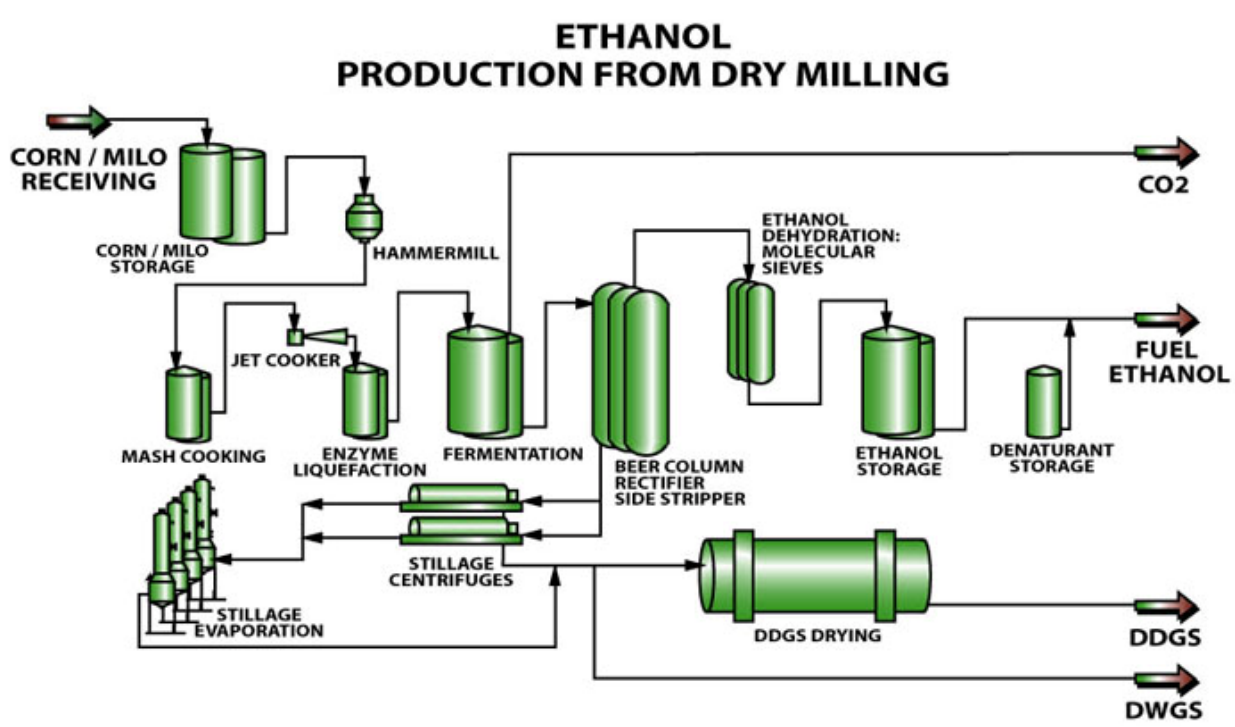
ETHANOL from Maize **Reference Data**

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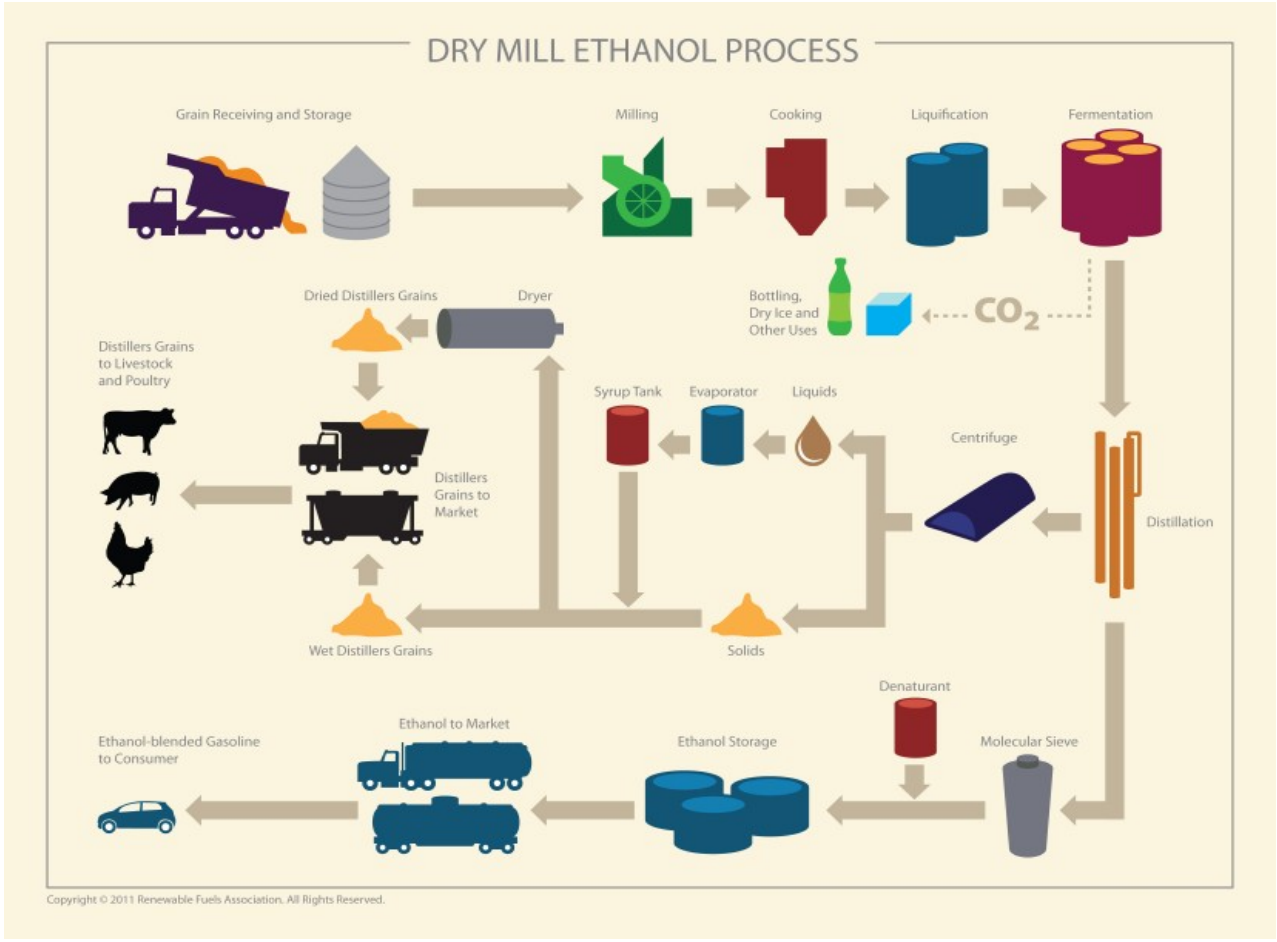
DRY MILL ETHANOL PROCESS
Grain Receiving and Storage
Milling
Cooking
Liquification
Fermentation
Dried Distillers Grains
Dryer
Bottling, Dry Ice and Other Uses
CO_2
