

Bio-fuels – Myth or Reality?

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Outline

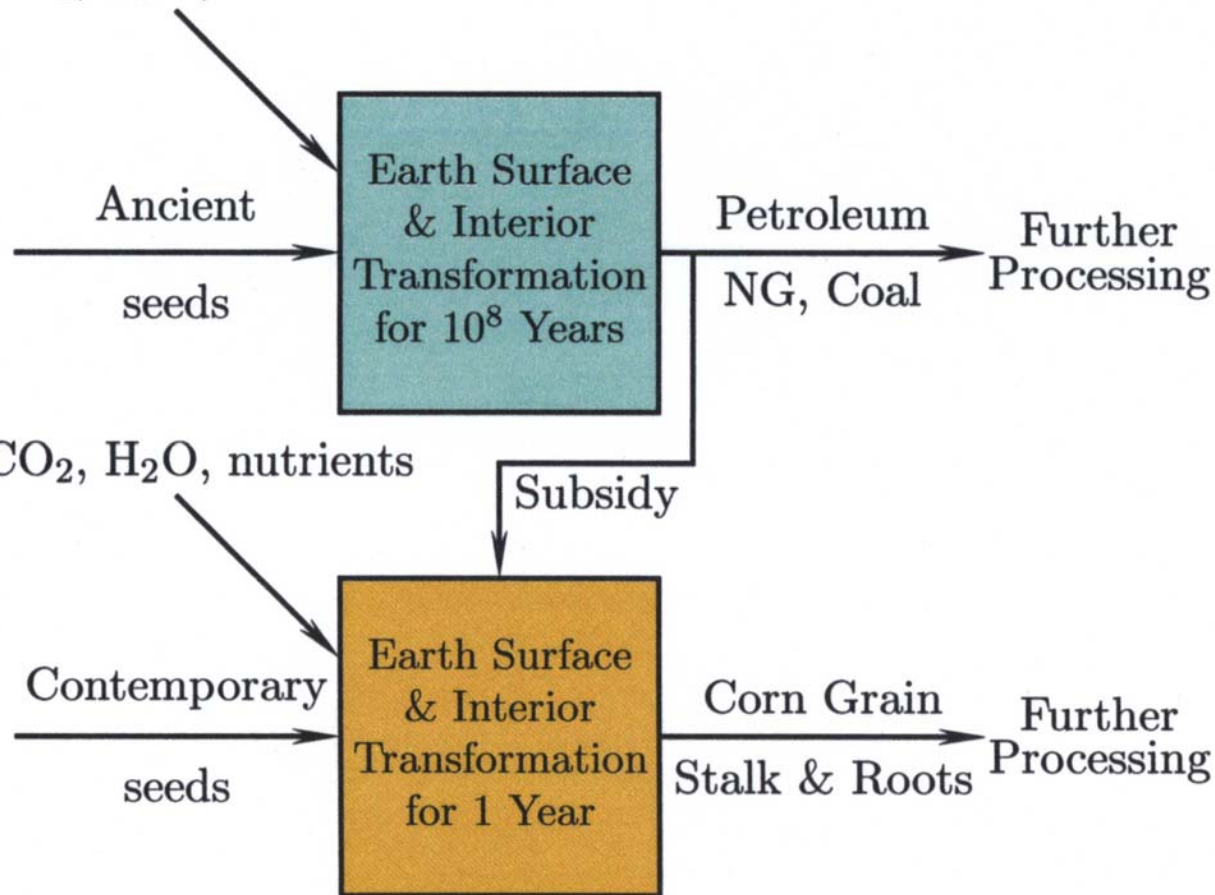
- Bio-fuels – Definition
- Processes
- Capacity and supply
- Conclusions

Bio-fuels

- Fuels made of feedstock which can be naturally grown over a short period of time
 - » Corn
 - » Sugarcane
 - » Switch grass
 - » Soyabean
 - » Palm oil

