BIOFUEL FACT SHEET

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DEFINITION

Biofuels are liquid fuels produced from biological materials like sugarcane, grains, grasses, crop residues, wood, and animal wastes.

UNITED STATES FOSSIL FUEL STATISTICS

- **National consumption of transportation fuel:** About 200 billion gal per year (140 billion gal gasoline, 60 billion gal diesel).
- **Amount imported:** 60% of national consumption, half of this (30% of total consumption) from unstable parts of the world – Middle East, Venezuela and Nigeria.
- **Oil company 2006 profits:** Exxon Mobil, $39.5 billion; BP, $22 billion; ConocoPhillips, $15,5 billion.
- **Other Statistics:** The US owns only 3% of the world's oil and has only 5% of the world's population, but uses 25% of the world's oil.
- **Impacts:** Imported oil is the largest contributor to the extremely costly negative balance of payments for the US, poses considerable risk in terms of national security and global climate change, and is probably a major reason for involvement of American military forces in Iraq.

ETHANOL

- Ethanol is the same alcohol as found in wine and other alcoholic beverages.
- It is mostly produced by fermenting sugars with microorganisms such as yeasts, as in the production of "moonshine".
- Ethanol can be used as an octane enhancer in gasoline (10% ethanol/90% gasoline) in place of the banned MTBE and as such, can be used in any vehicle, but if it is used as a primary fuel (up to 85% ethanol and 15% gasoline – or E-85), some engine modification is necessary.
- A gallon of ethanol contains only two thirds of the energy contained in a gallon of gasoline, so if gasoline costs $3.00/gal, an equivalent cost of ethanol would be about $2.00/gal.
- Ethanol cannot be transmitted by pipeline because it is corrosive; therefore, it is transported by rail or truck.
- There are currently about 6 million flex-fuel or E-85 vehicles in the US – about 2-3% of the national fleet.

ETHANOL FROM CORN

- **Background:** Production of ethanol from corn developed primarily as a means to use surplus corn, and almost all the ethanol in the US today is produced from corn grain. The starch in the corn is first broken down into sugars by biological catalysts known as enzymes, and the resultant sugars are then fermented into ethanol.
- **Yield:** Corn yields about 2.8 gal of ethanol per bushel, or about 100 bu/ac x 2.8 gal/bu = 280 gal/ac in Alabama, and 150 bu/ac x 2.8 gal/bu = 420 gal/ac in the Mid-West corn belt.
- **Energy balance:** For every unit of fossil fuel used in the production of ethanol from corn, about 1.67 units are produced in the form of ethanol.
- **Corn-to-ethanol plants:** There are a little over a hundred plants in production in the US, with about 70 new plants due to come on line in the next 2 years: most new plants are large (100 million gal/yr).
- **Capital costs:** A corn-to-ethanol plant costs about $1.50-$2.00/annual gallon, which means a 100 million gal/yr plant will cost $150-$200 million.
- **Corn consumption:** About 15% of the US corn crop was used in 2006 to produce ethanol.
- **Volume:** About 6 billion gallons (3% of national gasoline consumption) of ethanol is expected to be produced from corn in 2007.
- **Corn price:** The price of corn has risen from $2.80/bu to $4.20/bu over the last few months, and at the latter price will cost $1.50/gal for the corn alone, and over $2.00/gal if all costs are included.
- **Subsidy:** Without the 51 cents/gal subsidy, ethanol from corn would not be competitive with gasoline.
- **Environmental implications:** Essentially carbon neutral, therefore having a positive effect on global climate change if used in place of fissil fuels.
- **Impacts:** The sharp rise in the price of corn is driving food and feed prices up, and leading to an expansion in expected corn acreage from about 80 million acres in 2006 to 90 million acres in 2007, mainly at the expense of land in soybeans and cotton.

