Article 5 Crop Biofuels Unlikely to Halt Climate Change

The unmet promise that crop-based biofuels can become a carbon-neutral fuel allowing mankind to use as much as we like because the greenhouse gases (GHG) released will be perfectly offset by the GHG the plants absorb while being grown was shattered earlier this month. A team led by Dr. Timothy Searchinger of Princeton University concluded corn-based ethanol nearly doubles greenhouse emissions and switchgrass ethanol - sometimes called cellulosic ethanol - increases emissions by 50 percent. Giving hope for ethanol projects in Hawaii, Dr Searchinger said the GHG impact for ethanol from sugarcane was substantially better, but still not sufficiently quantified.

Natural Carbon Cycle

Since the start of the industrial revolution, most of mankind's energy needs have been met by coal and oil, the fossil fuels we now understand are causing a serious climate change problem. Burning fossil fuels releases large amounts of carbon into the atmosphere that had been safely locked underground for millions of years.

Burning fossil fuels interferes with the Earth's natural carbon cycle. In this cycle green plant life all over the world absorbs carbon dioxide (CO2) from the air and uses the carbon to build stalks and stems and leaves and tree trunks. At the end of the plant's life the carbon breaks down and is returned to the atmosphere as GHG. Even if the plant is eaten or harvested, the natural carbon cycle isn't disrupted, because eventually, the carbon ends up in something that decomposes back into GHG in the atmosphere.

The idea behind biofuels is a simple one–if mining million-year-old carbon disrupts the Earth's natural carbon cycle, why not stop doing it and take advantage of the natural carbon cycle itself to *grow* fuel. The idea of growing fuel is as old as mankind; it was the first fuel used to cook food, stay warm, and light the dark night. And the use of biofuels didn't end before the industrial revolution. Rudolf Diesel, who invented the diesel engine, ran his first models on peanut oil. Henry Ford's first prototype car ran on corn alcohol. In Europe during World War II, over a million vehicles we converted to run on wood-burning gasifiers because gasoline and diesel were often unavailable to civilians.

Biofuel Advantages But Numbers Are Daunting

It is easy to see why biofuels quickly became an apparent solution to climate change. The technology to make ethanol and diesel from a variety of crops is well understood and the world has an efficient infrastructure for growing crops. And biofuels are very compatible with our current energy infrastructure. These bioliquid fuels can be stored, transported, and sold just like their fossil fuel counterparts with almost no changes to the vast world wide energy infrastructure. Even the engine technology developed for more than a hundred years to burn fossil fuels can be easily converted to burn crop biofuels.

But our nation's current appetite for fuel far exceeds our land, making crop biofuels impractical as a simple strategy to replace fossil fuel. If America turned its entire annual

production of corn into ethanol, including the 2.25 billion bushels of corn America exports, it would only replace 12 percent of the gasoline we consume. If America turned its entire annual production of soybeans into biodiesel, including the 400 million bushels America currently exports, it would only replace six percent of the diesel we consume.

Food or Fuel

The huge amount of cropland required to make biofuels is the heart of the first problem with their large scale use. What is more important, food or fuel? While we can make more tractors and even shift labor into agriculture as demand for products increases, the foundation of farming is the land itself. And the most productive land is already in cultivation to grow food. The United Nations first major report on bio-energy released last May concluded "Liquid biofuel production could threaten the availability of adequate food supplies by diverting land and other productive resources away from food crops."

Dramatic, real impacts of this food vs. fuel conflict came to light last year: Corn tortillas are a staple in the diet of Mexico's poor, supplying more than forty percent of their daily protein. But tortilla prices tripled or quadrupled from summer 2006 to winter 2007 increasing hunger and starvation. Manuel Roig-Franzia of the Washington Post Foreign described the problem, "Mexico is in the grip of the worst tortilla crisis in its modern history. Dramatically rising international corn prices, spurred by demand for the grain-based fuel ethanol, have led to expensive tortillas."

