Major Issues Affecting Biofuel Growth and Development in the U.S.

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http://www.eia.doe.gov/oiaf/aeo/index.html
Why Biofuels?

- High World Oil Prices
- Renewable/Environment
- Regulatory Incentive
- Energy Security
- Liquid Fuel
- Agriculture
- Because the President said so ...
## Characteristics of Biofuels

<table>
<thead>
<tr>
<th>Feedstocks</th>
<th>Biodiesel</th>
<th>Ethanol</th>
<th>Cellulosic Ethanol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean Oil</td>
<td>Casein</td>
<td>Corn</td>
<td>Switchgrass</td>
</tr>
<tr>
<td>Canola Oil</td>
<td>Waste Grease</td>
<td>Sugar Cane</td>
<td>Woody Biomass</td>
</tr>
<tr>
<td>Waste Grease</td>
<td>Animal Fats</td>
<td>Sugar Beets</td>
<td>Biomass Residue</td>
</tr>
<tr>
<td>Animal Fats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common Blends</td>
<td>B2, B5, B20, B100</td>
<td>&lt;E10, E20, E85</td>
<td></td>
</tr>
<tr>
<td>2005 Production</td>
<td></td>
<td></td>
<td>Small</td>
</tr>
<tr>
<td>(MMgal)</td>
<td>91</td>
<td>3,900</td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>Transesterification</td>
<td>Dry Mills</td>
<td>Hydrolysis</td>
</tr>
<tr>
<td>Technique</td>
<td></td>
<td>Wet Mills</td>
<td>Gasification/F-T</td>
</tr>
<tr>
<td>ASTM Standard</td>
<td>D 6751</td>
<td>D 4806</td>
<td></td>
</tr>
</tbody>
</table>
## A Booming Biofuel Industry

<table>
<thead>
<tr>
<th>Year</th>
<th>Gasoline (billion gal)</th>
<th>Ethanol (billion gal)</th>
<th>% of Gasoline Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>128.7</td>
<td>1.63</td>
<td>1.27%</td>
</tr>
<tr>
<td>2001</td>
<td>129.3</td>
<td>1.77</td>
<td>1.37%</td>
</tr>
<tr>
<td>2002</td>
<td>132.8</td>
<td>2.13</td>
<td>1.60%</td>
</tr>
<tr>
<td>2003</td>
<td>134.1</td>
<td>2.80</td>
<td>2.09%</td>
</tr>
<tr>
<td>2004</td>
<td>137.0</td>
<td>3.40</td>
<td>2.48%</td>
</tr>
<tr>
<td>2005</td>
<td>136.9</td>
<td>3.90</td>
<td>2.85%</td>
</tr>
</tbody>
</table>

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Locations of Ethanol Facilities

- Biorefineries in Production (112)
- Biorefineries under Construction (76)

Source: Renewable Fuels Association
1.29.07
What are the Major Obstacles to Growth?

- Resource Limits
- Economic Constraints
- Technical Challenges
- Infrastructure Roadblocks
Resource Limitations

The amount of arable land in the United States is limited, no new land has been added, and existing land is under pressure to produce more than ever before.

U.S. Cropland - Breakdown by Use

- Cropland
- Idle
- Pasture

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Overcoming Resource Limitations

- **Find More Land** - convert CRP, forestlands, and pastureland to cropland (for cellulosic)

- **Use Existing Land More Efficiently**
  - Boost Corn/Soybean Yields
  - Engineer corn/soybeans to have more starch/oil

- **Change the Resource Limits**
  - Cellulosic Ethanol
  - Use “2nd-Generation” feedstocks: perennials, agricultural residue, forest biomass, dedicated oilseed crops, etc.
The Conservation Reserve Program

Active CRP Acreage (1/2007)

