IRON AND STEEL SLAG

(Data in million metric tons unless otherwise noted)

Domestic Production and Use: Ferrous slags are coproducts of the making of iron and steel and, after cooling and processing, are sold primarily to the construction industry. Data are unavailable on actual U.S. slag production, but it is estimated to have been in the range of 16 to 22 million tons in 2015. Domestic slag sales[1] in 2015 amounted to an estimated 17 million tons, valued at about $330 million (ex-plant). Iron (blast furnace) slag accounted for about 47% of the tonnage sold and had a value of about $260 million; nearly 90% of this value was from sales of granulated slag. Steel slag produced from basic oxygen and electric arc furnaces accounted for the remainder.[2] Slag was processed by about 25 companies servicing active iron and steel facilities or reprocessing old slag piles at about 140 processing plants 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, but rounded, averages for iron and steel slags sold for a variety of applications. Actual prices per ton ranged widely in 2015, from a few cents for some steel slags at a few locations to about $110 for some GGBFS. Air-cooled iron slag and steel slag are used primarily as aggregates in concrete (air-cooled iron slag only), asphaltic paving, fill, and road bases; both slag types also can be 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 low unit values, most slag types can be shipped only short distances by truck, but rail and waterborne transportation allow for greater distances. Because of much higher unit values, GGBFS can be shipped longer distances, including from overseas.

Salient Statistics—United States:	**2011**	**2012**	**2013**	**2014**	**2015[e]**
Production, marketed[1, 3]	15.4	16.0	15.5	16.6	17.0
Imports for consumption[4]	1.6	1.2	1.7	1.8	1.9
Exports	(5)	(5)	(5)	0.1	0.1
Consumption, apparent[4, 6]	15.4	16.0	15.5	16.5	16.9
Price average value, dollars per ton, f.o.b. plant[7]	17.00	17.00	17.50	19.00	19.50
Employment, number[e]	2,000	1,800	1,700	1,700	1,700
Net import reliance[8] as a percentage of apparent consumption	9	7	11	10	11

Recycling: Slag, after metal removal, can be 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, and is an important revenue source for the slag processors, but data on metal returns are unavailable.

Import Sources (2011–14): The dominant imported ferrous slag type is granulated blast furnace slag (mostly unground), but official import data in some years 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 2011–12. Based on official data, the principal country sources for 2011–14 were Canada, 35%; Japan, 32%; Spain, 12%; Italy, 5%, and other, 16%; however, much of the tonnage from Spain in 2013–14 may in fact be from Italy.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–15**
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: The supply of blast furnace slag overall is becoming problematic in the United States because of the closure and (or) continued idling of a number of active U.S. blast furnaces in recent years, including one in 2015, the lack of construction of new furnaces, and the depletion of old slag piles. Likewise, only a limited quantity of locally produced granulated blast furnace slag was available. At yearend 2015, granulation cooling was available at only two active U.S. blast furnaces, down from three in 2014. Other blast furnaces were being evaluated for the installation of granulators, but it was unclear if this would be economic. Pelletized blast furnace slag was in very limited supply (one site only), and it was uncertain if any additional pelletizing capacity was being planned. Basic oxygen furnace steel slag from domestic furnaces has become less available recently because of the closure of several integrated iron and steel complexes; thus, the long-term supply of steel slag will be increasingly reliant on electric arc furnaces. 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. Domestic- and import-supply constraints appear to have limited the domestic demand for GGBFS in recent years, and sales have failed to match the relative volume and price increases that have characterized the overall U.S. cement market since 2010. Long-term demand for GGBFS likely will increase because its use in concrete yields a superior product in many applications and reduces the unit carbon dioxide (CO_2) emissions footprint of the concrete related to the portland cement (clinker) content. Recent regulations to restrict emissions of CO_2 and mercury by coal-fired powerplants, together with the plant closures or switchover at many powerplants to lower-cost natural gas, have led to a reduction in the supply of fly ash in some areas, including that of material for use as cementitious additive for concrete. This has the potential to increase future demand for GGBFS, but the availability of material to satisfy this demand will increasingly depend on imports, either of ground or unground material. Imports may be constrained because of increasing international demand for the same material and because not all granulated slag produced overseas is of high quality. New restrictions on mercury emissions by cement plants may reduce demand for fly ash as a raw material for clinker manufacture, and this could lead to use of air-cooled and steel slags as replacement raw materials.

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 global iron slag output in 2015 was on the order of 300 to 360 million tons, and steel slag about 170 to 250 million tons, based on typical ratios of slag to crude iron and steel output.

World Resources: Not applicable.

Substitutes: In the construction sector, ferrous slags compete with crushed stone and sand and gravel as aggregates, but are far less widely available than the natural materials. As a cementitious additive in blended cements and concrete, GGBFS mainly competes with fly ash, metakaolin, and volcanic ash pozzolans, and to a lesser degree with silica fume. In this respect, GGBFS also competes with portland cement itself. Slags (especially steel slag) can be used as a partial substitute for limestone and some other natural raw materials for clinker (cement) manufacture. Some other metallurgical slags, such as copper slag, can compete with ferrous slags in some specialty markets, but they are generally in much more restricted supply than ferrous slags.

[e]Estimated.

[1]Data are from an annual survey of slag processors and 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.

[2]There were very minor sales of open hearth furnace steel slag from stockpiles but no domestic production of this slag type in 2011–15.

[3]Data 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.

[4]Based on official (U.S. Census Bureau) data. In some years, the official data appear to have understated the true imports; the apparent discrepancy was small for 2011–12, but may have been nearly 0.4 million tons in 2013 and 2014, depending on whether imports from Italy were mischaracterized as being from Spain or not. The U.S. Geological Survey canvass captures only part of the imported slag.

[5]Less than 0.05 million tons.

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

[7]Rounded to the nearest $1.00 per metric ton; component data include a large proportion of estimates.

[8]Defined as total imports of slag – exports of slag.