Land Use GHG Impacts

New information released this month ended the crop-based biofuel dream: the use of land itself can have a positive of negative impact on GHG emissions. "When you take this into account, most of the biofuel that people are using or planning to use would probably increase greenhouse gasses substantially," Dr. Timothy Searchinger told the New York Times. "Previously there's been an accounting error: land use change has been left out of prior analysis."

Burning and plowing to convert tropical rain forests or temperate pasture grasslands into cropland releases huge amounts of GHG. Once converted, cropland absorbs far less carbon than the rain forests, pasture and scrubland that it replaced. And the effect isn't minor. Joseph Fargione, a scientist at the Nature Conservancy, calculated clearing grassland releases 93 times the GHG that could be saved by the biofuel grown annually on that land. He explained, "So for the next 93 years you're making climate change worse, just at the time when we need to be bringing down carbon emissions."

Fargione and Searchinger's independent work taken together are damming: it doesn't matter what kind of land is cleared for crop biofuel production, the effect is that GHG emissions will increase significantly. They both also concluded that the production of crop biofuels almost universally resulted, albeit sometimes indirectly, in new cropland needing to be cleared.

Waste Not Want Not

Although crop-based biofuels will actually accelerate climate change instead of reducing it, there are ways to make fuels from organic sources without crops. Although the quantity of biofuels created will never be enough to completely replace liquid fuels as we use them today, these "clean" biofuels have an important part to play in slowing climate change.

A great deal of organic material is simply treated as garbage. Lumber mills produce bark, sawdust, wood chips, and wood scrap as waste. Landfills produce methane gas. And livestock farms create large amounts of animal waste. All this organic waste material creates a huge garbage problem, but could become clean energy.

Gasification of wood waste, like the idea proposed by Green Energy Hawaii's Eric Knutzen and Hawaiian Mahogany's Bill Cowern, is already in use around the world to turn garbage problems into an energy solutions. For example, the Tolko plywood mill in Heffley Creek, British Columbia produces tons of green bark wood waste. Instead of treating it like a garbage problem to dispose of, Tolko built a gasification plant that produces 65.3 million kilowatt-hours annually.

In landfills, like ours at Kekaha, organic garbage rots and releases methane gas. The US Environmental Protection Agency (EPA) reports that by 2004, more than 375 operational landfill energy projects in 38 states supplied 9 billion kilowatt-hours of electricity, and 74 billion cubic feet of methane to end users, the equivalent of 150 million barrels of oil.

Organic waste from livestock farmers can be efficiently converted to fuel. The federal AgStar program, run jointly by EPA, DOE, and the U.S. Department of Agriculture, works with livestock farmers to capture biogas from animal waste for on-farm energy. At a larger scale, a $200 million, 55 megawatt power plant is under construction that will be powered completely by manure from Minnesota's numerous turkey farms.

Future Possibilities

The focus on biofuels and climate change has resulted in a great deal of research on growing algae as a biofuel. Although the research has not yet resulted in anything beyond small prototypes, scientists hope to create an idea fuel source. Algae could be grown with little land use impact; it could avoid the food vs. fuel dilemma, and, in fact, could even be used to scrub CO2 directly from power plant emissions. If all that sounds too good to be true, it is probably because it isn't true yet today, and like many scientific efforts may not yield results for many years, if ever.

But significant work is ongoing, for example, GreenFuel's CO2 recycling technology is being tested at a coal-fired power plant in Dunkirk, N.Y. The work will investigate the technical and economic viability of using algae to consume CO2 emitted by power plants using prototype-scale equipment. The algae could then be converted into biofuel. In another algae biofuel project, Chevron Corporation and the U.S. Department of Energy's

National Renewable Energy Laboratory are trying to find algae that can be economically harvested and turned into transportation fuels such as jet fuel.

Ethanol Made from Kauai Sugarcane

Gay & Robinson, in partnership with Pacific West Energy, is planning a 12 million-gallon-per-year ethanol plant and a bagasse-fired boiler and turbine to generate electricity to sell to KIUC. The project, on the drawing board for years, has been delayed repeatedly for a variety of reasons: federal and state subsidies had to be firmed up, financing was an issue as the cost of the project grew, the price of ethanol has varied from $4 to $1.50 to $2.30 today affecting the financial model underpinning the project, and multiple federal and state permits are required. The last round of delays occurred as the plant was redesigned to reduce costs necessary to be competitive in a market with failing ethanol prices.