1 dot = 20,000 acres
The Promise of Cellulosic Ethanol

- Dedicated Energy Feedstocks
  - Limited Interaction with Food/Feed Markets
  - More Environmentally Friendly
  - Potentially much cheaper
- Resources are Larger
  - Derived from Waste Streams
  - Grown in less favorable conditions/on marginal land
- Liquid Fuel
- Long-term Growth Potential
Cellulosic Biomass Supplies (Excludes Corn Grain)

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Economic Constraints

- **World Oil Price**
- **Feedstock Price/Co-Product Values**
  - 57% of ethanol production cost is the feedstock
  - 70-78% of biodiesel production cost is the feedstock
  - High Value Co-Products essential to lower costs
- **Saturation of Co-Product Markets**
  - Large supply of DDGS, crude glycerin can depress prices
- **Federal Tax Incentives**
- **Blended Biofuels vs. Dedicated Biofuels**
Imported Crude Oil Prices
(Annual Energy Outlook 2007)

$ (2005)/barrel

Reference Case  Low Price  High Price

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The Importance of Co-Products

Biofuel Feedstock

Co-Products
DDGS
Crude Glycerin

Biofuel Production Facility

Biofuels
Ethanol
Biodiesel

Oil/Fuel Markets

Non-Fuel Markets
Regulatory Incentives

- EPAct 2005 - Renewable Fuel Standard
  - 7.5 billion gallons by 2012, 250 million from cellulosic
- Biofuel Tax Credits
  - $0.51/gal for ethanol - expire/reauthorize in 2010
  - $1.00/gal for biodiesel from virgin oil feedstocks
  - $0.50/gal for biodiesel from recycled/waste feedstocks
  - Biodiesel tax credit - expire/reauthorize in 2008
- Import Tariff on Ethanol - $0.54/gal extended to 2009
- State Incentives?
Blended vs. Dedicated Biofuels

Short-term demand for biofuels is primarily for blends. Long-term demand required for sustained industry growth must come from high-percentage, dedicated biofuels.

<table>
<thead>
<tr>
<th>2005 Biofuel Production (billion gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiesel</td>
</tr>
<tr>
<td>0.091</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential Blend Market (billion gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E10</td>
</tr>
<tr>
<td>B2</td>
</tr>
<tr>
<td>B5</td>
</tr>
<tr>
<td>B20</td>
</tr>
</tbody>
</table>
Infrastructure Roadblocks

• “Pumps, Pipelines and People”
  • Pumps - limited # of high-blend biofuel pumps
  • Pipelines - high transportation costs to end-markets
  • Low consumer awareness, limited # of FFV’s
Limited Biofuel Pump Availability

<table>
<thead>
<tr>
<th>Fuel</th>
<th># of Stations</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Fuels</td>
<td>~169,000</td>
<td>100%</td>
</tr>
<tr>
<td>Biofuels (Total)</td>
<td>2,125</td>
<td>1.25%</td>
</tr>
<tr>
<td>E85</td>
<td>1,157</td>
<td>0.7%</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>968</td>
<td>0.5%</td>
</tr>
</tbody>
</table>
Transporting Biofuels to Market

National Ethanol Price Map (11/30/2006)

Spot Prices (11/30/2006) $/gal Ethanol
- 2.11 - 2.14
- 2.15 - 2.17
- 2.18 - 2.2
- 2.21 - 2.23
- 2.24 - 2.27
- 2.28 - 2.31

Source: Ethanol & Biodiesel News - Dec. 4, 2006
Limited Numbers of FFV’s

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Technical Challenges

- Cellulosic Ethanol Capital Costs/Production Technology
- Retrofitting Pumps, Fuel Systems, Fuel Distributors
- Maintaining Fuel Quality
- After-market Biofuel Kits - emissions certification
- New Engine Designs - Biofuel Only?
- Energy Content and Fuel Volume
Energy Content and Fuel Volume

Energy Content (Btu/gallon)

- Gasoline
- E100
- E85
- Diesel
- B100

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Thank you

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