Ethanol

Winter 2005
Beth LaShell
TS2T 402
What is Ethanol

- Liquid ethanol is ethyl alcohol or grain alcohol
- 190 proof alcohol
- Colorless, volatile, flammable liquid
Ethanol Production

- **In 2000**
  - 1.5 billion gallons of ethanol produced
- **Found in 11% of gasoline sold in U.S.**
- **Forms found include**
  - 10% ethanol and 90% gasoline
  - Reformulated/oxygenated fuels
    - Replacement for MTBE
  - E-85: 85% ethanol and 15% gasoline
Ethanol production in Other Countries

- **Brazil** – 4 billion gallons /year
  - Began in 70’s
  - Made from sugar cane
  - 40% of cars run on pure ethanol
- **Sweden**
  - Uses ethanol in chemical production
  - Has cut crude oil consumption in half since 1980.
- **Canada**
  - Now exporting most of production to U.S.
- **India**
How is Ethanol made?

- Made by fermenting almost any material that contains starch
  - Mostly corn and sorghum
  - Also potatoes, sugarcane, artichokes

- Process
  - Remove starch
  - Break down into simple sugars
  - Fermentation - Add yeast to sugar mixture
    - Alcohol and carbon dioxide are produced
History of Ethanol

- 1860
  - Nicholas Otto uses ethanol as fuel
- 1862
  - Union congress puts $2/gallon tax on ethanol to fund Civil War
- 1896
  - Henry Ford runs first automobile on ethanol

http://msnbc.msn.com/id/3540967/ on 2/25/05
History....

- 1906
  - Ethanol tax removed
- 1917
  - Ethanol demand up to 50-60 m gallons
- 1930
  - Gasohol introduced (between 6-12% ethanol)

http://msnbc.msn.com/id/3540967/ on 2/25/05
History....

- 1941-45
  - Production increases during WW II
- 1945-78
  - Low fuel prices; less demand
- 1975
  - Lead gasoline phased out
  - Ethanol looked at as octane booster

http://msnbc.msn.com/id/3540967/ on 2/25/05
History....

- 1978-79
  - Energy Tax Act – Renewable fuels
  - $1 billion goes to research

- 1980
  - 10 ethanol facilities

- 1983
  - Ethanol subsidy at $.50 /gallon

http://msnbc.msn.com/id/3540967/ on 2/25/05
History....

- **1984**
  - $.60 subsidy
  - 163 ethanol plants

- **1985**
  - 74 Ethanol plants producing 595 m gallons
  - Crude oil prices low

- **1988**
  - Used as oxygenate along with MTBE and ETBE

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History....

- 1990
  - $.54 subsidy
  - Will be reduced to $.51 in 2005
- 1995-96
  - Corn prices double to $5.00/bushel
  - Some states created additional subsidies
- 2000
  - EPA recommends MTBE be phased out

http://msnbc.msn.com/id/3540967/ on 2/25/05
From a bushel of Corn (56 pounds)

- 2.5 gallons of ethanol
- 12.4 lb of 21% protein livestock feed
- 3.0 lb of gluten meal
- 1.5 lb of corn oil
  - 2 lb of margarine
- 17 lb of carbon dioxide
  - Refrigerant, carbonated beverages, flush oil wells
Ethanol Claims

- Improves combustion
- Reduces carbon dioxide emissions
- Reduces our dependence on foreign oil
- Stabilizes corn prices
  - Increases farm income
  - 3\textsuperscript{rd} largest user of corn
- Provides industry jobs to rural America
  - Increase state tax receipts
## Energy Ratios

<table>
<thead>
<tr>
<th></th>
<th>BTUs</th>
<th>Percentage</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave:</td>
<td>30,589</td>
<td>38%</td>
<td>1.38:1*</td>
</tr>
<tr>
<td>Best:</td>
<td>62,857</td>
<td>109%</td>
<td>2.06:1</td>
</tr>
<tr>
<td>State of art:</td>
<td>72,413</td>
<td>151%</td>
<td>2.51:1</td>
</tr>
</tbody>
</table>

*If 100 BTUs of energy are used to plant, harvest and transport crop then 138 BTUs are available in fuel ethanol

Argonne National Laboratory – US Department of Energy
Technology Improvements

Cost of Production

- **1980**
  - $1.40 per gallon

- **2001**
  - $1.00 per gallon
  - Cost at pump: $1.77
Critics of Ethanol

- Use grain for world hunger
- Ethanol industry receives too many favorable incentives
- Foreign oil imports only reduced slightly
- Can damage or plug fuel system components
- Does little to reduce emissions
- Reduces motor fuel tax

Dr. David Pimental; Cornell University
Ethanol Subsidies

- Of $1 billion total subsidy:
  - Archer Daniels Midland (ADM)
    - Receives 40% of total
    - $400 million/year
Who else receives subsidies?

- 1917
  - Oil industry receives first subsidy
- 1984:
  - 8.5 billion to oil industry
  - 1.7 billion to renewable fuel industries
According to GAO

- “little change in air quality or global environmental quality” would result if ethanol subsidies ended.

Grewell, J. Bishop, “Farm Subsidies are Harm Subsidies”. The Economist
http://www.taemag.com
Dr. Pimentel’s Study- 2001

- Ethanol uses 29% more energy than it creates
  - 99,119 BTUs used
  - 77,000 BTUs created

Versus Gasoline

- Ethanol production is extremely energy efficient, with a positive energy balance of 125%, compared to 85% for gasoline.
- Ethanol production is by far the most efficient method of producing liquid transportation fuels.
- According to USDA, each BTU (British Thermal Unit, an energy measure) used to produce a BTU of gasoline could be used to produce 8 BTUs of ethanol." -- American Coalition for Ethanol (ACE)

http://www.ethanol.org/ethanol_info.html
Current Wholesale Price Differences

http://www.neo.state.ne.us/statshtml/66.html on 2/25/2005