

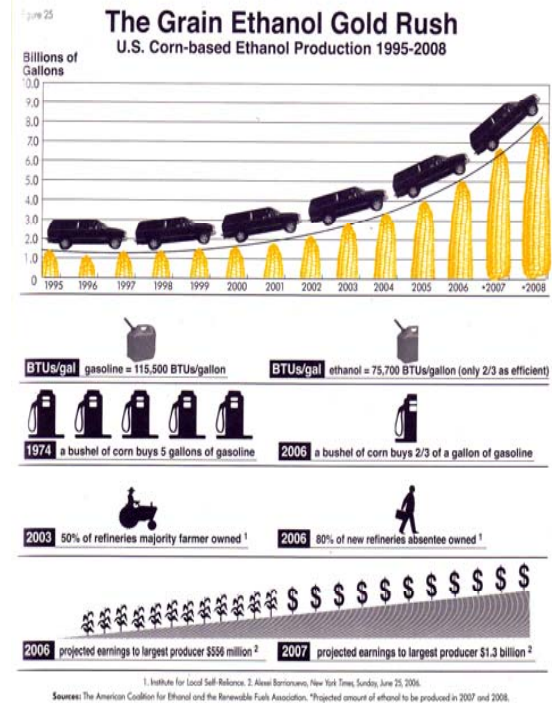
Ethanol from Corn: The Complete Story

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Important Terms to Know:

- **Biofuels** are fuels made from renewable biological materials; e.g. biodiesel, biogas, methane, and ethanol.
- **Biomass** refers to living and recently dead biological material that can be used as fuel or for industrial production.
- **Ethanol Fuel** or ethyl alcohol is a flammable, colorless, slightly toxic chemical compound that can be used as the alcohol in alcoholic beverages or as a fuel.
- **Corn Ethanol** is ethanol made from corn through industrial fermentation, chemical processing, and distillation.
- **CO₂ Emissions** occur when carbon dioxide is released into the atmosphere. CO₂ is a greenhouse gas, which means it contributes to the greenhouse effect, the warming of Earth's atmosphere to keep it habitable. Increasing CO₂ leads to global warming/climate change.
- **Global warming** is the increase in the average temperature of the Earth.
- **Nitrogen** is a chemical element often used in fertilizer that can have harmful impacts when large amounts run off into water.
- **Eutrophication** is when fertilizer, usually made from nitrogen and phosphorous, gets into water bodies, often leading to changes in animal and plant populations and degradation of water and habitat quality.

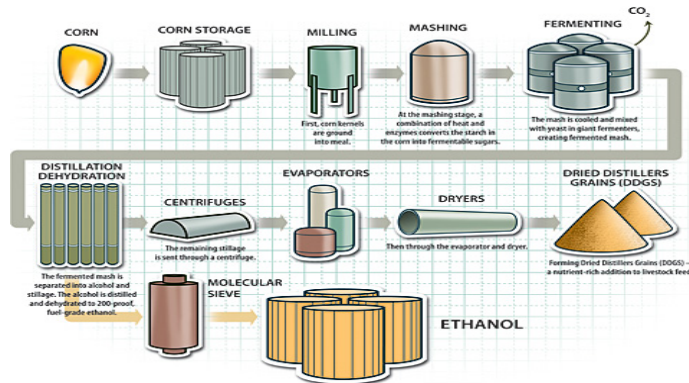
How Much are we Investing in Ethanol Now?



The Positive Aspects of Ethanol from Corn:

- **Renewable Resource:** unlike fossil fuels, corn is a renewable resource than can be produced in a short time span.
- **Business/Economy:** The raising of corn revitalizes the farming industry by bringing in new forms of business. Processing plants also bring industry and jobs to the United States.
- **Energy Independence:** with US grown and produced corn ethanol, we could reduce reliance on foreign nations for our oil.
- **Greenhouse Gas Emissions:** biofuels burn cleaner than gasoline and diesel. Plants also take in CO₂ when they grow, offsetting Global Warming.

How Is Corn Turned Into Ethanol?