Bio-fuel vs Gasoline

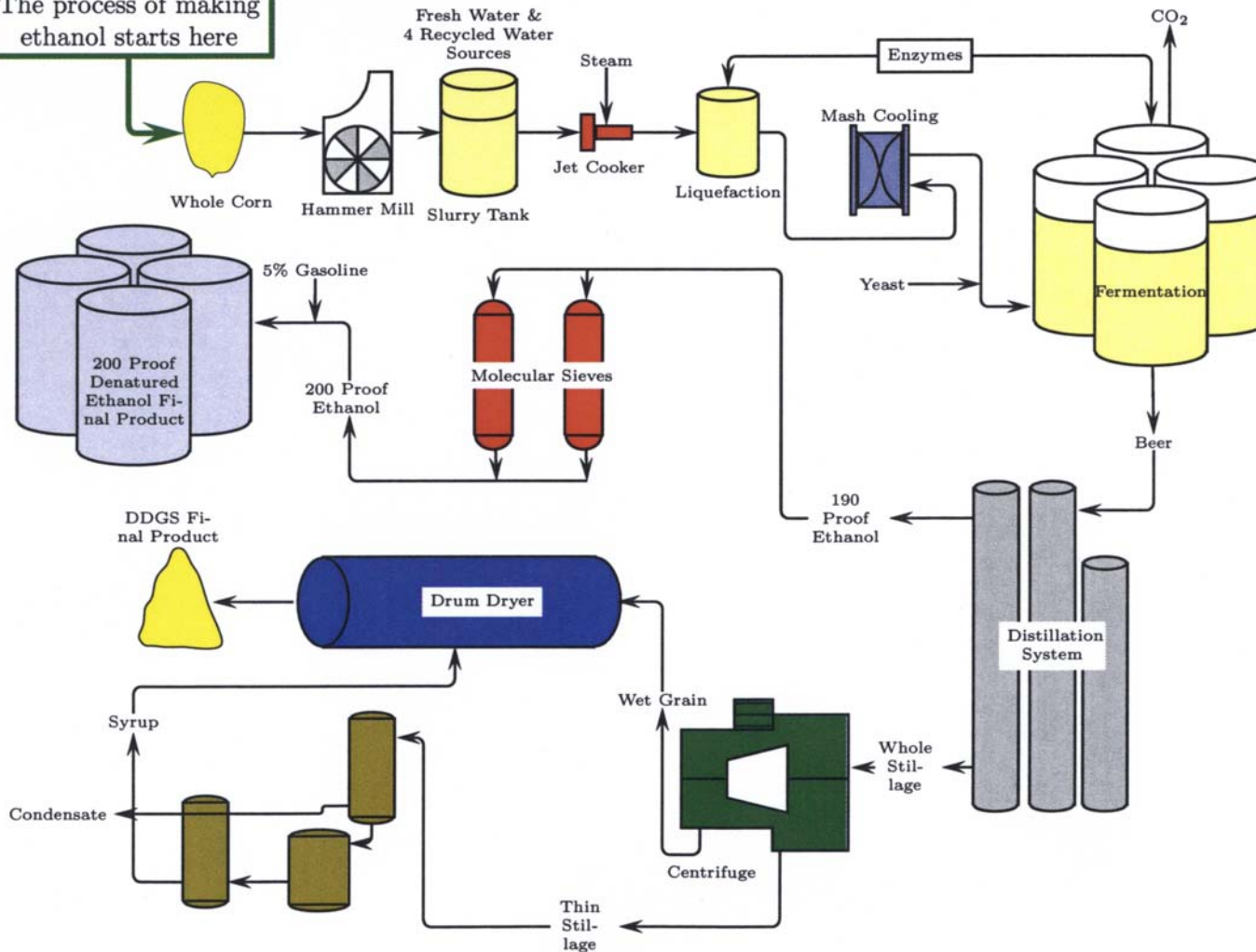
Sun, CO₂, H₂O, nutrients



After Patzek, T.W., 2006

Ethanol from Corn

The process of making ethanol starts here



After Patzek, T.W., 2006

Ethanol from Corn

- Typical extractable starch content: 66 %
- Typical ethanol yield: 2.6 gal/bushel – 2.8 gal/bushel
- Typical fossil fuel requirement (gas + electricity): 60 to 70 % of energy output by ethanol (this excludes transportation cost)
- Corn is widely dispersed and cannot be piped, so cost of transportation is significant
- Ethanol is highly corrosive, and will need to be trucked

Ethanol from Sugar cane

- Similar to the process for corn
- The input energy is about 50 % of the output energy
- Plantation of sugar cane has resulted in significant de-forestation in Brazil – the largest producer of sugarcane based on alcohol

Ethanol from Cellulosic Plants

- Wood, green plant materials (e.g., switch grass) is chemically separated and partially split into hexose and pentose and then fermented
- Very high cost of enzymes in the hydrolysis of cellulose to produce sugars
- Very difficult to decompose and energy intensive – costs 130 % more energy than the calorific value of ethanol
- Currently commercial process is not available to produce ethanol from cellulosic materials; however, many companies are trying to commercialize new enzymes or better fermentation technologies

Bio-diesel

- Conversion of vegetable oil (mostly palm oil), cooking oil into diesel
- Results in better efficiency than ethanol from corn
- The current cost is about \$ 3.50/gallon – making it difficult to be economical without subsidy – The available subsidy for it is about \$ 1/gallon from federal government

Bio-butanol

- Conversion of either corn or bio-mass to butanol
- Energy content lot closer to gasoline than ethanol
- Less corrosive, less vapor pressure
- High production costs about \$ 4/gal
- Two plants are under construction in UK



