



## Wet Corn Milling

### US Wet Corn Mills

NAICS 311221

- 27 Wet Corn Mills
- 7 Companies
- 11 States & Territories with Plants
- 8 ENERGY STAR Plants

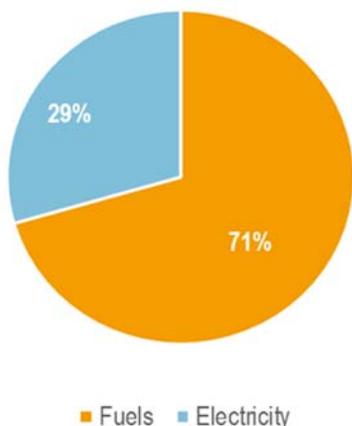
Wet Corn Mills, also known as corn refineries, process raw corn into sweeteners (corn syrup and fructose), starches, ethanol, corn oil, and animal feed. Products from Wet Corn Mills are used in multiple sectors of the economy. Wet Corn Mills are the most energy-intensive industry within the food processing sector and are one of most energy-intensive industries among US manufacturers.

The US Environmental Protection Agency's ENERGY STAR partnership has worked with Wet Corn Millers since 2002 to promote energy efficiency and energy management best practices within the sector through the ENERGY STAR Industrial Focus initiative.

### Energy Use Profile

Natural gas, coal, and electricity are the dominant energy sources used in Wet Corn Mills.

#### Energy Use Distribution



Electricity and fuel use vary by mill, and many mills have combined heat and power (CHP) systems. The table below provides an estimate of total energy use for each plant size category.<sup>1</sup>

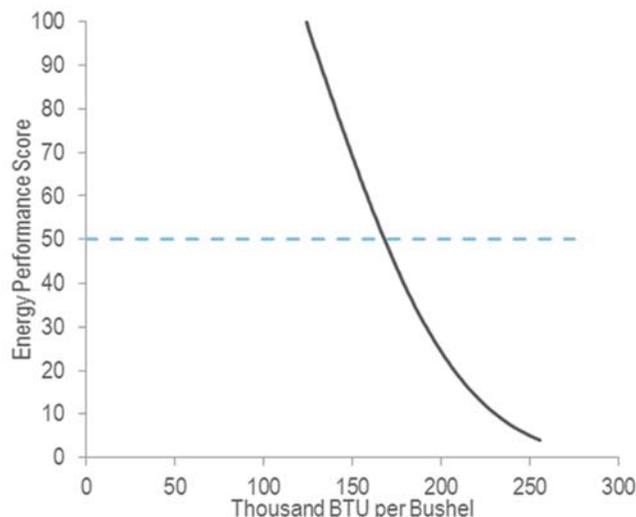
Plant Energy Use	Electric (MWh)	Fuels (MMBtu)
Small	~77,000	~2,100,000
Medium	~150,000	~3,700,000
Large	~330,000	~6,200,000

Fuels are the largest energy cost, representing 57% of total energy costs. In 2012, Wet Corn Mills spent over \$417 million on fuels and over \$319 million on electricity.<sup>2</sup>



### Distribution of Energy Performance

EPA, through the ENERGY STAR Wet Corn Milling Manufacturing Industrial Focus, has benchmarked the energy performance of Wet Corn Mills. The curve below, generated from the ENERGY STAR Wet Corn Mill Energy Performance Indicator (EPI) benchmarking tool, shows the normalized distribution of energy performance for a representative mill. A dashed line corresponding to the performance of an average mill 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 shows that the greatest energy efficiency opportunities are in plants in the lower percentiles of energy performance (< 30%). Here, improvements are likely to be found by upgrading or optimizing processes. The range of performance for plants in the middle and upper quartiles (> 50%) is fairly narrow, meaning there are fewer opportunities for major savings. New technologies or process designs will be needed to drive greater efficiencies in the upper quartiles.

## Major Energy Uses

Wet corn milling is an energy-intensive process because it involves multiple wet to dry processes. Electricity is used mostly for pumping, grinding, separating, and drying. Fuel is used to make steam and for direct drying. Steam is used in many process steps, including steeping, evaporation, fermentation, and drying. The table below outlines major energy using processes.<sup>3</sup>

Use / Process	Share of Energy
Starch drying	30%
Gluten dewatering & drying	26%
Steepwater evaporation	18%
Fiber washing & drying	10%
Germ washing & drying	7%
Corn handling, steeping, germ separation, feed drying, milling, and starch-gluten separation	9%

Companies report energy projects in all of the areas of the mill, including both capital and low cost upgrades. Due to the complexity of wet corn mills, larger capital projects will involve other non-energy objectives, such as improving yield and quality. Operational and behavioral-based strategies are being used to address recurring maintenance issues and wasteful energy uses.