The Negative Aspects of Ethanol From Corn:

In General:

- **Energy Return on Investment:** Research shows that more energy is needed to make corn ethanol than the final product actually contains. Studies say that it takes 29% more energy to produce a gallon of ethanol than its output contains.

From Land Usage Change:

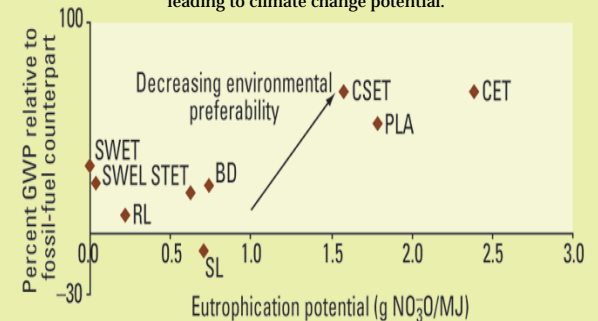
- **Fertilizers:** Corn requires large amounts of fertilizer. This fertilizer can have run off, leading to eutrophication.
- **Insecticides and herbicides:** corn production requires more of these than other crops.
- **Water:** More water will be used for irrigation in the growing of corn.
- **Soil erosion:** continuous corn production causes up to 70% more soil erosion than rotating different crops.
- **Fossil fuels:** Diesel fuel will be needed for the trucks and tractors used to plant, harvest, and transport the corn.

From Ethanol Processing Plants:

- **Wastewater:** 160 gallons of contaminated wastewater is produced for every gallon of ethanol produced. Run off of these chemicals is also a factor in groundwater and soil contamination.
- **VOCs:** volatile organic compounds, are emitted from processing plants during fermentation, distillation, and drying.
- **Carbon Monoxide:** emitted from combustion in the boiler.
- **Particulate Matter:** emitted from cooling towers, leading to air pollution.
- **Pipelines:** Gasoline pipelines cannot be used for ethanol transport because ethanol absorbs water and impurities that may be in gas pipelines. New pipelines would have to be constructed or another solution would have to be imagined.
- **Fossil Fuels:** Coal, oil, and natural gas are used for electricity needed to grind and process the corn and are used to produce heat to distill the sugar derived from the corn biomass to make the actual ethanol.

Eutrophication Potential vs. Relative Global Warming Potential for Biobased Products

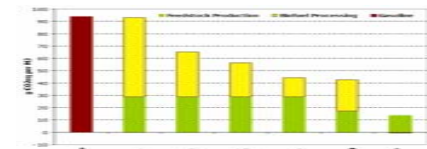
*GWP: global warming potential, is net positive carbon emissions, leading to climate change potential.



CET - Corn Ethanol, **RL - Rapeseed Lubricant**, **SWEL - Switchgrass Electricity**, **SWET - Switchgrass Ethanol**, **BD - Biodiesel**, **CSET - Corn and Stover Ethanol**, **PLA - Polylactic Acid**, **SL - Soybean Lubricant**.

So what are the Alternatives?

Cleaner methods of converting corn to ethanol. Less fossil fuel usage in the conversion of corn to ethanol.



- **Other Sources of Ethanol.** Switchgrass, Sugar Cane, Soy, and Miscanthus are still in development stages, but seem to have less global warming potential.
 - **Other Substitutes for Gasoline.** Gas-Electric Hybrids that could be supplemented with wind energy or other sources.
 - **More Research!** Until we know the costs and benefits, financially and environmentally, we should not devote all of our efforts to corn ethanol.
- Image from: UC Berkeley Transportation Sustainability Research Center

For More Information, See these Websites:

•20/20 Interview:

This debunks the myth that politicians are selling.
http://www.youtube.com/watch?v=j9QQcP_YIII

•The Why Files: Renewable fuel: Help for global warming?

Very plain language website with very useful info.
<http://whyfiles.org/253ethanol/index.php?g=2.tst>

This poster was developed as an assignment for Honors 295: **Population, Environment, Sustainability - Ethics for Living into the Future**, Fall 2007. References can be obtained by contacting the author.