Biofuels 101: the Short Course

DEFINITION: "Wood-derived processed fuels and chemicals, generated through conversion of the chemicals found in wood into other forms, and generally serving as replacements for petroleum-derived products currently in the marketplace."[1]

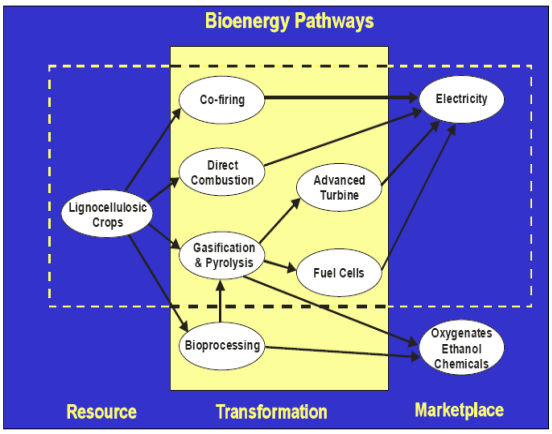
PROCESSES TO DERIVE BIOFUELS

- Fermentation
- Gasification
- Pyrolysis
- Fractionation

MULTIPLE PRODUCT STREAMS*[3]

- Ethanol
- Diesel
- Dimethyl ether (propane substitute)
- Methanol
- Acetic acid
- Mixed alcohols
- Resins
- Levulininic acid (platform chemical for multiple products)

Bioenergy Pathways[2]



CAPITAL COST PER GALLON OF ANNUAL PRODUCTION†[4]

Company	Feedstock	Capital cost per annual gallon
Abengoa	Ag residues	$16.70+
Alico	citrus peel/wood/energy cane	<$4.00
Bluefire	sorted MSW	$5.30
Iogen	Ag energy crops	$11.10
Range Fuels	Wood	$4.60
	Corn	$1.60

Capital cost and operating costs for 150 MMGPY gasoline equivalent plants (2005 dollars)[5]

Fuel	Total capital cost ($ millions)	Capital cost per unit production (pbpd)*	Operating cost ($ per gallon)**
Grain ethanol	111	13,000	1.22
Cellulosic ethanol	756	76,000	1.76
Methanol	606	66,000	1.28
Hydrogen	543	59,000	1.05
Fischer-Tropsch	854	86,000	1.80

* Per barrel per day gasoline equivalent.

** Gallons gasoline equivalent.

Note: These figures were developed using a corn price of $2.12/bushel. As corn prices rise, the cost differential between conventional grain ethanol production and cellulosic ethanol product closes up. Three-month futures for corn on CBOT were at ~ $3.30/bushel as of 07 September 2007.

CHALLENGES FOR DEVELOPMENT OF WOOD-BASED BIOFUEL FACILITIES[6]

- Process economics: Economics not proven for Maine at commercial scale.
- High capital cost: Technology still in relative infancy.
- Cost and availability of feedstock: Volatile, likely to increase as demand increases, competes with existing pulp and paper, biomass to energy facilities.
- Perspectives of scale: What is considered a large wood processing facility is considered small for a typical refinery.

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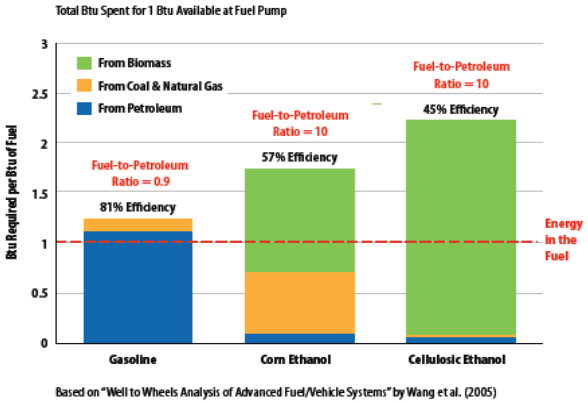
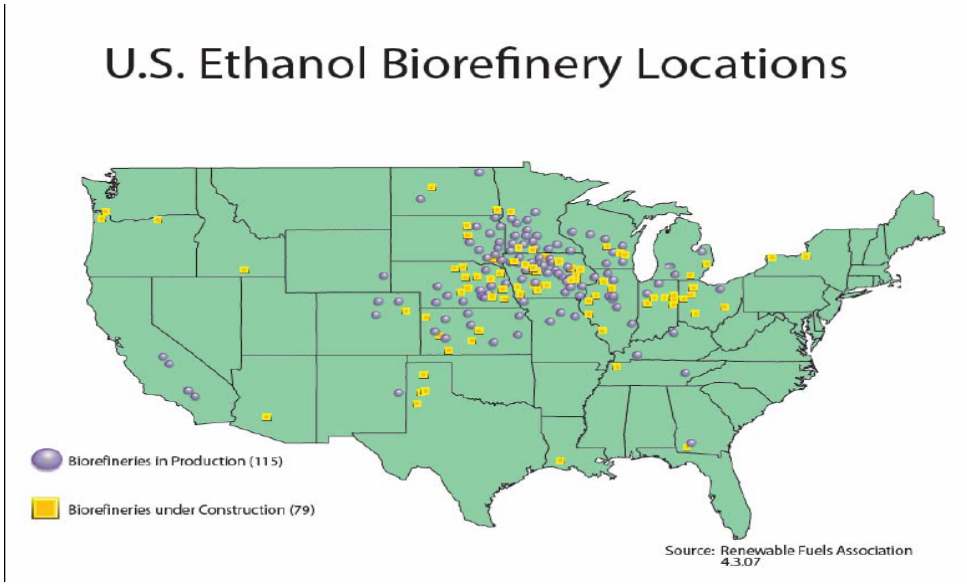
* Depending on technology used.
† Cost estimates only for funded technologies.

Energy required to produce fuels[7]



INTERESTING TIDBITS

- A dry ton of biomass yields about 67 gallons of ethanol.[‡8]
- Compared to conventional petroleum diesel, biodiesel reduces carbon dioxide emissions by 78%, particulate matter by 32%, carbon monoxide emissions by 35%, sulfur oxide emissions by 8% (on a life cycle basis).[9]



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[7] National Renewable Energy Laboratory. n.d. From biomass to biofuels: NREL leads the way. 6 pp. http://www.nrel.gov/biomass/pdfs/39436.pdf. Last accessed 14 September 2007.
[8] http://genomicsgtl.energy.gov/biofuels/transportation.shtml. Last accessed 14 September 2007.
[9] http://www.epa.gov/otaq/models/analysis/biodsl/p02001.pdf. Last accessed 14 September 2007.

[‡] This is a conservative estimate. Others estimate conversion at 80-100 gallons (Kingsely, E. 2007, personal communication.)