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3/10/04

## Ethanol

With the US importing most of its oil, alternative renewable and clean energies are in great demand. But is Ethanol the answer? Much debate has consumed scientists over the viability of Ethanol as an alternative fuel. Pimentel was one of the first to communicate dissent on the subject. According to him, not only was Ethanol an energy loser, but it was not as good for the environment as everyone claimed it to be. He also raised concern over the use of land for fuel instead of food. Still others profess ethanol as the answer to our energy woes.

*A nice overview of the issues. A good introductory paragraph.*

The history of ethanol by itself would seem to suggest that market economics simply rooted out an energy loser. The first [Ford] model As were designed to be run on either gasoline or ethanol. Big Oil was blamed for quickly gaining the monopoly on account of the liquor tax that first made ethanol unviable.<sup>1</sup> Later during oil crunch time in the 70s ethanol made a come back as a cleaner, renewable fuel that would supplement diminishing oil supplies. Yet in 1979 Pimentel first published his findings that Ethanol was an energy loser.

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<sup>1</sup> [http://running\\_on\\_alcohol.tripod.com/ethanolfuel/id18.html](http://running_on_alcohol.tripod.com/ethanolfuel/id18.html)

Today some 1.5 billion gallons [*per day, month, year . . . ?*] of ethanol is used in the US, with an expected increase, backed by US policy, to 5 billion gallons by 2012.

Using 5 billion gallons of ethanol would displace about 250,000 barrels of oil a day.<sup>2</sup>

*Need to put numbers like this in perspective. How big a dent would this make in U.S. oil consumption? You do this below.*

But is ethanol really a winner if it is necessary to prop up the industry with subsidies and quotas implemented by the government and paid for with tax dollars at 54 cent-a-gallon?<sup>3</sup>

Pimentel said, "U.S. drivers couldn't afford it, either, if it weren't for government subsidies to artificially lower the price." Also subsidized corn results in higher prices for meat, milk and eggs because about 70 percent of corn grain is fed to livestock and poultry in the United States. Increasing ethanol production would further inflate corn prices. One ethanol producer, Archer-Daniels-Midland Co., supposedly garners half the federal ethanol funding and also gives millions to candidates who support ethanol subsidies.<sup>4</sup>

According to the USDA "Corn ethanol is energy efficient, as indicated by an energy ratio of 1.24, that is, for every Btu dedicated to producing ethanol, there is a 24-percent energy gain," with gasoline at an energy ratio of 0.74.

*Gasoline is an energy loser?*

Energy ratio is defined here by the energy output divided by the energy input or the fossil energy used to extract, transport and manufacture the raw material. The following year they released the new energy ratio for ethanol as 1.34. The USDA's bias for agricultural subsidies diminishes the validity of their claims.

<sup>2</sup> <http://www.foe.org/powerpolitics/8.26.pdf>

<sup>3</sup> <http://www.junkscience.com/news2/ethanol.htm>

<sup>4</sup> <http://www.junkscience.com/news2/ethanol.htm>

Pimentel tells a very different story however. Using figures as old as 1979, with the most recent being from 1993, he concluded that using 'current' technologies ethanol has a net energy loss. He cites 10,200 kcals of input to the 6200 kcals of output of one liter of ethanol (210). Other figures of Pimentel's fluctuate. One article cites ethanol with an energy value of 77,000 btu while another found in his book, ranges from 87,000 to 108,000 btu per 131,000 of input, which is relatively static in all quotations.

The analysis of Ethanol's net energy gain or loss clearly resides in a game of figures. The inclusion or exclusion of hundreds of variables can change and skew the data. Claims that the energy balances are based on outdated figures or on plants that distill a higher grade of alcohol than is necessary for combustion put doubt to Pimentel's work. New methods have increased efficiency in fertilizer production, and distillation technologies.<sup>5</sup> On farm distilleries have advantages over larger distilleries due to the lack of transportation costs – citing 60% of operating costs as the purchase and transportation of a crop. The farmer only inputs are then energy to plant cultivate and harvest the crop. Also alcohol distilleries can be profitable as a secondary industry to primary industries that produce wastes that can be turned into alcohol and recycled. (17 Carley) If farmers choose not to use fertilizers, phosphates herbicides or insecticides, they will reduce the cost significantly but would be partly mediated by shrinking yields.

