Renewable Fuels Association

Analysis of
"Biofuels: Environmental Consequences and Interactions with Changing Land Use"
by Howarth et al.
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The recently released assessment on the environmental impacts of biofuels raises several important issues for discussion, but relies excessively on unproven science and flawed assumptions that have been widely questioned if not fully repudiated.

Following is a critique of several of the central arguments raised in the paper:

Lifecycle Direct Greenhouse Gas Emissions

The paper acknowledges that biofuels offer significant direct greenhouse gas reduction benefits (up to 50% for corn ethanol and 80% for sugar cane). This finding is supported by recent literature.

- A recently released report prepared for the International Energy Agency (IEA) details the dramatic improvement in greenhouse gas (GHG) emission benefits offered by corn-based ethanol and predicts GHG reductions of nearly 60% from corn-based ethanol compared to gasoline by 2015. The report found 2005-era corn ethanol offered a 39% GHG reduction relative to gasoline.

- In January, the *Journal of Industrial Ecology* published a paper (Liska et al., 2009) regarding improvements in the lifecycle energy efficiency and GHG emissions of corn ethanol. The authors found, "Direct effect GHG emissions were estimated to be equivalent to a 48% to 59% reduction compared to gasoline, a twofold to threefold greater reduction than reported in previous studies. Such improved technologies have the potential to move corn-ethanol closer to the hypothetical performance of cellulosic biofuels. These results suggest that corn-ethanol systems have substantially greater potential to mitigate GHG emissions and reduce dependence on imported petroleum for transportation fuels than reported previously."

Land Use Change

After conceding that biofuels offer distinct direct GHG reduction benefits, the authors proceed to discuss highly uncertain indirect carbon effects. The paper states, "One of the greatest concerns is the effect of indirect land use change on (the biofuel-related) emission of greenhouse gases." However, there is no empirical evidence positively establishing causation of indirect land use changes; nor is there any peer-reviewed research that undeniably and defensibly links biofuels expansion to indirect land conversions.

- Analysis of the indirect effects associated with any product's supply chain is highly uncertain and fraught with unknowns. In the case of predicting biofuels-related indirect land use changes, *even the best available methodologies and models have proven to be significantly imprecise.* The methodology used by Searchinger et al. to estimate land use changes resulting from biofuels expansion has been roundly rejected by broad array of experts, including the author of the GREET lifecycle model, Department of Energy officials, university professors and others.

- While existing tools are instructive in determining the location and degree of land use changes, *they simply cannot positively assign the cause of those land conversions*. According to a recent paper published by the National Academies of Sciences, the complex factors that drive land use change "…tend to be difficult to connect empirically to land outcomes, typically owing to the number and complexity of the linkages involved." (Turner et al., 2007)

- Due to the highly uncertain nature of indirect land use change analysis, the European Parliament recently decided to postpone inclusion of indirect land use change penalties in emerging biofuels regulations for the European Union. Rather, the Parliament directed the initiation of a two-year study aimed at gaining a better understanding of the land impacts of biofuels and refining methodologies.

- A recent study by Air Improvement Resources, Inc. (AIR), found that expansion of U.S. corn ethanol production to 15 billion gallons per year in 2015 is *unlikely to result in the conversion of non-agricultural lands in the U.S. or abroad*. Increasing crop yields and growing supplies of nutrient-dense feed co-products are likely to nullify the need to expand global cropland to meet the corn ethanol requirements of the Renewable Fuels Standard, the study found.

- According to a Feb. 25, 2009 letter to Gov. Arnold Schwarzenegger signed by 111 scientists and academics, "Enforcing different compliance metrics against different fuels is the equivalent of picking winners and losers, which is in direct conflict with the ambition of the LCFS." The letter's signatories, including members of the National Academies of Sciences and Engineering, further stated that the proposal "…creates an asymmetry or bias in a regulation designed to create a level playing field. It violates the fundamental presumption that all fuels in a performance-based standard should be judged the same way…"

The Howarth et al. paper states, "The rapidly growing production of biofuels requires additional cropland." However, empirical data suggests total global cropland has not expanded appreciably in response to biofuels expansion.

- In 2007/08, just 0.9 percent of world major cropland was needed (on a gross basis) to meet the grain requirements of the U.S. ethanol industry. When the ethanol industry's production of feed co-products are factored in, the net use of global cropland for U.S. ethanol production was 0.6 percent, or an area roughly the size of the state of West Virginia.

