

# STAGES OF ETHANOL PRODUCTION



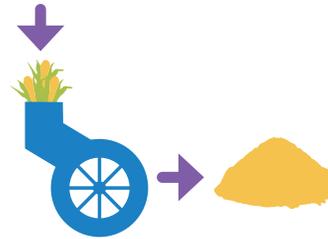
## CORN PRODUCTION

Corn is grown across the United States with a concentration primarily in the Midwest. Corn has many uses in the United States including animal feed, seed and industrial uses, and in the production of ethanol.



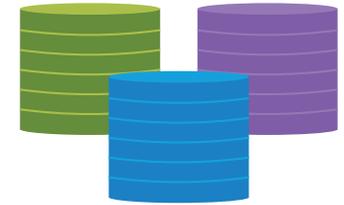
## GRAIN RECEIVING

Corn is typically harvested in the United States at the end of summer and fall (August-October). Upon harvest, it can be transported to feed lots, put on trains or barge for export, stored in grain bins, or transported to ethanol refineries for fermentation.



## MILLING

The first stage in ethanol production requires filtering of the grain to remove foreign material. Additionally, the corn is ground up into a mill to increase contact with water and enzymes in later stages.



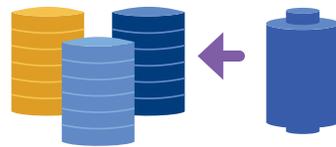
## SLURRY TANKS AND LIQUIFICATION

In these stages, water and enzymes are added to the ground corn mixture and the mixture sets to form a mixture called "mash".



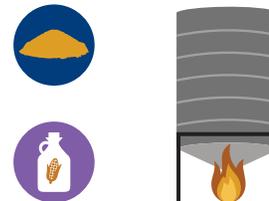
## STORAGE & GLOBAL TRANSPORT

Upon completion of the refining process, ethanol is transported by truck, train, or barge to blending facilities where it is mixed with gasoline or to storage terminals near export channels. In the United States, around 10% of ethanol production is exported every year while the remaining 90% of production is used in the domestic gasoline supply.



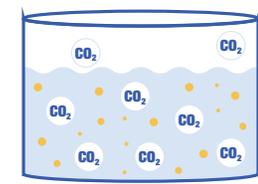
## MOLECULAR SIEVE

During this stage, the 95% ethanol mixture passes through a sieve that absorbs water and concentrates the ethanol mixture to around 99% ethanol by volume. After this stage, ethanol can be further dried to meet different specifications, or a denaturant can be added.



## DISTILLATION

The ethanol/mash mixture is distilled with heat to separate the alcohol from the solid material in the mash. After separating, a mixture containing approximately 95% ethanol evaporates and is captured, while the remaining mixture (called stillage) is further processed into distiller grains and corn syrup used for animal feed and other uses.



## FERMENTATION

Enzymes break down the mixture to form simple sugars that are then mixed with yeast to produce ethanol and carbon dioxide. This mixture typically is made up of approximately 15% ethanol and solids from the grain and yeast. During this stage, carbon dioxide can be recovered and sold as a co-product to carbonate beverages.

Source: ICM and RFA

[http://www.icminc.com/prev\\_site\\_resources/production\\_process/diagram/](http://www.icminc.com/prev_site_resources/production_process/diagram/)

[https://i2.wp.com/ethanolrfa.org/wp-content/uploads/2019/02/drymill\\_process.jpg?fit=1024%2C766&ssl=1](https://i2.wp.com/ethanolrfa.org/wp-content/uploads/2019/02/drymill_process.jpg?fit=1024%2C766&ssl=1)



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