U.S. Ethanol Supply Could Replace Gasoline

Jime Lane Biofuels Digest *[1] — September 14, 2009*
For a number of years, biofuels studies have suggested that, even under the most optimistic scenarios, biofuel production in the United States could only replace a fraction of overall US fuel consumption.

The most optimistic scenarios — produced by the Sandia National Laboratory — previously suggested a limit of 90 billion gallons of biofuel. However, a combination of slowing US gasoline demand, and rising yields from cellulosic and first-generation fuel technologies, suggest that, at least on the gasoline side, US resources may in fact exceed total demand.

According to EIA projections, US gasoline demand will fall this year to as low as 125 billion gallons [2].

Further, ZeaChem is reporting projected yields of 135 gallons per ton of poplar biomass [3], while Fulcrum BioEnergy is reporting yields of 120 gallons per ton on post-sort municipal solid waste.

Using these figures, and commencing with a baseline of 11 billion gallons from corn ethanol, US potential capacity could be 152 billion gallons of ethanol under the most optimistic assessment of biomass resources presented by the Oak Ridge National Laboratory in their landmark "Billion ton study" in 2005 [4]. The billion tons of biomass is a long-term projection and is based on both land-use change and sustained increases in yields over a 30–40 year period.

Grain production: 4 billion bushels @ 3.0 gallons/bushel (POET – BPX process) — 12 billion gallons

Cellulosic biomass: 913 million tons @ 135 gallons per ton — 123 billion gallons

Municipal solid waste: 165 million recoverable post-sort tons @ 120 gallons per ton — 20 billion gallons

Total: 155 billion gallon potential ethanol supply*

***Please note:**

1. *These are theoretical limits based on three technologies that do not control 100 percent of the feedstocks markets, nor are likely to. Other technologies have lower yields.*
2. *ZeaChem and Fulcrum yields are based on pilot scale projects, and ZeaChem's process has not been demonstrated against all potential*

feedstocks in the "billion ton study". Actual yields may vary. However, there would be enough ethanol to replace all US gasoline – based on the Oak Ridge biomass projections – at yields of 101 gallons per ton, or a 25 percent drop in average yields from the current ZeaChem numbers. As ZeaChem points out, the difference between traditional yield estimates capping at around 110 gallons per ton for wood biomass is that ZeaChem's proces more efficiently recovers carbon dioxide.

3. The cellulosic biomass tonnage is based on projections from Oak Ridge National Laboratory *[4] based on land-use change and sustained high-level increases in annual yields. 4. Municipal solid waste recoverable post-sort tons are an estimate made by private waste-to-energy producers, although total US MSW production exceeds the figure.*

Background on ZeaChem

In July, ZeaChem, ranked #11 in the Hottest Companies in Bioenergy for 2008-09 [5], confirmed that it is on track to complete a demonstration-scale plant in Boardman, Oregon [6] where yields of more than 2,000 gallons per acre per year can be achieved.

A slideshow on the company is located here [6].

Why the high yields, which approach the yields associate with microcrops such as algae? It's a combination of a 135 gallons per dry ton yield from ZeaChem's process, plus the use of fast-growing biomass such as poplar which can be sustainably harvested at 15 bone-dry tons of biomass per acre per year.

Sugarcane ethanol yields are generally considered to be in the 800 gpa range, but sugarcane biomass remains the most promising macrocrop in terms of potential yield due to the fast growing rates of the crop, as much as 76 tons per acre per year in Hawaii. Brazilian sugarcane yields are generally in the 30 tons per acre range.

With the launch of the Boardman facility, the company expects to confirm that it can produce not only cellulosic ethanol from forest biomass, but a host of C2- and C3-based chemical products that have even higher prices than ethanol and offer a series of hedges against fuel price volatility.

Imbler said that the long-term advantage of the ZeaChem process was that the technology did not lose its CO2, and that conversion of wood-based cellulose "hits a wall at around 110 gallons per dry ton if CO2 is lost in the process."

Imbler said that the company's focus on wood-based cellulose was dictated by strategy rather than a limitation imposed by technology, remarking that the partnership with forest products industry generally involved "larger chunks of land," and that with other feedstocks it was harder to achieve conversion of farmland from traditional crops such as corn and soy and that it was difficult to get the the needed concentration of biomass with grasses and residues.

The ZeaChem process, according to company projections based on production rates

of 15 bone-dry tons of biomass per year and an auto efficiency of 25 miles per gallon, would provide ten times the miles per acre as corn ethanol provides today. The ZeaChem process, according to the company's internal documentation, reduces CO2e emissions to 1.45 pounds per gallon from 12.54 pounds per gallon with a corn dry mill.

Background on Fulcrum Bioenergy

In California, Fulcrum BioEnergy announced today that it has successfully demonstrated [7] the ability to economically produce renewable ethanol from garbage at its TurningPoint Ethanol Demonstration Plant. The company's 10.5 Mgy Sierra BioFuels Plant, located approximately 20 miles east of Reno, will commence operations in 2011 and will convert 90,000 tons of municipal solid waste (MSW).

The company expects to produce fuel for less than $1 a gallon, at a yield of 120 gallons per ton. In a two-step thermochemical process, organic materials recovered from MSW are gasified in a plasma enhanced gasifier – the syngas is then converted to ethanol using a licensed proprietary catalytic technology jointly developed and owned by Nipawin Biomass Ethanol New Generation Co-operative Ltd. and Saskatchewan Research Council.

Background on Sandia study

In February, researchers at Sandia National Laboratories released a study [8] concluding that the United States has sufficient biomass to produce 90 billion gallons per year of ethanol, including 75 billion produced from cellulosic feedstocks including switchgrass, corn stover and woods.

The study also found that cellulosic ethanol would be competitive with oil at prices of $70–$90 per barrel based on a 91 gallons per ton conversion rate for CE, with investment costs for ethanol production equivalent to the exploration and production costs of an equivalent amount of fossil oils.

The study concluded that ethanol would cost $1.65 per gallon to produce, based on a a cost of $40 per dry ton for biomass and a construction cost of $3.60 per gallon.

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[4] http://feedstockreview.ornl.gov/pdf/billion_ton_vision.pdf
[5] http://biofuelsdigest.com/blog2/2009/07/24/zeachem-says-2000-gallon-per-acre-threshold-in-sight-for-its-cellulosic-ethanol-process-high-yield-path-with-fewer-technical-challenges-than-algae/
[6] http://www.slideshare.net/EntrepreneurTrek/dan-verser-cofounder-zeachem
[7] http://www.fulcrum-bioenergy.com
[8] http://biofuelsdigest.com/blog2/2009/02/11/sandia-national-lab-releases-studying-finding-90-billion-gallons-per-year-in-eu-ethanol-capacity-75-bgy-from-cellulose/