

Fuel from the Farm

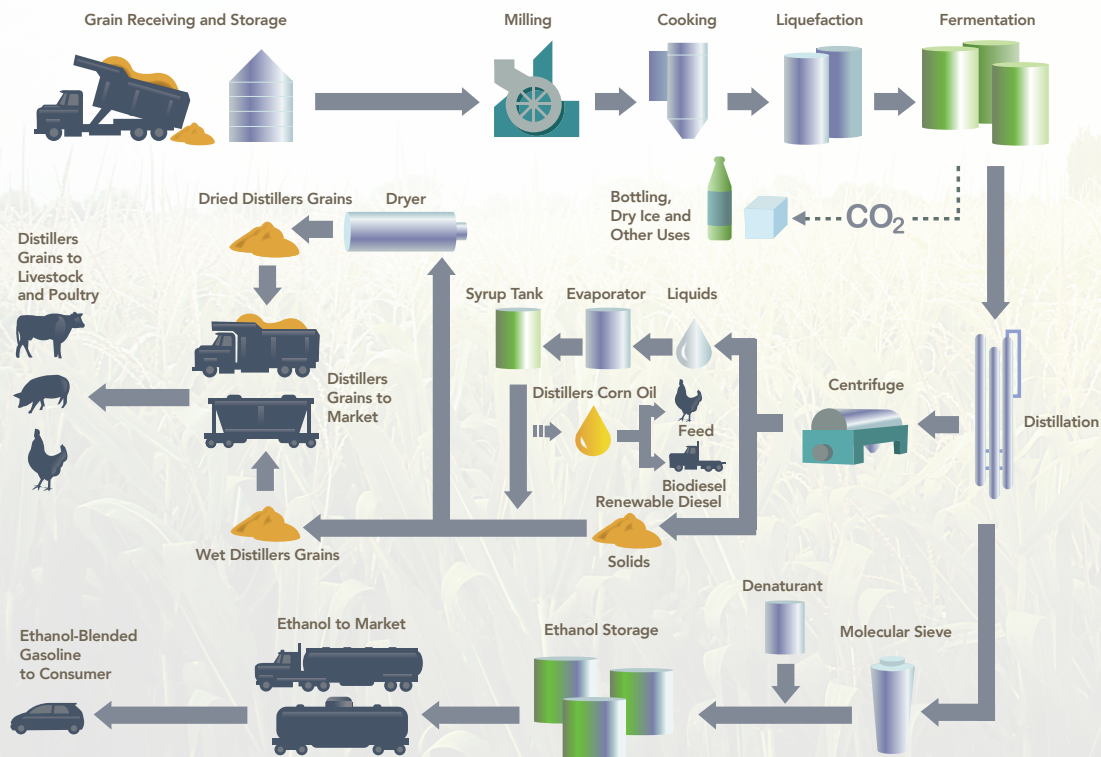
Ethanol's potential to change the world for the better was recognized long ago, and the past four decades have shown great growth in an industry that started on the American farm. Today, roughly 200 ethanol biorefineries across the United States are living up to the potential first identified by some of our nation's foremost inventors, such as Alexander Graham Bell, Henry Ford and Thomas Edison.

Modern-day facilities use state-of-the-art technologies to produce ethanol and valuable co-products from the starches and sugars found in grains, beverage and food waste, and other feedstocks, and American farmers themselves are actively involved in many of the ethanol biorefining businesses through ownership, investment, or leadership roles. While corn is by far the predominant U.S. feedstock for ethanol, grain sorghum also is used, and biorefineries typically use about one-third of the nation's sorghum crop for ethanol production.

Well over 90 percent of U.S. fuel ethanol is produced using the dry mill process, with the remaining amount coming from wet mills. The main difference between the two processes is in the initial treatment of the grain.

In **DRY MILLING**, the entire grain kernel is first ground into meal, then slurried with water to form a mash. Enzymes are added to the mash to convert starch to sugar. The mash is first cooked, then cooled and transferred to fermenters. Yeast is added and the conversion of sugar to alcohol begins. After fermentation, the resulting "beer" (not the kind you might drink) is separated from the remaining stillage. The ethanol is distilled and dehydrated, then blended with about 2 percent denaturant (such as gasoline) to render it undrinkable. It is then ready for shipment. The stillage is sent through a centrifuge that separates the solids from the solubles. These co-products eventually become distillers grains and distillers corn oil.

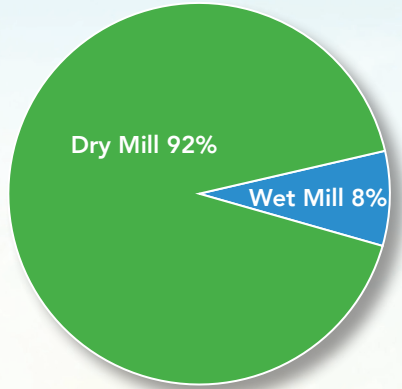
DRY MILL ETHANOL PROCESS



Source: RFA

In **WET MILLING**, the grain is first separated into its basic components through soaking. After steeping, the slurry is processed through grinders to separate the corn germ. The remaining fiber, gluten and starch components are further segregated. The gluten component (protein) is filtered and dried to produce animal feed. The remaining starch can then be fermented into ethanol, using a process like the dry mill process.

U.S. ETHANOL PRODUCTION BY TECHNOLOGY TYPE



Source: RFA based on U.S. Dept. of Agriculture data



What Comes from Corn

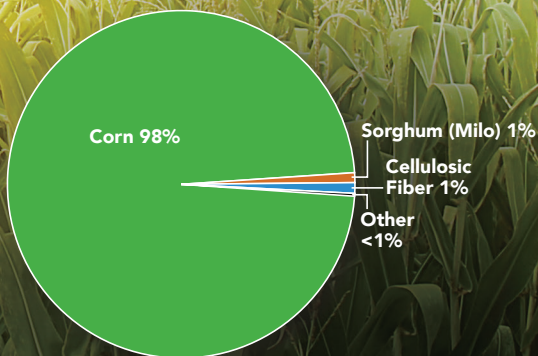
On average, 1 bushel of corn (56 pounds) processed by a dry mill ethanol biorefinery produces:

2.9 gallons	Denatured fuel ethanol
14.8 pounds	Distillers grains animal feed (10% moisture)
0.9 pounds	Distillers corn oil
16 pounds	Captured biogenic carbon dioxide*

In 2023, ethanol biorefineries captured roughly 2.6 million tons of CO₂, which was utilized for dry ice production, bottling, food processing, and other uses.

Source: RFA based on U.S. Dept. of Agriculture data
*Approximately 30 percent of U.S. dry mills capture CO₂ from fermentation.

U.S. ETHANOL PRODUCTION BY FEEDSTOCK TYPE



Sources: RFA using U.S. Dept. of Agriculture, U.S. Energy Information Admin., and California Air Resources Board data

