Fuel Life Cycle Assessment of Bioethanol Produced from Corn Stover in US Transportation

May Wu and Michael Wang
Center for Transportation Research, Argonne National Laboratory

A large amount of corn stover as a biomass feedstock is available in the U.S. corn belt for cellulosic bioethanol production when the production technology becomes commercially ready. With R&D advancement in cellulosic fermentation technologies, this pathway could serve as a starting point for producing cellulosic liquid transportation fuel to reduce nation's demand for petroleum oil. With available data for corn stover collection and transportation and for cellulosic ethanol production, we have added the corn stover-to-ethanol pathway in the GREET model, a fuel-cycle model developed at Argonne National Laboratory. With the GREET model, we assessed the life cycle energy use and emission impacts of corn stover-derived fuel ethanol that used in light duty vehicles (LDVs). The analysis includes corn farming, fertilizer manufacturing, farming machinery manufacturing, stover collection and transportation, ethanol production, ethanol transportation and ethanol use in LDVs as E10 or E85. Energy consumptions of petroleum oil and fossil, emissions of greenhouse gaseous CO2, N2O and CH4, and emissions of criteria pollutants CO, VOC, NOx, SOx and PM10 during the fuel cycle are estimated. Near term scenarios of corn grain ethanol alone, corn grain and stover together, and other cellulosic ethanol are then compared with conventional petroleum based transportation fuel. Results showed LDVs fueled with corn stover ethanol blend offers substantial energy savings. The ethanol pathway is capable of avoiding a significant amount of greenhouse gaseous emissions. Our analysis suggests that farming operation is a key to the improvement of overall fuel life cycle criteria pollutants emissions.