Myth vs. Reality

- Generating fuel from corn is much more efficient
- Considering input v output energy requirements, it takes 60 to 70 % of the energy to produce ethanol from corn. It only takes 12 % of the energy to generate gasoline from crude oil

Myth vs. Reality

- Using corn will result in less emission of CO₂ in the atmosphere and hence less green house gas
- The most optimistic study states that 12 % less emission of green house effect gases than gasoline; other studies predict more green house gases due to use of fossil fuels in making ethanol

Myth vs. Reality

- Ethanol is much more efficient fuel than gasoline
- Ethanol has higher octane value; however, currently 1 gallon of ethanol can provide the same mileage as 0.8 gallon of gasoline

Myth vs. Reality

- Ethanol is cheaper than gasoline
- The cost of bushel of corn has increased more than 80 % in the last two years. With a cost of \$ 4/bushel, the cost of feed stock alone is \$ 1.50/gallon

Myth vs. Reality

- Ethanol can be produced without subsidies
- Federal government provides subsidies to farmers to grow corn and convert it into ethanol. The total subsidy is approaching \$ 1.20/gallon – with no end in sight

Myth vs. Reality

- Ethanol can replace gasoline and hence energy dependence on foreign oil in the U.S.
- If the entire corn harvest is used to produce ethanol, it would replace 12 % of gasoline in the U.S.; however, once we account for energy required to produce ethanol, it would only replace about 3 % of current gasoline use

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Myth vs. Reality

- Using corn for ethanol production should be ok since we have excess corn production
- To fill one tank of SUV will require the same corn as one person eating for a whole year. A clear competition between fuel vs. food

Myth vs. Reality

- Using corn for ethanol production should not affect other parts of life
- Increase in corn prices will affect the prices of cereals and foods. It will also adversely affect the meat and poultry industries

Myth vs. Reality

- We can always increase corn production per acre with improved farming techniques
- It is possible but not sustainable; large amounts of fertilizers, water and other resources would be needed; crops like wheat which require less water would be replaced with corn – environmentally may be challenging

Myth vs. Reality

- If US likes ethanol as a fuel for cars, it must be encouraging import of ethanol over crude oil
- US likes ethanol but not that much!
Currently, 50 c/gallon import tax is imposed on imported ethanol from Brazil

Myth vs. Reality

- Look at success in Brazil where they are replacing 40 % of gasoline with sugarcane based alcohol
- Brazilians fill 60 % of their cars with diesel, so 40 % of replaced gasoline only represents 16 % of the total fuel; secondly, Petrobras has made Brazil energy independent; therefore, it is trying to export the produce ethanol

Myth vs. Reality

- Look at success in Brazil where they are replacing 40 % of gasoline with sugarcane based alcohol. This must have favorable environmental impact
- 80 % of Brazil's greenhouse emissions come from deforestation when forests are cut and used for sugarcane. A hectare of land saves 13 tons of CO₂ if used to grow sugarcane; but the same hectare can absorb 20 tons of CO₂ if it remains forested.

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Myth vs. Reality

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- Requires 45 % of more energy to harvest and process than the value of fuel that is produced. Will require significant agricultural land to produce sufficient amount to make a noticeable difference

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Myth vs. Reality

- U.S. can grow enough biomass (1.3 billion tons) to produce 130 billion gallons per year in 20 years
- Will require 72 % of areable land to produce that much biomass and it would replace 50 % of the car fuel. If we include fuel required to produce that biomass, it would replace 10 % of the fuel

Myth vs. Reality

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- Deforestation can accelerate soil erosion 30 times more than soil erosion. Many rare species living in tropical climate would be lost permanently

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Myth vs. Reality

- If biofuels are that bad, why the stocks of the companies making biofuels is increasing?
- Currently, government (both federal and state) subsidies are skewing the true economic picture of making biofuels. Shares of the most companies involved in ethanol production have significantly lost value in the last 6 years

Myth vs. Reality

- The politicians must understand the true cost of biofuel, so they will only propose policies which will help us solve the problem of energy dependence in the long term
- Senator McCain: “ethanol is a giveaway to special interests in corn growing states at the expense of rest of the country” (2002)
- “ethanol is a vital alternative energy source not only because of our dependency on foreign oil (2006)

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- Senator Clinton: “ethanol subsidies were equivalent to new tax” (2002)
- “we need to limit our dependence on foreign oil. We have a perfect example of that in Iowa where so much ethanol being produced here” (2006)

Myth vs. Reality

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- Senator Obama: “lowering the tariffs on (brazillian based ethanol) would make us dependent on foreign ethanol” (2006)



What are the real solutions?

- Try to understand what is a sustainable energy source
- Think about conserving fossil fuels and using them more wisely
- Use energy efficient energy extraction processes



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