

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 marketed primarily to the construction center. Data on U.S. slag production are unavailable, but it is estimated to have been in the range of 16 to 21 million tons in 2011. Sales improved owing largely to greater slag availability but remained constrained by continued low levels of construction spending. An estimated 17 million tons of iron and steel slag, valued at about \$290 million¹ (f.o.b. plant), was sold in 2011. 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 2011 from a few cents for some steel slags at a few locations to about \$100 for some GGBFS. The major uses of air-cooled iron slag and for steel slag are as aggregates for asphaltic paving, fill, and road bases and as a feed for cement kilns; air-cooled slag also is used as an aggregate for concrete. 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:	2007	2008	2009	2010	2011^e
Production, marketed ^{1, 3}	19.6	18.8	12.5	15.7	17.0
Imports for consumption ⁴	1.9	1.3	1.3	1.4	1.5
Exports	0.1	(5)	(5)	0.1	0.1
Consumption, apparent ^{4, 6}	19.6	18.8	12.5	15.7	16.9
Price average value, dollars per ton, f.o.b. plant	22.00	18.00	19.00	17.00	17.00
Stocks, yearend	NA	NA	NA	NA	NA
Employment, number ^e	2,200	2,100	2,000	2,100	2,100
Net import reliance ⁷ as a percentage of apparent consumption	9	7	10	8	8

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 (2007–10): Granulated blast furnace slag (mostly unground) is the dominant type of ferrous slag imported, but official import data show significant year-to-year variations in tonnage and unit value and commonly include some shipments of industrial residues other than ferrous slags (such as fly ash, silica fume, and cenospheres) or of slags of other metallurgical industries. Furthermore, the official data in recent years appear to underrepresent true import levels of granulated slag. Based on official data, the principal country sources for 2007–10 were Japan, 47%; Canada, 35%; South Africa, 7%; Italy, 7%; and other, 4%.

Tariff:	Item	Number	Normal Trade Relations
			12-31-11
	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 constrained by the general decline in recent years in the number of active U.S. blast furnaces, the lack of construction of new furnaces, and the depletion of old slag piles. Granulation cooling is currently installed at only four active blast furnaces but is being evaluated for installation at other sites, contingent on the sites remaining active. Pelletized blast furnace slag is in very limited supply, but it is uncertain if any additional pelletizing capacity is being planned. Production of basic oxygen furnace steel slag from integrated iron and steel works has increased recently as some previously idled furnaces have been restarted, but slag availability for the market remains constrained by significant volumes of slag being returned to the 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 tended to be 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, there has been a general growth in this slag's share of the cementitious material market in recent years, albeit still at a very small percentage of the total. Although sales prices for GGBFS remain lower than those for portland cement, the differences have become small owing to significant declines in cement prices in recent years. Draft regulations released in 2009–10 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 thus could lead to an increase in demand for GGBFS. Long-term growth in the supply of GGBFS is likely to hinge 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 2011 was on the order of 260 to 310 million tons, and steel slag about 130 to 210 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 2006–10.

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 significantly understate the true imports of granulated slag. The USGS canvass appears to capture only part of the imported slag. Thus the apparent consumption statistics are likely too low by about 0.1 to 1.3 million tons per year for the range of years listed.

⁵Less than ½ unit.

⁶Defined as total sales of slag (includes that from imported feed) minus exports. Calculation is based on unrounded original data.

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