

Emission Trends in Metals Production

Greenhouse Gas Reporting Program (GHGRP) emissions reported for the metals sector decreased significantly from 112 million metric tons (MMT) CO₂e in 2011 to 82 MMT CO₂e in 2021, a decrease of 27 percent. Reported emissions decreased steadily between 2011 and 2016, with the largest decrease occurring in 2015 (13%). Emissions have remained below 2014 levels in recent years. Annual emissions from the metals sector decreased in 2016 to 88 MMT CO₂e, and then increased slightly in 2017 (89 MMT CO₂e) and 2018 (92 MMT CO₂e). Emissions then decreased again in 2019 and 2020. Emissions in 2020 were 12 MMT CO₂e (13%) lower than 2019. Metals production experienced decreased demand from the manufacturing industry related to impacts of the COVID-19 pandemic. [1] Capacity utilization within primary metal manufacturing (NAICS codes beginning with 331) declined each month from January through May 2020 (from 72% to 52%) and then began to gradually recover through December of that year to 67 percent. This recovery continued in 2021, reaching a peak of 76 percent in October. [2] Emissions in 2021 were 82.4 MMT CO₂e, representing a 6 percent increase over 2020.

Iron and Steel Production. Iron and steel production are responsible for approximately 80 percent of the reported emissions in the metals sector. Steel production is closely tied to economic conditions and can vary from year to year, with corresponding fluctuations in emissions. Since 2011, iron production has declined while steel production has remained relatively stable. The decrease in reported emissions for this industry can also be attributed to restructuring of the industry, technological improvements, and increased scrap steel utilization. [3] The number of reporters in the iron and steel subsector also decreased during this period from 129 facilities in 2011 to 121 facilities in 2021. Consistent with the trends across the metals sector, there was an anomalous decrease in production and emissions for iron and steel in 2020. In 2020, production of pig iron and raw steel decreased by 18 percent and 17 percent from 2019, respectively, while CO₂e emissions across both iron and steel decreased by 10.0 MMT (14 percent). In 2021, production nearly returned to 2019 levels and CO₂e emissions increased by 4.1 MMT (6.6 percent) from 62.2 MMT to 66.3 MMT.

Emission Source	Annual Production (million metric tons)[4]										
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Pig Iron Production	30.2	30.1	30.3	29.4	26	22.3	22.4	24.1	22.3	18.3	22
Raw Steel Production	86.4	88.7	86.9	88.2	78.8	78.5	81.6	86.6	87.8	72.7	87
Sector	Annual Emissions Total (MMT CO ₂ e)										
Iron and Steel Production	89.2	84.0	84.0	82.9	71.3	70.6	71.9	73.7	72.2	62.2	66.3

Aluminum Production. For 2021, aluminum production accounts for 3.6 percent of the total CO₂e emissions reported for the metals sector. Emissions reported for this subsector have decreased from a high of 7.3 MMT CO₂e in 2011 to a low of 2.7 MMT CO₂e in 2017. In 2018 and 2019, emissions steadily increased to 3.4 MMT CO₂e and 3.8 MMT CO₂e, respectively. From 2019 to 2021, reported emissions decreased by approximately 24 percent to 2.9 MMT CO₂e. The decrease in reported emissions from 2011 to 2017 was due to industry emission reduction efforts and lower aluminum production. [3] The increases in emissions reported in 2018 and 2019 are likely due to increased aluminum production resulting from improved market conditions for U.S. aluminum plants. After declining each year since 2012, primary aluminum production increased in 2018 and 2019 by 20 percent and 23 percent, respectively. [5] Primary aluminum production facilities were exempted from COVID-19 lockdown orders, but manufacturers consuming aluminum shut down or reduced production starting in March 2020 in response to the COVID-19 pandemic. [5] This resulted in a 7.4% decrease in 2020 primary aluminum production from 2019 levels. [6] In 2021, primary production decreased by 13 percent due to reduced smelter operation. [6]

Ferroalloy, Lead, Magnesium, and Zinc. Ferroalloy, lead, magnesium, and zinc production account for about 5.1 percent of the total CO₂e emissions reported for the metals sector in 2021. The combined emissions reported for the ferroalloy, lead, magnesium, and zinc subsectors have decreased from 6.1 MT CO₂e in 2011 to 4.2 MMT CO₂e in 2021. The largest reduction was in the magnesium production subsector, which decreased by approximately 720,000 MT CO₂e (about 40 percent). The reduction in emissions for the ferroalloy, lead, magnesium, and zinc subsectors is partly due to industry emission reduction efforts and an overall decrease in the number of reporters, which decreased from 38 in 2011 to 33 in 2021. The emissions in 2021 were about 3.9 percent higher than reported in 2020, despite one less facility reporting in 2021 than 2020.

Other Metal Production. The other metal production facilities are those operating under NAICS codes beginning with 331 (primary metal manufacturing) that are not otherwise subject to a metal subpart under Part 98. This subsector includes iron foundries, facilities that engage in secondary smelting and alloying of aluminum, and facilities that manufacture finished products from purchased metals by rolling, drawing, and/or extrusion. This subsector accounts for about 11 percent of the total CO₂e emissions reported by the metals sector. Unlike the other subsectors, these facilities report only GHG emissions from stationary fuel combustion sources. Overall, emissions reported by this subsector slightly decreased from 9.4 MMT CO₂e in 2011 to 9.0 MMT CO₂e in 2021. The number of reporters increased from 121 in 2011 to 136 in 2021. Emissions for this subsector increased between 2011 and 2014 by 13 percent (1.2 MMT CO₂e) from 9.4 MMT CO₂e to 10.6 MMT CO₂e. This increase in reported emissions was due to both an increase in the number of facilities reporting (8 more facilities reported in 2014 than in 2011) and an increase of 4,570 MT CO₂e in the average annual emissions per facility. Beginning in 2015, the average annual emissions per facility declined from about 82,000 MT CO₂e in 2014 to 71,000 MT CO₂e in 2019. In 2020, average annual emissions per facility were about 61,000 MT CO₂e and increased in 2021 to 66,000 MT CO₂e.

[1] U.S. Geological Survey, *Mineral Commodity Summaries 2022*, January 2022, Available at: <https://www.usgs.gov/centers/nmic/mineral-commodity-summaries>.

[2] Board of Governors of the Federal Reserve System (US), *Capacity Utilization: Manufacturing: Durable Goods: Primary Metal (NAICS = 331)* [CAPUTLG331S], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/CAPUTLG331S>, January 17, 2023.

[3] U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020*. April 15, 2022. EPA 430-R-22-003. Available at: <https://www.epa.gov/system/files/documents/2022-04/us-ghg-inventory-2022-main-text.pdf>.

[4] United States Geological Service Mineral Commodity Summaries 2022, available at: https://minerals.usgs.gov/minerals/pubs/commodity/iron_&_steel/.

[5] U.S. Geological Survey, *Annual Aluminum Mineral Commodity Summary*, January 2021, Available at: <https://pubs.usgs.gov/periodicals/mcs2021/mcs2021-aluminum.pdf>.

[6] U.S. Geological Survey, *Annual Aluminum Mineral Commodity Summary*, January 2022, Available at: <https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-aluminum.pdf>.

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