ETHANOL'S POTENTIAL

PROMISE OR THREAT?

By Sylvia Welke

Touted by many as the answer to air pollution, greenhouse gas emissions (GHG), and dependence on foreign oil, production of ethanol from plant biomass is rapidly gaining momentum.

Almost every country, it seems, is on the ethanol bandwagon. China, South American and African countries are eagerly following Brazil, the world leader in ethanol production.

Prime Minister Stephen Harper announced that by 2010, 45% of all gasoline sold in Canada will contain 10% ethanol and the rest should contain 5%. For some, the government should have gone even further. The Saskatchewan government, for example, was lobbying for at least a 10% ethanol blend for all gasoline by 2010.

Canada is a minor player in terms of ethanol production. Brazil produces 45.2% of the world's total (16.5 billion litres according to 2005 figures) from sugar cane, and the United States produces 44.5% (16.2 billion litres) from corn. Ethanol supporters complain that Canada is lagging behind many countries when it comes to legislating the use of ethanol.[1]

Yet, despite the hype about ethanol, is it all it is cracked up to be? The production of ethanol has become a topic of much debate with its proponents claiming it to be key in solving the energy crisis while critics point to its negative environmental, economic and social impacts.

Ethanol is an alcohol usually produced from sugar cane (in Brazil) or corn (in the United States), and is used to replace or supplement gasoline.
Biodiesel is used in diesel engines and is derived from vegetable oils, animal fats, or waste vegetable oils.
Cellulose conversion technology allows for ethanol and biodiesel to be produced from any biomass, such as willow trees, switchgrass, and agricultural or forestry residues.[4]

Ethanol's potential

Ethanol's supporters often cite the potential for ethanol-blended gasoline to reduce greenhouse gas (GHG) emissions from transportation. The argument is that most currently produced biofuels generally have a positive GHG balance because energy crops can sequester (bind) soil carbon as they grow, thereby taking carbon dioxide out of the atmosphere.

Biofuel production has the added appeal of creating jobs and keeping money within the national economy rather than spending it on imported oil. Brazil can attest to this with savings of about $120-billion over a thirty-year period due to reduced oil imports and avoided interest that would have been paid on foreign debt. And then there are carbon credits which would put ethanol production in good economic stead.

The energy balance

The debate over the energy balance of biofuel production is heated. Critics suggest that for most energy crops, particularly corn, more energy is required to produce ethanol than the energy it can supply. Dr. Pimentel and his colleagues from Cornell University suggest that the production of ethanol from corn is highly inefficient requiring nearly four units of energy per unit of energy used.[2]

Researchers for the United States National Corn Growers Association see Pimentel's research as fear-

According to Environment Canada, biofuel is "fuel derived from recently living organisms or their metabolic byproducts, rather than natural resources, such as petroleum, coal and nuclear fuel."

Driving smaller, less-polluting vehicles is one key ingredient to a healthier planet.

mongering and claim that he used old and/or irrevelant data. One study from Minnesota showed that ethanol from corn produced 25% more energy than it consumed.

Ultimately, the energy balance depends on the feedstock used (e.g. corn vs. poplar), the transportation costs, and the energy required for processing.

Food into fuel?

For a whole host of environmental, ecological and social reasons, ethanol production from plant biomass is not the panacea it appears to be. Some critics are cautious about growing crops for fuel rather than for food. Others believe industrial-scale ethanol production (requiring vast acreages of agricultural land) poses a major threat to food production and could lead to mass starvation.

Will we see corn, sugar cane, soybeans, canola and palm oil at the gas pump rather than on grocery store shelves? We could, when food and feed crop prices are low and oil prices are high. Those commodities will go to the highest bidder. Consider this: in 2004, the US used 32 million tons of corn to produce ethanol and although this represented a mere 12% of the country's corn crop, it would have fed 100 million people. In many developing countries, biofuel production is perceived as an opportunity to provide an income for farmers. Biofuels are one way to decrease imports and foreign debt.

However, countries need to look at the balance between food and feed production, and the benefit from lower oil imports through the production of biofuel. If, for example, the European Union wanted to provide 10% of its energy needs with biofuel, it would have to convert 70% of its agricultural land into energy crop production.[1] The US, Brazil and Canada would have to convert about 30%, 3% and 0.3% of agricultural land, respectively.[1]

As technology is refined, cellulose-based feedstocks could be used, such as corn stalks, woody residues, wood from fast-growing plantations and even leaves. This would reduce the cost of ethanol production and reduce the market impact on food and feed commodities. Still this technology is in its infancy, leaving the real threat of agricultural land conversion to biomass crops.

Ecological impact

Biofuel production threatens more than our food supply. Expanding sugar cane production in Brazil into the Amazon basin for biofuel production puts plant and animal diversity at risk. The same could be said for the huge acreage of mono-cultivated corn for fuel in Iowa and harvesting wood from tropical rainforests to use as biofuel.

