ENERGY STAR®
INDUSTRIALINSIGHTS™

Flat Glass Manufacturing

US Flat Glass Plants

NAICS 327211

- 25 Flat Glass Plants[1]
- 7 Companies[1]
- 16 States & Territories with Plants[1]
- 0 ENERGY STAR Plants

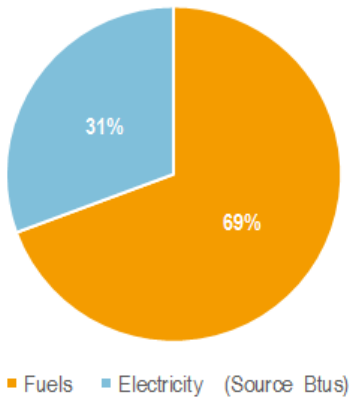
Flat glass manufacturing plants process sand, soda ash, and other raw materials into sheet and float glass for building products, automotive applications, tabletops, mirrors, and other uses. It is the second largest segment of the glass industry in the United States (based on production) and is one of the most energy-intensive industrial processes. Additionally, it is a sector where energy costs comprise a significant percentage of operating costs.

The US Environmental Protection Agency's ENERGY STAR partnership has worked with the glass industry since 2006 to promote energy efficiency and energy management best practices within the sector through the ENERGY STAR Industrial Focus initiative.

Energy Use Profile

Natural gas and electricity are the dominant energy sources used in flat glass manufacturing.[2]

Energy Use Distribution



Electricity and natural gas use vary by plant size and product mix. The table below provides an estimate of total energy use for each plant size category.[3]

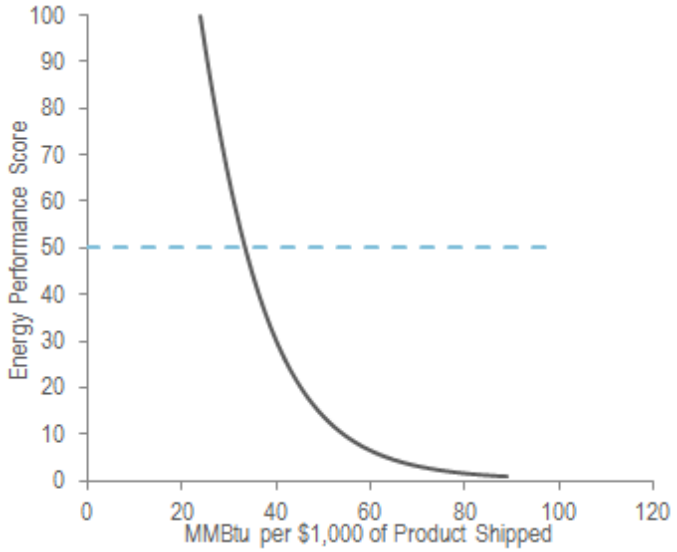
Plant Energy Use	Total Energy (MMBtu)
Small	~534,000
Medium	~1,597,500
Large	~3,115,000

Fuels are the largest energy cost, representing 64% of total energy costs. In 2013, flat glass plants spent over $218 million on fuels and over $125 million on electricity.[4]

Electric Costs (36%)	Fuel Costs (64%)

Distribution of Energy Performance

EPA, through the ENERGY STAR Glass Manufacturing Industrial Focus, has benchmarked the energy performance of flat glass plants. The curve below, generated from the ENERGY STAR Flat Glass Plant Energy Performance Indicator (EPI) benchmarking tool, shows the normalized distribution of energy performance for a representative plant. A dashed line corresponding to the performance of an average plant is provided for reference. An Energy Performance Score (EPS) of 75 or higher is defined by EPA as the threshold for efficient plants.



This curve reveals a narrow range of energy performance between the majority of plants. The largest energy efficiency opportunities are in plants in the lowest percentiles of energy performance (<30%). For these plants, the greatest efficiency gains will likely be made during scheduled rebuilds of glass furnaces. Increasing the use of cullet (recycled glass) can improve the energy performance of all plants.