Distillers Grains to Livestock and Poultry
Syrup Tank
Evaporator
Liquids
Centrifuge
Distillers Grains to Market
Distillation
Wet Distillers Grains
Solids
Denaturant
Ethanol to Market
Ethanol-blended Gasoline to Consumer
Ethanol Storage
Molecular Sieve
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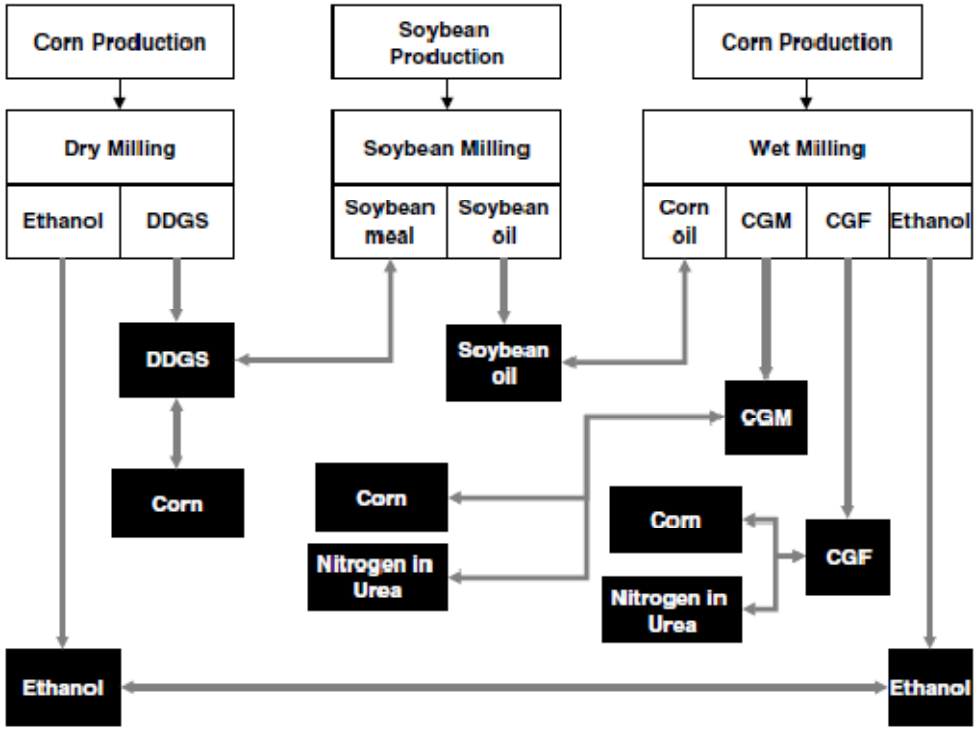
MaZda


