherwise noted)

Domestic Production and Use: Ferrous slags are coproducts of iron- and steelmaking and are sold primarily to the construction industry. Data on U.S. slag production are unavailable, but it is estimated to have been in the range of 17 to 22 million tons in 2012. Sales improved modestly but remained constrained by continued low levels of construction spending, particularly in the public sector. An estimated 16 million tons of iron and steel slag, valued at about \$270 million¹ (f.o.b. plant), was sold in 2012. Iron (blast furnace) slag accounted for about 50% of the tonnage sold and had a value of about \$250 million; nearly 85% of this value was granulated slag. Steel slag produced from basic oxygen and electric arc furnaces accounted for the remainder.² Slag was processed by nearly 30 companies servicing active iron and (or) steel facilities or reprocessing old slag piles at about 120 sites in 32 States; included in this tally are a number of facilities that grind and sell ground granulated blast furnace slag (GGBFS) based on imported unground feed.

The prices listed in the table below are weighted, rounded averages for iron and steel slags sold for a variety of applications. Actual prices per ton ranged widely in 2012 from a few cents for some steel slags at a few locations to about \$100 for some GGBFS. Air-cooled iron slag and steel slag are mainly used as aggregates in concrete (air-cooled iron slag only), asphaltic paving, fill, and road bases; both slag types also are used as a feed for cement kilns. Almost all GGBFS is used as a partial substitute for portland cement in concrete mixes or in blended cements. Pelletized slag is generally used for lightweight aggregate but can be ground into material similar to GGBFS. Owing to their low unit values, most slag types can be shipped by truck only over short distances, but rail and waterborne transportation can be longer. The much higher unit value of GGBFS allows this slag to be shipped economically over longer distances.

Salient Statistics—United States:	2008	2009	2010	2011	2012^e
Production, marketed ^{1, 3}	18.8	12.5	15.8	15.4	16.0
Imports for consumption ⁴	1.3	1.3	1.4	1.5	1.6
Exports	(5)	(5)	0.1	(5)	0.1
Consumption, apparent ^{4, 6}	18.8	12.5	15.8	15.4	16.0
Price average value, dollars per ton, f.o.b. plant	18.00	19.00	17.00	16.50	17.00
Stocks, yearend	NA	NA	NA	NA	NA
Employment, number ^e	2,100	2,000	2,100	2,000	1,800
Net import reliance ⁷ as a percentage of apparent consumption	7	10	8	9	9

Recycling: Slag is commonly returned to the blast and steel furnaces as ferrous and flux feed, but data on these returns are incomplete. Entrained metal, particularly in steel slag, is routinely recovered during slag processing for return to the furnaces, but data on metal returns are unavailable.

Import Sources (2008–11): Granulated blast furnace slag (mostly unground) is the dominant type of ferrous slag imported, but official import data include significant tonnages of nonslag materials (such as cenospheres, fly ash, and silica fume) and slags or other residues of various metallurgical industries (such as copper slag) whose unit values are outside the range expected for granulated slag. The official data appear to have underreported the granulated slag imports in some recent years, but likely not in 2011. Based on official data, the principal country sources for 2008–11 were Japan, 43%; Canada, 37%; Italy, 8%; South Africa, 7%; and other, 5%.

Tariff:	Item	Number	Normal Trade Relations
			12–31–12
	Granulated slag	2618.00.0000	Free.
	Slag, dross, scale, from manufacture of iron and steel	2619.00.3000	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

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Events, Trends, and Issues: Blast furnace slag availability overall is becoming increasingly constrained by the general decline in recent years in the number of active U.S. blast furnaces (with three closing in 2012, perhaps permanently), the lack of construction of new furnaces, and the depletion of old slag piles. At yearend 2012, granulation cooling was installed at only three active blast furnaces but was being evaluated for installation at other sites, contingent on the sites remaining active. Pelletized blast furnace slag was in very limited supply, but it was uncertain if any additional pelletizing capacity was being planned. Production of basic oxygen furnace steel slag from integrated iron and steel works has increased recently as some previously idled steel furnaces were restarted, but slag availability for the construction market remained constrained by significant volumes of slag being returned to the furnaces and by the uncertain fate of the blast furnaces. Slag from electric arc steel furnaces (largely fed with steel scrap) remains relatively abundant. Where slag availability has not been a problem, slag (as aggregate) sales to the construction sector have sometimes been less volatile than those of natural aggregates or of cement. In contrast, sales of GGBFS have trended more in line with those of cement, but, for both environmental and performance reasons, this slag's share of the cementitious material market has increased in recent years, although it remains a very small share. Sales prices for GGBFS remain lower than those for portland cement; however, the differences have become small owing to significant declines in cement prices in recent years. Draft regulations released in 2009–11 to restrict emissions (especially of mercury) by U.S. cement plants and to reclassify fly ash as a hazardous waste for disposal purposes have the potential to reduce the supply of these cementitious materials to the U.S. market and could lead to an increase in demand for GGBFS. Long-term growth in the supply of GGBFS will mainly depend on imports, either of ground or unground material.

World Mine Production and Reserves: Slag is not a mined material and thus the concept of reserves does not apply to this mineral commodity. Slag production data for the world are unavailable, but it is estimated that annual world iron slag output in 2012 was on the order of 270 to 320 million tons, and steel slag about 150 to 230 million tons, based on typical ratios of slag to crude iron and steel output.

World Resources: Not applicable.

Substitutes: Slag competes with crushed stone and sand and gravel as aggregates in the construction sector. Fly ash, natural pozzolans, and silica fume are common alternatives to GGBFS as cementitious additives in blended cements and concrete. Slags (especially steel slag) can be used as a partial substitute for limestone and some other natural (rock) materials as raw material for clinker (cement) manufacture. Some other metallurgical slags, such as copper slag, can compete with ferrous slags in some specialty markets but are generally in much more restricted supply than ferrous slags.

⁰Estimated. NA Not available.

¹The data (obtained from an annual survey of slag processors) pertain to the quantities of processed slag sold rather than that processed or produced during the year. The data exclude any entrained metal that may be recovered during slag processing and returned to iron and, especially, steel furnaces, and are incomplete regarding slag returns to the furnaces.

²There were very minor sales of open hearth furnace steel slag from stockpiles but no domestic production of this slag type in 2008–12.

³Data include sales of imported granulated blast furnace slag, either after domestic grinding or still unground, and exclude sales of pelletized slag (proprietary but very small). Overall, actual production of blast furnace slag may be estimated as equivalent to 25% to 30% of crude (pig) iron production and steel furnace slag as about 10% to 15% of crude steel output.

⁴Comparison of official (U.S. Census Bureau) with unofficial import data suggest that the official data may have understated the true imports of granulated slag, at least prior to 2010, by amounts up to about 1 million tons per year. The USGS canvass appears to capture only part of the imported slag.

⁵Less than 0.05 million metric tons.

⁶Although definable as total sales of slag (including those from imported feed) minus exports, apparent consumption of slag does not significantly differ from total sales owing to the very small export tonnages.

⁷Defined as total imports of slag minus exports of slag. Data are not available to allow adjustments for changes in stocks.