



Pharmaceutical Manufacturing

US Pharmaceutical Sector

NAICS 325412

- 270** Plants¹
- 170** Companies¹
- 37** States & Territories with Plants¹
- 11** ENERGY STAR Plants

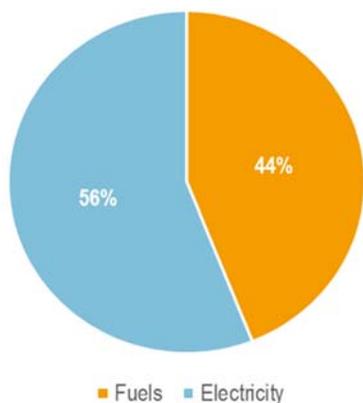
Pharmaceutical manufacturers produce a wide array of finished medical products in plants regulated by the US Food & Drug Administration (FDA). Pharmaceutical manufacturing generally involves two main processes: *bulk chemical* and *fill-finish*. Bulk chemical processes produce active pharmacological ingredients (API) through chemical synthesis or biological methods. The fill-finish step processes API into final dose sized medicines. Pharmaceutical plants may perform both processes or specialize in a single processes.

The US Environmental Protection Agency's ENERGY STAR partnership has worked with the pharmaceutical sector since 2004 to promote energy efficiency and best practices within the sector through the ENERGY STAR Industrial Focus initiative.

Energy Use Profile

Electricity and natural gas are the main energy sources used in pharmaceutical manufacturing.²

Energy Use Distribution



Electricity and fuel use vary by facility size and process. Bulk chemical plants are more fuel intensive than fill-finish. The table below provides an estimate of total energy use for each plant size category based industry averages.²

Plant Energy Use	Electric (MWh)	Fuels (MMBtu)
Small	~2,700	~560
Medium	~30,500	~84,000
Large	~205,000	~1,980,000

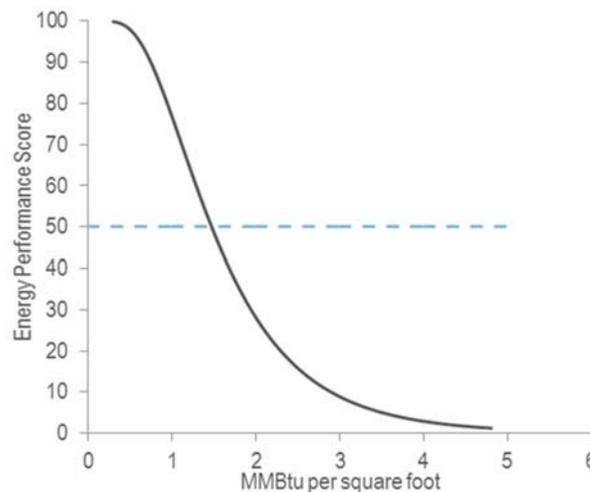
Electricity is the largest energy cost, representing 70% of total energy costs.³ In 2013, pharmaceutical manufacturers spent \$806 million on electricity and \$349 million on fuels.³

Electric Costs (70%)

Fuel Costs (30%)

Distribution of Energy Performance

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



This curve shows a fairly wide distribution of energy performance. The greatest energy efficiency opportunities are in plants in the lower percentiles (< 50%). Here, improvements are likely to be found by upgrading to more efficient equipment, designing more efficient processes, and optimizing processes during periods of production changes and revalidation of operations to meet FDA requirements. At the higher percentiles, optimizing process equipment and operating practices may yield additional efficiency and performance improvements.

Major Energy Uses

Energy use in pharmaceutical manufacturing varies by plant type. Bulk chemical processes use the greatest amount of energy and are the most fuel intensive. Fill-finish processes require clean rooms, often with 100% make-up air and high air-change rates that use a lot of electricity. Some bulk chemical processes also require intensive ventilation. Major energy using systems by process type are listed below:⁴

Bulk Chemical	Fill-Finish
Biologics fermentation / incubators	Ventilation / HVAC systems
Chemical synthesis processes	Mixers
Ventilation / HVAC systems	Motors
Separation processes	Fill and packaging processes
Centrifuges	Lighting

Pharmaceutical companies report conducting energy projects in all plant types. Ventilation and HVAC systems are frequently the focus of energy initiatives. Concerns that energy projects could jeopardize FDA validation requirements can limit or delay implementation of upgrades and efficiency strategies.