- According to America's Farmland Trust, more than 16 million acres of farmland have come out of production in the last 10 years.

- Despite increases in the amount of coarse grains used for ethanol, the amount of land dedicated to coarse grains (corn, grain sorghum, barley, oats, rye, and millet) globally has decreased over the past 30 years. Global area for coarse grains has decreased 8 percent since 1980, while world grain ethanol production has increased dramatically. Despite a reduction in land dedicated to coarse grains, annual world coarse grain production has increased nearly 50 percent since 1980.

Carbon Debt

Assuming that biofuels expansion does induce indirect land use change, the paper suggests repayment of the carbon debt from land conversion takes "decades or even hundreds of years to balance out the initial carbon losses." This statement stands in stark contrast to recent research on the ability of certain agricultural practices to mitigate carbon debt.

- A recent analysis published in Environmental Science & Technology (Kim, Kim and Dale, 2009) showed that "…cropping management is a key factor in estimating greenhouse gas emissions associated with land use change. Sustainable cropping management practices (no-till and no-till plus cover crops) reduce the payback period to 3 years for the grassland conversion case and to 14 years for the forest conversion case." This a major departure from the "hundreds to thousands" of years cited by biofuel critics.

- Recent research by Oak Ridge National Laboratory personnel suggests biofuels can, in fact, improve land quality. The researchers found, "Biofuels can reduce recurring use of fire and GHG emissions, reduce pressure to clear more land, and improve soil carbon."

Nitrogen Effects

Howarth et al. rashly suggest any carbon benefits resulting from increased biofuels production may be erased because of emissions and runoff from nitrogen fertilizer. In determining nitrous oxide emissions, most lifecycle analyses utilize at least part of the methodology recommended by the Intergovernmental Panel on Climate Change (IPCC). By contrast, the Howarth et al. paper's discussion of nitrous oxide emissions relies excessively on a debatable paper by Crutzen et al. The paper also makes several unsubstantiated claims regarding the role of biofuels in nitrogen run-off and the hypoxic "dead zone."

- It is important to understand that the methodology employed by Crutzen and that of the IPCC are very different and cannot be directly compared. The Crutzen approach has been described as a "top down" method and the IPCC is very much a "bottom up" approach.

- The Crutzen "top down" approach estimated the global N_2O emissions from the atmospheric concentrations of N_2O and estimated the portion that was attributable to agricultural soils by eliminating the estimated contributions from other sources. Top down approaches that are based on elimination can be very sensitive to the accuracy of the values being eliminated. It has been suggested by other experts that the Crutzen paper missed some sources such as biomass combustion, livestock, and even transportation.

- Hypoxia in the Gulf of Mexico is a complex issue that is not fully understood by the scientific community. In its "Gulf Hypoxia Action Plan 2008," the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force acknowledged that "uncertainties remain in the ability to characterize the spatial and temporal dynamics of hypoxia and the biological, chemical, and physical properties that contribute to it."

- The task force also suggested that, “Additional analysis of detailed nutrient pollution contributions from multiple sectors, including point sources and non-agricultural contributions needs to be undertaken.”

- The Task Force also found that, “Net anthropogenic nitrogen inputs (NANI) and net phosphorus inputs for the Mississippi/Atchafalaya River Basin have declined in the last decade, because of more efficient use of fertilizer (as evidenced by increasing corn harvest and constant or declining fertilizer application rates).”

Appropriate Comparisons

The paper focuses on the direct and indirect environmental impacts of expanded biofuels production, but fails to make appropriate comparisons to the environmental impacts of petroleum production. While the authors suggest biofuels induce indirect carbon effects, they fail to examine the indirect carbon effects associated with oil production. Biofuels are being scrutinized for a highly uncertain and unproven market-mediated effect known as indirect land use change (ILUC), while *other regulated fuels are assumed not to cause any significant indirect effects.* The tar sand projects in Canada are a prime example of the degrading environmental profile of petroleum as traditional supplies are depleted and marginal barrels are brought on the market.

- Preliminary analysis by Life Cycle Associates presented in January indicated several potential sources of indirect and direct GHG emissions associated with oil production that have been overlooked in traditional lifecycle analyses. Examples of these emissions include methane from flaring, methane from tailing ponds, and emissions associated with some refinery byproducts. The report said that other fuels could—and should—be run through economic models and other analytics to test for indirect effects.