IRON AND STEEL SLAG

(Data in million metric tons unless otherwise noted)

Domestic Production and Use: Iron and steel (ferrous) slags are formed by the combination of slagging agents and impurities during the production of crude (or pig) iron and crude steel. The slags are tapped separately from the metals, then cooled and processed, and are primarily used in the construction industry. Data were unavailable on actual U.S. ferrous slag production, but domestic slag sales[1] in 2022 were estimated to be 15 million tons valued at about $795 million. Blast furnace slag was about 49% of the tonnage sold and accounted for 87% of the total value of slag, most of which was granulated. Steel slag produced from basic oxygen and electric arc furnaces accounted for the remainder of sales. Slag was processed by 25 companies servicing active iron and steel facilities or reprocessing old slag piles at about 123 processing plants (including some iron and steel plants with more than one slag-processing facility) in 33 States, including facilities that import and grind unground slag to sell as ground granulated blast furnace slag (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. Actual prices per ton ranged from a few cents for some steel slags at a few locations to about $120 or more for some GGBFS in 2022. Owing to low unit values, most slag types can be shipped only short distances by truck, but rail and waterborne transportation allow for greater travel distances. Because much higher unit values make it economical to ship GGBFS longer distances, much of the GGBFS consumed in the United States is imported.

Salient Statistics—United States:	**2018**	**2019**	**2020**	**2021**	**2022[e]**
Production (sales)[e, 1, 2]	16.8	16.3	13.4	15.7	15
Imports for consumption[e, 3]	2.6	2.1	2.3	2.4	2.0
Exports	(4)	(4)	(4)	(4)	(4)
Consumption, apparent[e, 5]	17	16	13	16	15
Price, average unit value, free on board plant, dollars per metric ton[6]	26.50	28.50	31.00	40.50	53
Employment, number[e]	1,500	1,500	1,500	1,500	1,500
Net import reliance[7] as a percentage of apparent consumption	13	10	14	15	13

Recycling: Following removal of entrained metal, slag 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 slag processors; data on metal returns are unavailable.

Import Sources (2018–21): Japan, 46%; Brazil, 17%; China, 15%; and other, 22%.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–22**
Granulated slag	2618.00.0000	Free.
Slag, dross, scalings, and other waste from manufacture of iron and steel:		
Ferrous scale	2619.00.3000	Free.
Other	2619.00.9000	Free.

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Depletion Allowance: Not applicable.

Government Stockpile: None.

Events, Trends, and Issues: The availability of steel slag is tied closely to the rates of raw steel production and the cost consideration of recovering slag for use in low-value downstream applications. The majority of U.S. steel slag production is from electric arc furnaces, which accounted for an estimated 72% of U.S. steel production in 2022 owing to the overall cost advantages of environmental factors, such as less feedstock and power consumption and the price and availability of ferrous scrap feedstock. In recent years, the percentage of basic oxygen furnace steel production has continued to decline as capacity has idled or closed; however, slag stockpiling at furnaces allows for processing of slag for years after closures. The World Steel Association[8] forecast global finished steel consumption to decrease by 2.3% in 2022 and increase by 1.0% in 2023. The U.S. iron and steel industry produced raw steel in 2022 with an estimated value of about $132 billion, a 13% increase from $118 billion in 2021. Pig iron production in the United States was estimated to have decreased by 5% to 21 million tons in 2022 from 22.2 million tons in 2021.

During 2022, domestic GGBFS remained in limited supply because granulation cooling was known to be available at only two active U.S. blast furnaces while, elsewhere, only one domestic plant produced pelletized slag in limited supply. Grinding of granulated blast furnace slag was only done domestically by cement companies.

The domestic supply of fly ash, which is used as an additive in concrete production, rebounded from low production levels in 2020; however, supply remained constrained and was expected to decrease in upcoming years owing to restrictions of mercury and carbon dioxide (CO_2) emissions at coal-fired powerplants, powerplant closures, and conversion of powerplants to natural gas. Demand for GGBFS is likely to increase because its use in cement yields a beneficial product in many applications and reduces the unit CO_2 emissions in the production of the cement.

World Production and Reserves: Because slag is not mined, the concept of reserves does not apply. World production data for slag were not available, but iron slag from blast furnaces may be estimated to be 25% to 30% of crude (pig) iron production, and steel furnace slag may be estimated to be 10% to 15% of raw steel production. In 2022, world iron slag production was estimated to be between 330 million and 390 million tons, and steel slag production was estimated to be between 190 million and 290 million tons.

World Resources: Not applicable.

Substitutes: In the construction sector, ferrous slags compete with natural aggregates (crushed stone and construction sand and gravel) 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. In this respect, GGBFS reduces the amount of portland cement per ton of concrete, thus allowing more concrete to be made per ton of portland cement. Slags (especially steel slag) can be used as a partial substitute for limestone and some other natural raw materials for clinker (cement) manufacture and compete in this use with fly ash and bottom ash. Some other metallurgical slags, such as copper slag, can compete with ferrous slags in some specialty markets, such as a ferrous feed in clinker manufacture, but are generally in much more restricted supply than ferrous slags.

[e]Estimated.

[1]Processed slag sold during the year, excluding entrained metal.

[2]Data include sales of domestic and imported granulated blast furnace slag and exclude sales of pelletized slag.

[3]U.S. Census Bureau data adjusted by the U.S. Geological Survey to remove nonslag materials (such as cenospheres, fly ash, and silica fume) and slags or other residues of other metallurgical industries (especially copper slag), whose unit values are outside the range expected for granulated slag. In some years, tonnages may be underreported.

[4]Less than 50,000 tons.

[5]Defined as sales – exports.

[6]Rounded to the nearest $0.50 per ton.

[7]Defined as imports – exports.

[8]Source: World Steel Association, 2022, Short range outlook October 2022: Brussels, Belgium, World Steel Association press release, October 19, 6 p.