ENERGY STAR Resources

The ENERGY STAR Pharmaceutical Focus, a collaborative effort between EPA and industry, has developed the following materials for improving energy efficiency in pharmaceutical manufacturing 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 plants that demonstrate energy performance in the top quartile nationally. Since 2008, **11 plants** have earned ENERGY STAR certification by scoring 75 or higher on the Pharmaceutical Manufacturing EPI.

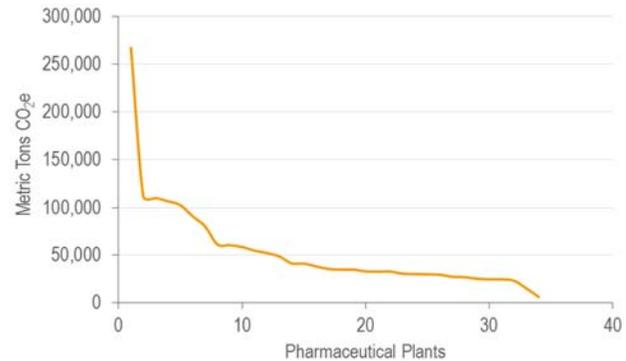
References:

1. Plant, company, and state counts based on the US EPA's ECHO database.
2. Based on data used to develop the Pharmaceutical plant EPI. The Plant Energy Use table was compiled to show plant-level consumption for representative small (10th percentile), medium (median), and large (90th percentile) plants.
3. 2013 Annual Survey of Manufacturers for NAICS 3254.
4. ENERGY STAR Energy Efficiency Improvement and Cost Saving Opportunities for the Pharmaceutical Industry.
5. EPA Greenhouse Gas Reporting Program Database (ghgdata.epa.gov)
6. Estimate based on 2006 electricity data used to develop the Pharmaceutical EPI.
7. 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

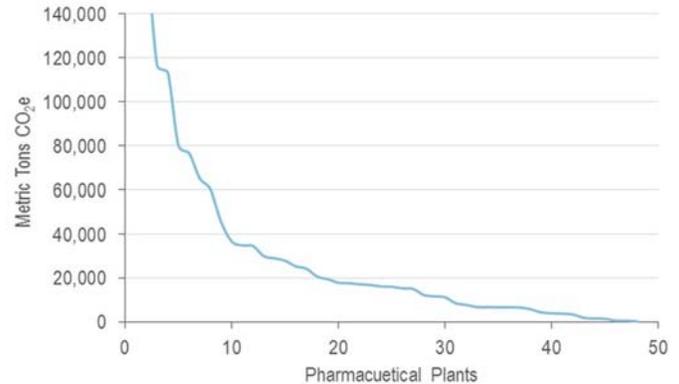
Direct GHG emissions from pharmaceutical plants are primarily from on-site fuel use. Thirty-four plants reported direct emissions to EPA's Greenhouse Gas reporting program in 2013, totaling 1.8 million metric tons of CO₂e (MMTCO₂e).⁵ As shown below, emissions ranged from 11 to 287,436 metric tons of CO₂e (mtCO₂e) and averaged around 55,000 mtCO₂e.⁵

Direct Emissions Distribution



Total indirect emissions from purchased electricity were around 6 MMTCO₂e in 2013.³ The chart below shows the distribution of indirect emissions from selected plants in 2006.²

Indirect Emissions Distribution



Total GHG emissions for pharmaceutical manufacturing were approximately 7.8 MMTCO₂e in 2013.⁷ The majority of these reported emissions are from energy use.

GHG Emissions by Source