## ENERGY STAR Resources

The ENERGY STAR Wet Corn Milling Focus, a collaborative effort between EPA and the industry, has developed the following materials for energy efficiency in Wet Corn Mills:

- **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 Wet Corn Mills that demonstrate energy performance in the top quartile nationally. Since 2006, **eight mills** have earned ENERGY STAR certification by scoring 75 or higher on the Wet Corn Mill EPI.

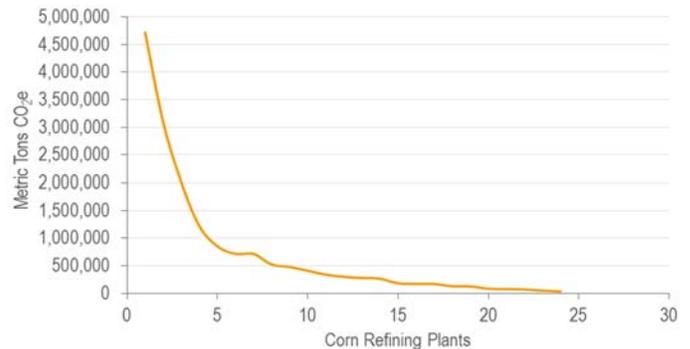
### References:

1. Based on data used to develop the Wet Corn Milling EPI. For more information, see: Measuring Improvement in the energy performance of the U.S. Corn Refining Industry, Boyd and Delgado (2012). The Plant Energy Use table was compiled to show plant-level consumption for representative small (10th percentile), medium (median), and large (90th percentile) plants.
2. 2012 Economic Census.
3. ENERGY STAR Energy Efficiency Improvement and Cost Saving Opportunities for the Wet Corn Milling Industry.
4. EPA Greenhouse Gas Reporting Program Database (ghgdata.epa.gov).
5. Estimate based on 2009 electricity data used to develop the Wet Corn Mill EPI.
6. Estimate calculated from purchased electricity in 2012 Economic Census.

## Greenhouse Gas (GHG) Emissions

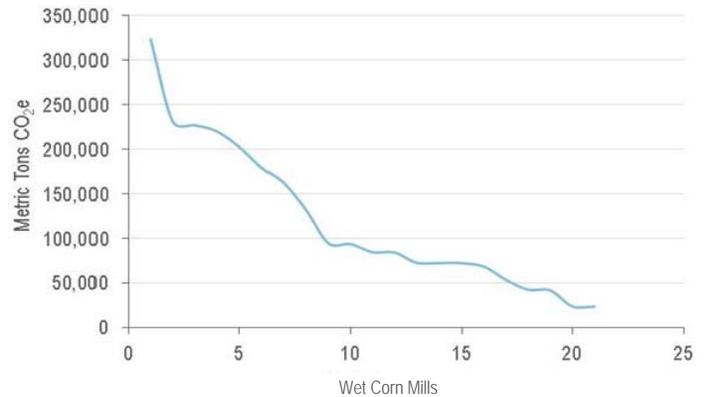
Direct GHG emissions from Wet Corn Mills are primarily from fuel use. Twenty-four plants reported direct emissions to EPA's Greenhouse Gas reporting program in 2012, totaling over 16 million metric tons of CO<sub>2</sub>e (MMTCO<sub>2</sub>e).<sup>4</sup> As shown below, emissions ranged from 4.7 million to 31,357 metric tons of CO<sub>2</sub>e (mtCO<sub>2</sub>e) and averaged around 300,000 mtCO<sub>2</sub>e.<sup>4</sup>

### Direct Emissions Distribution



Indirect emissions from purchased electricity were around 3.4 MMTCO<sub>2</sub>e in 2012.<sup>5</sup> The distribution of indirect emissions is shown in the chart below.<sup>6</sup>

### Indirect Emissions Distribution



Total emissions from Wet Corn Mills were roughly 20 MMTCO<sub>2</sub>e in 2012.<sup>4,6</sup> The majority of emissions come from energy use, however, some mills report emissions from on-site wastewater treatment and landfills.

### GHG Emissions by Source