BIODIESEL

- **Definition:** A liquid fuel produced by trans-esterification of vegetable oils or animal fats.
- **US Production:** A total of about 250 million gal (0.4% of total US annual diesel consumption) of biodiesel is expected to be produced in the US in 2007, mainly from soybean oil.
- **Plant size:** Size of biodiesel plants is highly variable, ranging from small units that often process used cooking oil into a few thousand gallons per year, up to 50 million gal/year plants and bigger.
- **Use:** Biodiesel can be used in any diesel engine without modification.
- **Problems:** Biodiesel can congeal at low temperatures, and it can also clog fuel filters: therefore, it is typically use in a mixture at 5-20% with 95-80% conventional diesel (B5 to B20), and some diesel vehicle manufacturers will not honor warrantees on new vehicles if more than B5 is used.
- **Energy balance:** The energy balance for biodiesel production is higher than for ethanol production, and typically above 3:1.
- **Environmental:** Biodiesel is also essentially carbon neutral, produces very little in the way of offensive emissions.
- **Impact:** Use of soybeans to produce biodiesel is also impacting food process, but use of used cooking oil solves some environmental problems otherwise experienced with disposal of this material.

CELLULOSIC BIOFUELS

- **Definition:** Cellulosic biofuels are liquid transportation fuels (including ethanol, but also regular diesel, gasoline and aviation fuel) produced from cellulosic materials (mostly plant materials made up mainly of cellulose and hemicellulose, such as wood, grass, forest and crop residues, and animal waste).
- **Current status:** At this time there is no commercial plant in the world that is producing cellulosic biofuels, but there is an enormous amount of R&D being undertaken in this field.
- **Technologies:** Many technologies to produce cellulosic biofuels are under development: links to company web sites for some of these are provided below:

  Dilute acid hydrolysis and fermentation
  SEKAB: http://www.sekab.com
  Concentrated acid hydrolysis and fermentation
  Arkenol: http://www.arkenol.com/
  Brelsford Engineering: http://www.beienginc.com/
  Enzyme hydrolysis and fermentation
  Abengoa Bioenergy: http://www.abengoabioenergy.com
  Celunol: www.celunol.com
  Iogen: www.iogen.ca
  Gasification and catalytic conversion
  Range Fuels: www.rangefuels.com
  Woodland Chemical Systems: www.woodlandchemicals.com
  Gasification and catalytic conversion to diesel
  Rentech Inc.: http://www.rentechinc.com/
  Choren Industries: www.choren.com
  Depolymerization and catalytic synthesis
  Green Power Inc. http://www.cleanenergyprojects.com/
- **Energy balance:** The energy balance for production of cellulosic biofuels is expected to be considerably higher than that for corn-to-ethanol: 4:1 or better.
- **Yield:** Depending on technology, yields of 65 to 100 or more gallons per ton of raw material are expected for cellulosic biofuel production, and for a crop like switchgrass that can produce 7.5 tons/acre/yr in commercial fields, this will amount to 488-750 gal/acre/yr.
- **Capacity:** A report from the USDA and DOE released in 2005 indicated that 1.36 billion tons of plant biomass could be produced every year in the US: if this is converted at an efficiency of 100 gal/ton it would result in 136 billion gal/yr, or 68% of total US transportation fuel consumption and more than all the fuel currently produced from imported oil.
- **Impact:** Cellulosic biofuels are also essentially carbon neutral, but since they are produced from non-food and non-food materials their use will not have the same negative impacts on feed and food prices and supply that are currently being experienced with use of grains to produce biofuels.

SUMMARY

In his 2007 State of the Union Address, President Bush announced the "20 in 10" plan: to reduce the consumption of gasoline in the US by 20% within 10 years. This goal cannot be achieved by using only grain to produce transportation fuels, but use of cellulosic biofuels along with fuel saving technologies, like hybrid electric cars, could well lead to successful accomplishment of this vision. Consequently, the US Department of Energy recently announced six grants totaling $385 million for private companies to build the first commercial-scale cellulosic biofuel plants in the United States over the next few years.