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Corn, the principal feedstock for ethanol in North America, is hardly environmentally benign. It requires intensive inputs of pesticides and fertilizers (which in turn require the use of fossil fuels in their production). Also, conventional corn cultivation is associated with significant releases of nitrogen, phosphorus and pesticides in its runoff. These compounds can make their way into drinking water. There is also

Ethanol in brief

- One acre (2.5 hectares) of corn can produce 300 gallons (1136 l) of ethanol.
- Global ethanol production more than doubled between 2000 and 2005, and comprises about 1.2% of the world's gasoline supply by volume.
- Ethanol production is touted to create 100 times more jobs than the fossil fuel industry. In Brazil, it accounts for half a million direct jobs.

increased potential for soil erosion and eventual loss in site productivity. It is easy to see how ethanol produced from corn makes little economic or environmental sense.

The increased demand for wood for ethanol could result in pressure on forests and lead to increased cutting and greater land degradation. Wood biofuel should come from existing wood residues, such as precommercial thinning, harvesting and processing residues, and dedicated woody crops.

Greenhouse gases (GHG) are emitted when fossil fuels are used in the ethanol production process, be it for the production of fertilizers and pesticides used in growing the corn, or for fueling the ethanol production process (e.g. coal or nuclear). Furthermore, when forests are converted to biofuel, the carbon that was stored is released both in terms of the wood that is cut and the increased decomposition that follows in soils.

The goal of society should be to have no or very low emissions, rather than just a small reduction in GHG emissions over the current rate. The increased use of inputs for growing energy crops, the conversion of forested land and the use of fossil fuels for the production of biofuel do not present a likely scenario for achieving this.

Biodiesel, if made from virgin oils, has a lifecycle that, in Canada, begins with the process of growing a feedstock such as canola or soybeans. Feedstock production is the most expensive and environmentally-damaging stage in the biodiesel lifecycle, mainly due to the use of fossil fuel-based fertilizers and pesticides. However, the primary source of energy at this stage is solar. The plant also consumes carbon dioxide, a greenhouse gas, during its growth.

Transforming solar energy and carbon dioxide into a fuel source is the reason biodiesel is considered a renewable fuel with low greenhouse gas emissions. Once harvested, the oilseeds are transported to a crushing facility to produce vegetable oil and meal (an animal feed that Canada currently imports). This oil is then transported to a biodiesel facility to be chemically converted into biodiesel.[4]

—Ostertag, 2006

The question of genetically-engineered (GE) organisms also arises. For example, Brazil plans to use GE soybeans for biofuel. The use of GE crops has the potential to contaminate non-GE crops. Hybrid poplar or other fast-growing trees can also be genetically modified and thus have consequences in terms of forest ecology.

Human health

With increased concentrations of ethanol in gasoline, the production of smog-producing substances will further endanger the health of humans, particularly children, the elderly and the immuno-compromised. Ethanol increases emissions of known carcinogens acetaldehyde and formaldehyde up to 70%. Increased use of ethanol may also increase atmospheric levels of peroxyacetyl-nitrate, a substance that is genotoxic (causes damage to genetic material).

Increased exposure to ethanol may contribute to other health effects including developmental toxicity, central nervous system dysfunction, teratogenicity (birth defects), reproductive disorders and cancer. While data is still lacking, some studies suggest that these impacts on human health may occur at low ethanol exposure.

Organic biofuel?

Researchers in Denmark have suggested that organic farming in that country has considerable potential to provide national bioenergy.[3] Biogas, for example, could be derived from livestock manures and from grass/clover production. Some canola oil for

Alfalfa electricity

Alfalfa was the primary biofuel source in the Minnesota AgriPower project, which was mothballed, apparently due to pressure from the corn lobby. The leaves were to be used as a high protein feed supplement while the stems were to be gasified to power a 75- megawatt turbine. The project provided for electrical generation without carbon dioxide emissions, economic diversification of cropping systems, enhancement of environmental quality and wildlife habit, and rural development. See www.ars.usda.gov/research/publications/publications.htm?SEQ_NO_115=113410 for details.

biodiesel is already being manufactured but acreage could be increased and alders could be planted. According to their models, organic biofuel crops could lead to a 20% reduction in oil consumption and a 25% reduction in energy consumption for housing and machinery.

Ecologically sound biofuel production should aim, as organic agriculture has done or has tried to do, for a relatively closed energy cycle. At the same time, it should ensure lower energy consumption per unit energy produced, protected water quality, recycling of nutrients, reduced nitrous oxide emissions and increased soil carbon storage.

The Danish study points to the possibility of integrating ethanol production at the small, local scale into existing farms without threatening agricultural land but possibly contributing to a reduction in oil use.

The bigger picture

Even proponents of ethanol generally agree that it is only a small part of the solution. Surely driving less, using mass transport more, and driving smaller, less-polluting vehicles are key ingredients to a healthier planet and its inhabitants. Redesigning cities to facilitate cycling, walking to work and amenities, and discouraging vehicular traffic is essential to a solution. Sprawling suburbia is not. Perhaps electric and/or solar powered vehicles are part of the answer too. All of these potential solutions require social change which is always more difficult and long-term (i.e. less politically appealing) than a quick-fix solution like a seemingly 'green' fuel.

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Photo by Karyn Wright.

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