Major Energy Uses

Flat glass manufacturing is an energy-intensive process that involves melting raw materials at extreme heat followed by multiple finishing processes. The table below outlines major energy using processes.[5]

Use / Process	Share of Energy
Batch (raw material) preparation	3%
Melting and refining furnaces.	63%
Forming	15%
Finishing (tempering, coating, etc.)	19%

Furnaces used to melt and refine raw materials into glass are designed to operate continuously for 8 to 10 years before stopping for major maintenance and rebuilding. Consequently, significant efficiency improvements to furnaces usually occur only during rebuilds. Increasing the use of cullet (recycled glass), which requires much less energy to melt than other raw materials, will improve efficiency. In furnaces, smaller efficiency gains can be made by optimizing oxygen levels, upgrading burners, and increasing insulation. Compressed air is used extensively in the forming and finishing phases, making it a focus area for energy management.

ENERGY STAR Resources

The ENERGY STAR Glass Manufacturing Focus, a collaborative effort between EPA and the industry, has developed the following materials for energy efficiency in flat glass plants:

- **Energy Performance Indicator** (EPI): Benchmarks and rates plant energy performance.
- **Energy Guide**: Technical guidance on energy saving opportunities.

ENERGY STAR Certified Plants

EPA's ENERGY STAR program certifies flat glass plants that demonstrate energy performance in the top quartile nationally using the Flat Glass Plant Energy Performance Indicator (EPI).

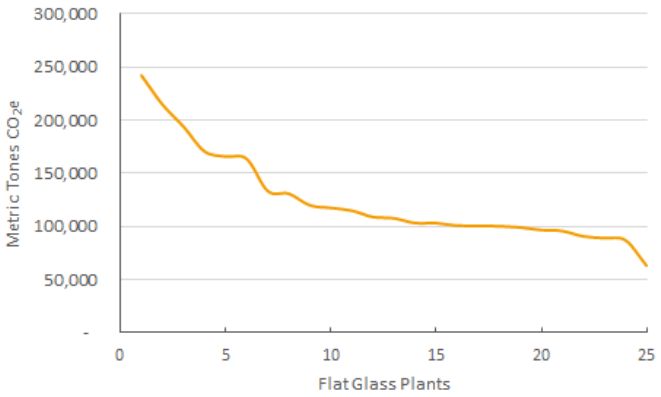
References:

1. Plant, company, and state counts from the EPA FLIGHT Database (ghgdata.epa.gov).
2. Fuels from 2013 EPA FLIGHT Database (ghgdata.epa.gov). Electric from 2013 Annual Survey of Manufacturers.
3. 2010 Manufacturers Economic Census Survey, Table 6.3.
4. 2013 Annual Survey of Manufacturers.
5. ENERGY STAR Energy Efficiency Improvement and Cost Saving Opportunities for the Glass Industry.
6. EPA Greenhouse Gas Reporting Program Database (ghgdata.epa.gov).
7. Estimate calculated from purchased electricity reported in the 2013 Annual Survey of Manufacturers.
8. Estimate calculated by combining direct emissions from the EPA Greenhouse Gas Reporting program with estimates from the 2013 Annual Survey of Manufacturers.

Greenhouse Gas (GHG) Emissions

Direct GHG emissions from flat glass plants are produced from both fuel use and the chemical reactions in the glass making process. Twenty-five plants reported direct emissions to EPA's Greenhouse Gas reporting program in 2013, totaling over 3.1 million metric tons of CO_2e ($MMTCO_2e$).[6] As shown below, emissions ranged from 241,977 to 63,163 metric tons of CO_2e ($mtCO_2e$) and averaged around 124,526 $mtCO_2e$.[6]

Direct Emissions Distribution



Indirect emissions from electricity purchases were approximately 1.1 $MMTCO_2e$ in 2013.[7]

Total GHG emissions from flat glass plants were approximately 4.2 $MMTCO_2e$ in 2013.[7,8] Just over half of the GHG emissions in flat glass plants are from fuels (natural gas) used for heating and melting processes, as shown in the graphic below.

GHG Emissions by Source