Corn Production
Soybean Production
Corn Production
Dry Milling
Soybean Milling
Wet Milling
Ethanol
DDGS
Soybean meal
Soybean oil
Corn oil
CGM
CGF
Ethanol
DDGS
Soybean oil
CGM
Corn
Corn
Corn
CGF
Nitrogen in Urea
Nitrogen in Urea
Ethanol
Ethanol

There are two main types of corn ethanol production: dry milling and wet milling. The products of each type are utilized in different ways.

In the dry milling process the entire corn kernel is ground into flour and referred to as "meal." The meal is then slurried by adding water. Enzymes are added to the mash that convert starch to dextrose, a simple sugar. Ammonia is added to control the pH and as a nutrient for the yeast, which is added later. The mixture is processed at high-temperatures to reduce the bacteria levels and transferred and cooled in fermenters. This is where the yeast is added and conversion from sugar to ethanol and carbon dioxide begins.

The entire process takes between 40 to 50 hours, during which time the mash is kept cool and agitated in order to facilitate yeast activity. After the process is complete, everything is transferred to distillation columns where the ethanol is removed from the "stillage". The ethanol is dehydrated to about 200 proof using a molecular sieve system and a denaturant such as gasoline is added to render the product undrinkable.

With this last addition, the process is complete and the product is ready to ship to gasoline retailers or terminals. The remaining stillage then undergoes a different process to produce a highly nutritious livestock feed. The carbon dioxide released from the process is also utilized to carbonate beverages and to aid in the manufacturing of dry ice.

The process of wet milling takes the corn grain and steeps it in a dilute combination of sulfuric acid and water for 24 to 48 hours in order to separate the grain into many components. The slurry mix then goes through a series of grinders to separate out the corn germ. Corn oil is a by-product of this process and is extracted and sold. The remaining components of fiber, gluten and starch are segregated out using screen, hydroclonic and centrifugal separators.

The gluten protein is dried and filtered to make a corn gluten- meals co-product and is highly sought after by poultry broiler operators as a feed ingredient. The steeping liquor produced is concentrated and dried with the fiber and sold as corn gluten feed to in the livestock industry. The heavy steep water is also sold as a feed ingredient and is used as an environmentally friendly alternative to salt in the winter months. The corn starch and remaining water can then be processed one of three ways: 1) fermented into ethanol, through a similar process as dry milling, 2) dried and sold as modified corn starch, or 3) made into corn syrup.

The production of corn ethanol uses water in two ways – irrigation and processing. There are two types of ethanol processing, wet milling and dry milling, and the central difference between the two processes is how they initially treat the grain. In wet milling, the corn grain is steeped in water, and then separated for processing in the first step. Dry milling, which is more common, requires a different process. According to a report by the National Renewable Energy Laboratory, "Over 80% of U.S. ethanol is produced from corn by the dry grind process."[*citation needed*] The dry grind process proceeds as follows:

"Corn grain is milled, then slurried with water to create 'mash.' Enzymes are added to the mash and this mixture is then cooked to hydrolyze the starch into glucose sugars. Yeast ferment these sugars into ethanol and carbon dioxide and the ethanol is purified through a combination of distillation and molecular sieve dehydration to create fuel ethanol. The byproduct of this process is known as distiller's dried grains and solubles (DDGS) and is used wet or dry as animal feed."