The energy values, profits and profits forgone of co-products can be included or not included into the analysis according to how one wishes to slant the figures. Stillage, the non-fermentable residue, can be used as a high protein animal feed supplement, which would free up feed grain.<sup>6</sup> Pimentel argues that the "by-products would most likely

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<sup>5</sup> [http://running\\_on\\_alcohol.tripod.com/ethanolfuel/id18.html](http://running_on_alcohol.tripod.com/ethanolfuel/id18.html)

<sup>6</sup> [http://running\\_on\\_alcohol.tripod.com/ethanolfuel/id18.html](http://running_on_alcohol.tripod.com/ethanolfuel/id18.html)

decline in price as they saturate the market. More over, the protein in ethanol by-products is expensive compared with alternate sources of protein, such as soybeans.”<sup>7</sup>

Ethanol is not as clean as it claims to be due to burning fossil fuels in the production process. The burning of ethanol, while reducing carbon monoxide emissions, increases Nitrogen Oxide aldehydes and other alcohol pollutants.<sup>8</sup> Solutions offered include the use of renewable sources to fuel the production of ethanol such as geothermal energy where applicable, or the use of stillage or unusable by-products to fuel the process. It is unclear what the environmental implications are of burning this material.

Most economic analyses of corn-to-ethanol production neglect the costs of externalities or environmental degradation, which Pimentel says should add another 23 cents per gallon. Corn production in the U.S. erodes soil about 12 times faster than the soil can be reformed and irrigating corn depletes groundwater 25 percent faster than the natural recharge rate of ground water. “The environmental system in which corn is being produced is being rapidly degraded. Corn should not be considered a renewable resource for ethanol energy production, especially when human food is being converted into ethanol.”<sup>9</sup>

A question here arises over the use of land for fuel. Some 2.5 billion bushels of surplus grain rotted in the US. Certainly there is more of a shortage of fuel than of food - at least in the US. Farmers are even paid tax dollars in the form of subsidies in order to let

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<sup>7</sup> Pimentel, David and Marcia. *Food, Energy and Society: Revised Edition*..p246. University Press of Colorado. 1996..pdf

<sup>8</sup> <http://www.foe.org/powerpolitics/8.26>

<sup>9</sup> Pimentel, David and Marcia. *Food, Energy and Society: Revised Edition*..p152. University Press of Colorado. 1996.

land lay fallow. However with “more than a quarter of a million people added [to the world population] each day” the use of land for fuel is ethically questionable.<sup>10</sup>

The average U.S. automobile, traveling 10,000 miles a year on pure ethanol (not a gasoline-ethanol mix) would need about 850 gallons.

*This is only 11.7 miles per gallon. Why so low?*

This would consume 11 acres to grow, based on net ethanol production. This is the same amount of cropland required to feed seven Americans.<sup>11</sup> The sharp increase in corn production might help farmers in the short run, but monoculture cropland has been known to be detrimental to the biodiversity and balance of an ecosystem as well as severely limiting economically as corn will become less and less fruitful in the area.

Enthusiasts who claim you get 34% more out than you put in, or sceptics who say that you get 18% less? *[period]* Maybe it does not matter. They both admit that ethanol production involves converting massive amounts of energy from one form to another. Whatever the USDA may say, the corn growers and ethanol distillers can't escape the second law of thermodynamics. If ethanol from corn is so cost effective, why does its production need federal subsidies?

*You've stated the important issues well, and there's a lot to think about. Many of the issues are still controversial, and I don't expect you to know all the answers – probably the experts don't either. A good paper though a bit on the short side, and Prof. Baker says you could have been better prepared for your presentation.*

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<sup>10</sup> Pimentel, David and Marcia. *Food, Energy and Society: Revised Edition*..p268. University Press of Colorado. 1996.

<sup>11</sup> Pimentel, David and Marcia. *Food, Energy and Society: Revised Edition*..p196. University Press of Colorado. 1996.