Ohio Environmental Council

[UNLEASHING THE POWER OF GREEN]

Fact Sheet

Ethanol

Options for a sustainable energy future

Background

Just a few years ago, Americans rediscovered ethanol – a versatile liquid motor fuel which had originally powered Henry Ford's Model T. It was seen as a renewable alternative to petroleum-based gasoline for powering our cars and trucks.

The American public quickly became enamored with the notion of a domestically produced, cleaner burning fuel that also carried the side benefits of helping to support local farmers and, hopefully, eliminate our need to enforce order in some of the world's most unruly regions, such as the Mideast.

The timing seemed perfect for ethanol's development, so farmers in many Midwestern States teamed up with several successful American companies to jump-start a fledgling ethanol industry.

The industry chose corn as its primary feedstock. At the time, corn was plentiful and cheap, with a pre-existing infrastructure of warehousing, transportation, and processing facilities across the corn belt. In the early years, profits for ethanol producers were astoundingly high, with multi-million dollar plant investments being repaid in just a few years. It seemed too good to be true – and of course it was.

Today ethanol producers are in rapid economic decline as world petroleum prices have receded sharply and global corn prices have been erratic at a range well above the historic 10 year average. Beyond the pure economics of ethanol production, several other issues have arisen to corrode the luster of the ethanol boom.

Food vs. Fuel

The recent spike in global commodity prices has propelled global food prices to historically high levels. Global commodity trading has been dampened, as traditional grain exporting nations hoarded crops to appease hungry domestic citizens.

Despite the fact that several other factors had contributed to the run-up of global commodity values, many prominent analysts have pointed the finger at the uniquely American practice of using corn for ethanol production as the primary driver in runaway global food prices.

Because the surges in corn-ethanol production and grain prices coincided with growing concern about "Peak Oil" and global climate change, analysts also began to apply close scrutiny to the "lifecycle" energy demands and "carbon footprint" of corn-ethanol.

These life-cycle assessments consider not only what energy is consumed and what greenhouse gasses (GHG) are emitted in manufacturing the final product, but also consider the energy consumption and emissions produced in growing the raw ingredients.

Because modern corn production typically involves the use of substantial quantities of petroleum fuels, petro-chemical-based pesticides and large quantities of nitrogen fertilizer (produced with natural gas), two additional concerns were raised about corn-based ethanol:

- First, concern that the product actually had a modest to negative energy balance – that more petroleum energy was required to produce corn-ethanol, than was replaced by burning the final product in lieu of gasoline.[1]
- Second, that the "lifecycle" production and use of corn-ethanol might actually exacerbate the total production and emission of GHG.

The first issue has been robustly debated, with the consensus of opinion siding with those who espouse a modest but positive energy balance. Virtually all scientists agree that corn is not an ideal feedstock for ethanol production. As illustrated by the Brazilian experience, sugar cane is vastly superior.

Rapid advances in domestic process design and manufacturing efficiencies along with advances in plant breeding have increased net energy return into the positive range. Debate will continue, with results dependant on the limits of the "lifecycle analysis."

The second additional question, about corn-based ethanol's carbon footprint, is complex as well. As mentioned earlier, modern corn production practices rely heavily on high tech products and equipment – produced from or powered by oil or natural gas.

Theoretically, if the carbon footprint involved with feedstock production were not an issue, the use of motor fuels made from growing crops instead of underground carbon stores (petroleum) would make a substantial improvement in total GHG emissions.

In our global economy however, major changes in crop use have additional implications for land use decisions globally. If one considers the incremental deforestation which may result from higher global crop prices, a substantial reduction in GHG from ethanol could be entirely negated. Deforestation in the developing world could result in an alarming increase (perhaps a doubling) in GHG over the next 30 years.[2]

Europeans had noted a similar phenomenon as increased biodiesel demand over the last decade in the E.U. enticed the replacement of vast tracts of rain forest with Palm Oil plantations. More recently, Brazil has reported a 64% increase in the rate of deforestation in the past 12 months compared to year earlier.[3]

[1] Heywood, Groode, MIT, 2007

[2] "Use of U.S. cropland for biofuels increases greenhouse gasses," T. Searchinger et al, Science Express, Feb, 2008

[3] "Guardian," U.K. Tom Phillips, Sept, 2008

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Ethanol as a Consumer of Water

As domestic corn-ethanol production has ratcheted up in the Midwest, another worrisome feature of the manufacturing process has arisen – that of water consumption. Conventional ethanol production techniques use 3.5 – 6 gallons of water per gallon of ethanol produced, although ongoing process refinements are continuing to reduce the usage. Notably, some conceptual cellulosic ethanol facilities expect to use only 1 - 2 gallons.

Just recently in Greenville Ohio, the ethanol facility owned by Marathon Oil and the Andersons has found the well fields in their Industrial park to failing, necessitating the construction of a new connection to the city's surface water sources.

Due to valid concerns over the inherent suitability of corn as a feedstock, concerns about the lifecycle energy balance and carbon footprint of corn ethanol and to concerns about excessive water use, corn-based ethanol does not appear to merit consideration as more that a "bridge technology" to more efficient production techniques and more sustainable feed stocks.

Beyond Corn to a More Promising Futuer

Considering the numerous problematic aspects of the current ethanol industry, it is important not to throw the baby out with the bath water. Ethanol is an extremely viable, well-proven motor fuel.

It was the fuel of choice for Henry Ford's original Model T. It has demonstrated its excellent performance characteristics from the back roads of Appalachia (helping "moonshiners" to outrun the "revenuers") to the racing venues of today's Nascar circuit. It has a more benign emissions profile than gasoline and it is a renewable fuel, made from crops grown here in America.

The key to the future of ethanol fuel will lie in new technologies for processing the fuel from a range of biomass sources which can be efficiently grown or salvaged in American communities.

Several promising cellulosic ethanol processing techniques are emerging. Most are focusing on perennial biomass crops such as switchgrass or non-food biomass like wood chips or crop residues as a feedstock.

Cellulosic ethanol production derives the same product (ethanol) from an entirely different technique. Instead of fermenting sugars from corn starches, they use microorganisms to digest the cellulose from plant material into ethanol.

The benefits are two-fold. First, cellulosic digestion is inherently more efficient, producing more gallons of fuel per ton of feedstock. Second, the choice of cellulosic feedstocks avoids the conflict between food and fuel. Some emerging cellulosic technologies can use a wide range of feedstocks, including solid waste, so their production costs are projected to be quite low (below $1/gal).

Bottom Line

Ethanol is a versatile, time-tested liquid motor fuel but as sited above, corn has proven to be an inferior feedstock.

Continued research into various cellulosic production processes are needed to make more efficient and truly sustainable ethanol fuels a reality. Assuming the veracity of "Peak Oil" theories, corn-based ethanol may be a useful bridge technology - allowing some measure of independence from petroleum-based fuels until cellulosic technologies are refined.