

Flat or float glass plants (NAICS 327211) operate high temperature furnaces that melt siliceous minerals and other materials to produce glass typically used in windows, glazing, and windshields. Glass manufacturing is energy intensive and a significant source of greenhouse gas (GHG) emissions from the industrial sector. Emissions from plants producing flat glass are the largest source of GHG emissions in the manufacturing lifecycle of products made with flat glass. In 2019, 22 flat glass plants reported direct emissions of 2.95 million metric tons of carbon dioxide equivalents (CO_{2e}) to the U.S. Environmental Protection Agency (EPA).ⁱ Emissions from these plants represent nearly 70% of total direct emissions from flat glass industry.ⁱⁱ

Reducing glass plant GHG emissions and product carbon intensity are important goals for both the glass industry and its customers. To assist the U.S. flat glass industry in evaluating its efforts to decarbonize, EPA calculated the 2019 carbon intensities based on total direct emissions and glass produced (i.e., melted). These intensities serve as reference points for the industry’s carbon performance, represented as metric tons of carbon emitted per ton of glass produced. The intensities are derived from flat glass plant data reported to the U.S. EPA Greenhouse Gas Reporting Program (GHGRP) and reflect direct emissions (Scope 1) from on-site fuel use and process emissions, contributing approximately 75% of total (direct + indirect) GHG emissions from flat glass plants.ⁱⁱⁱ The table below presents quartile carbon emissions intensities for total glass produced.^{iv} For this study, the 75th percentile reflects plants with lower carbon intensities and the 25th percentile reflects plants with higher carbon intensities. The 50th percentile is the median.

2019 Direct Carbon Intensities

Quartile	Metric Ton CO _{2e} / Metric Ton (MT) of Flat Glass	Carbon Intensity
75 th percentile	0.465	Low
50 th percentile (median)	0.542	Midpoint
25 th percentile	0.579	High

Methodology

Flat glass plants operating in the United States and its territories with annual emissions of 25,000 MT CO_{2e} or greater report total annual greenhouse gas emissions and total glass produced under the U.S. EPA GHGRP. These emissions reflect all GHG emissions from fuel combustion and the release of carbon dioxide from processing of carbonated raw materials (process emissions) at the plant.^v Data for calendar year 2019 (January – December) were analyzed. Carbon intensities for glass produced were calculated for each plant by dividing total annual CO_{2e} emissions from by the plant’s total annual glass production. A distribution of plant carbon intensities was created, and the intensity levels for the 25th, 50th, and 75th percentiles were calculated.

For the purposes of this evaluation, a plant with a carbon intensity at the 75th percentile emits less carbon dioxide per metric ton of glass than a plant with carbon intensity around the median intensity level (i.e., 50th percentile). Flat glass plants operating at the 50th percentile perform at the midpoint for the industry, while plants operating above the 50th percentile (i.e., those plants with intensities lower than 0.542 CO_{2e} per ton of glass) are operating at above average carbon performance and emit lower levels of CO_{2e} per ton of glass than plants below the median. Plants operating at or below the 25th percentile emit higher levels of CO_{2e} per ton of glass. Those seeking to compare their flat glass plant’s carbon intensity to the benchmarked quartiles should use the plant’s annual data submission to U.S. EPA, if available, or follow the reporting rules of the U.S. EPA GHGRP for calendar year 2019 and the following calculation using metric tons (MT):

$$MT\ CO_2e/MT\ glass\ produced = Total\ plant\ MT\ CO_2e\ emissions / total\ plant\ MT\ glass\ production$$

Observations

The quartile distributions of carbon intensities for flat glass show a range of performance. For example, flat glass from plants at the 75th percentile is 14% less carbon intensive than glass from plants at the 50th percentile. The difference in carbon intensity between glass from plants at the 50th versus 25th quartiles is 6%. The table below shows the differences in carbon intensity between the quartiles.

Inter-quartile differences in carbon intensity ^{vi}	Flat Glass
75 th vs 50 th	14%
50 th vs 25 th	6%
75 th vs 25 th	20%

No correlations were observed between carbon intensity and plant location, with plants in all quartiles being found in different parts of the country.

Glass manufacturers can reduce carbon dioxide emissions from on-site fuel use in furnaces and from process-related emissions in a variety of ways, including:

- increased use of cullet,
- enhanced adoption of energy efficiency measures that reduce fuel consumption; and
- electrification of furnaces as the grid incorporates greater renewable energy.

Periodically reviewing emissions intensities provides an opportunity to see the progress made by manufacturers' adoption of these and other strategies that can lower carbon intensity in the production of final glass products.

For more information about the EPA's Greenhouse Reporting program

Glass Plant Reporting Requirements: <https://www.epa.gov/ghgreporting/subpart-n-glass-production>

Glass Technical Support Documentation: <https://www.epa.gov/ghgreporting/subpart-n-technical-support-document>

Code of Federal Regulations – Subpart N Glass Plants: <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-N>

Relationship of the GHGRP to the national *Inventory of U.S. Greenhouse Gas Emissions and Sinks*: <https://www.epa.gov/ghgreporting/greenhouse-gas-reporting-program-and-us-inventory-greenhouse-gas-emissions-and-sinks>.

ⁱ In 2019, total direct emissions from all glass manufacturing plants reporting to the GHGRP were 7.8 million metric tons of CO₂e from 102 plants. 38% of these emissions are from flat glass.

ⁱⁱ Glass plants with annual emissions of 25,000 MTCO₂e or higher are required to report to the GHGRP. In 2019, 22 flat glass plants reported total emissions of 2,945,533 MT CO₂e. Using other EPA databases, company plant lists, and other sources, EPA estimates there are 33 large flat glass plants currently operating in the U.S. 11 of these plants have annual emissions under 25,000 MT CO₂e and are not required to report to the GHGRP.

ⁱⁱⁱ Indirect (Scope 2) GHG emissions associated with electricity use represent about 25% of total emissions from flat glass plants. Direct emissions (Scope 1) from fuel use (55%) and process emissions (20%) make up 75% of total emissions.

^{iv} 40 CFR 98.146(a)(2) and (b)(3) requires reporting of the annual quantity of glass produced by each glass melting furnace and by all furnaces combined (tons).

^v Emissions include non-CO₂ greenhouse gases converted to CO₂e based on the gas's global warming potential. Non-CO₂ gases represent less than 1% of total GHG emissions in the glass sector.

^{vi} The inter-quartile difference was calculated as the percent difference between a lower quartile and a higher quartile (i.e., 50th-25th / 25th).