Biofuels, Fossil Fuels & the Greenhouse Gas Factor

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Fort Collins, Colorado [RenewableEnergyAccess.com] 2007-04-11 Researchers at Colorado State University and the U.S. Department of Agriculture, Agricultural Research Service have completed an analysis of greenhouse gas emissions from biofuel production. Study results revealed that when compared with the life cycle of gasoline and diesel, ethanol and biodiesel from corn and soybean rotations reduced greenhouse gas emission by nearly 40 percent, reed canarygrass by 85 percent, and switchgrass and hybrid poplar by 115 percent.

Hybrid poplar and switchgrass were found to offset the largest amounts of fossil fuels and therefore reduced emissions the most out of the studied crops.

"Biofuels have a great potential to reduce our dependence on imported gasoline and diesel fuel," said William Parton, researcher from Colorado State's Natural Resource Ecology Laboratory (NREL). "We have performed a unique analysis of the net biofuel greenhouse emissions from major biofuel cropping systems by combining ecosystem computer model data with estimates of the amount fossil fuels used to grow and produce crops for biofuels."

Parton, along with Stephen Del Grosso, USDA scientist and NREL researcher; and Paul Adler from the USDA used the DAYCENT biogeochemistry model, developed by Parton and Del Grosso, to assess soil greenhouse gas fluxes and biomass yields for corn, soybean, alfalfa, hybrid poplar, reed canarygrass and switchgrass.

"Although fossil fuel inputs are required to produce and process biofuels, hybrid poplar and switchgrass converted to ethanol compensate for these emissions and actually remove greenhouse gasses from the atmosphere when the benefits of co-products are included. Greenhouse gas savings from biomass gasification for electricity generation are even greater. This research provides the basis for evaluating net biofuel greenhouse gas emissions and highlights the need to improve the technologies used for large scale conversion of biomass to energy and to more fully exploit agricultural co-products," Del Grosso said.

Ethanol and biodiesel from corn and soybean are currently the main biofuel crops in the U.S., but the perennial crops alfalfa, hybrid poplar, reed canarygrass and switchgrass have been proposed as future dedicated energy crops.

Bioenergy crops are able to offset carbon dioxide emissions by converting atmospheric carbon dioxide into organic carbon in biomass and soil, but the production of biofuels requires fossil fuels and impacts greenhouse gas fluxes.

The primary sources of greenhouse gas emissions associated with crop production are soil nitrous oxide emissions and the CO2 emissions from farm machinery, farm inputs and agricultural processes. Colorado State and USDA scientists quantified all of these factors to determine the net effect of several bioenergy crops on greenhouse gas emissions.

Researchers found that, once the DAYCENT results were combined with estimates of the amounts of fossil fuels used to provide farm inputs and operate agricultural machinery and the amount of fossil fuel offsets from biomass yields, they were able to calculate the net greenhouse gas fluxes for each cropping system.

"We used extensive observed greenhouse gas flux and crop yield data to verify DAYCENT model predictions of crop yields and net greenhouse gas fluxes from all of the biofuel crop rotations. DAYCENT model results were combined with life cycle analyses of crop production, conversion to biofuel, and fossil fuel displaced to estimate net greenhouse gas

emissions," said Parton.

This study was a unique and complete analysis of bioenergy cropping for several reasons. Different crops vary with respect to length of plant life cycle, yields, biomass conversion efficiencies, required nutrients, net soil carbon balance, nitrogen losses and other characteristics which in turn impact management operations. Additionally, crops have different requirements for farm machinery inputs from planting, growing, soil tillage, applying fertilizer and pesticide and finally harvesting.

The researchers were able to use life cycle analyses and the DAYCENT model to account for all of these factors as well as integrate climate, soil properties and land use to accurately evaluate the impact of bioenergy cropping systems on crop production, soil organic carbon and greenhouse gas fluxes.

The study was published in the April 2007 issue of Ecological Applications.