The project's developers point out key benefits to the project, including economic development on Kauai's west side and reducing our dependence on imported foreign oil. The benefit important to reduce climate change is a possible net reduction in GHG when some of Hawaii's gasoline appetite is replaced with 12 million gallons of ethanol from the plant each year.

Brazilian studies estimated GHG reductions of 86 percent when ethanol from sugarcane replaces the use of gasoline. These savings require that waste bagasse be used to produce electricity, further displacing fossil fuel emissions, as is planed for the Kauai project. However, the Brazilian estimates do not include GHG emissions resulting from land use changes, the issue identified in studies early this month by Searchinger and Fargione as the critical factor which make the use of crop biofuels a source of increased GHG emissions hastening climate change.

The sugar used to make ethanol on Kauai must be offset by increased production of sugar for food somewhere else in the world. Searchinger calculates the GHG emissions from putting rainforest acreage into sugar production somewhere else in the world will result in a GHG payback period for sugarcane ethanol of 46 years. Worse yet, if the replacement sugarcane is grown in wetlands, common in the mainland United States, the emissions could be significantly greater and the payback period much longer. While diverting Kauai's sugar production into ethanol may have local benefits, it will increase GHG emissions and speed climate change.

However, ethanol production on Kauai may not deserve the negative GHG credit for this land use effect. Unable to compete with sugar grown more cheaply elsewhere, the profitability of sugar production on Kauai is steadily declining. A&B closed its McBryde Sugar Co. on Kauai in September 1996. Amfac stopped growing sugar on Kauai in 2000. If growing sugar on Kauai for food will eventually stop irrespective of ethanol production here, then a different land conversion calculation results in a better GHG tradeoff for the project's ethanol. If Kauai's sugar land would eventually become fallow, then no indirect conversion of land anywhere else can be attributed to local ethanol production. In this

case Searchinger estimates a four-year GHG payback period. That is, the sugarcane-ethanol-instead-of-gasoline GHG savings for the first four years of production would be offset by the GHG emissions associated with land conversion. But, after four years the actual ethanol-instead-of-gasoline GHG savings would apply.

Growing sugarcane on Kauai to make ethanol, if the alternative is to let the land go uncultivated, may be one of the few biofuel crops with a practical chance of reducing GHG emissions.

Refocus Required

To reduce GHG emissions and fight climate change we must stop encouraging crop biofuels. Tad Patzek, an engineering professor at the University of California and co-author of a recent report on ethanol, points out that if we channeled the billions of dollars spent on corn crop ethanol, including the seven billion dollars in tax subsidies, into fuel-efficient cars and solar cells, "That would give us so much more bang for the buck that it's a no-brainer." This point of view has become almost universal across academics, economists, and renewable energy scientists. "The amount of subsidies provided for ethanol could easily be used to switch this country to plug-in hybrid vehicles, and ultimately have a much greater impact on reducing oil dependency," says Jigar Shah, CEO of SunEdison, a solar power company.

Another place to direct our priorities is to capture practical waste biomass for energy. Every industrial scale process that results in wood waste, plant waste, animal waste, or organic garbage is a candidate for producing clean energy. And since much of this organic waste, when unused, produces methane, a GHG more than 20 times as reactive as CO2, these projects would have double the positive effect on climate change–they directly reduce methane GHG emissions, and indirectly reduce GHG emissions for the energy they produce.

Of course, using energy more efficiently and conserving energy should remain a top priority to reduce GHG and slow climate change. Eberhard Jochem, professor of economics and energy economics at the Swiss Federal Institute of Technology, explained in *Scientific American*, “The huge potential of energy efficiency measures for mitigating the release of greenhouse gases into the atmosphere attracts little attention when placed alongside the more glamorous alternatives of nuclear, hydrogen or renewable energies. But developing a comprehensive efficiency strategy is the fastest and cheapest thing we can do to reduce carbon emissions. Wasting less energy is the quickest, least expensive way to stem carbon emissions.”