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Carbon Intensity of Corn Ethanol

Additional submitted attachment is included below.

Carbon intensity of corn ethanol in the United States: state of the science

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Abstract

The carbon intensity (CI) of corn ethanol, the primary renewable fuel used in transportation, has been actively researched and quantified over the last three decades. Reliable estimates of greenhouse gas (GHG) emissions for corn ethanol are important since these values help determine significant policy and market decisions on state, national, and international levels. We reviewed well-to-wheel GHG life cycle analyses (LCAs) for corn ethanol and evaluated models, input data, and results for farming, fuel production, co-product credit, land use change (LUC), transport of feedstock and fuel, tailpipe, and denaturant.

Compared to earlier analyses, recent LCAs for corn ethanol contain updates to modeling systems and data that reflect: (a) market-driven changes in corn production that lowered the intensity of fertilizer and fossil fuel use on farms; (b) more efficient use of natural gas and recent electric generation mix data for energy consumed at ethanol refineries, and (c) LUC analyses based on hybrid economic-biophysical models that account for land conversion, land productivity, and land intensification.

LCAs that include these latest developments yield a central best estimate of CI for corn ethanol of 51.4 $gCO_2e\ MJ^{-1}$ (range of 37.6–65.1 $gCO_2e\ MJ^{-1}$) which is 46% lower than the average CI for neat gasoline. The largest components of total CI are ethanol production (29.6 $gCO_2e\ MJ^{-1}$, 58% of total) and farming practices net of co-product credit (13.2 $gCO_2e\ MJ^{-1}$, 26%), while LUC is a minor contributor (3.9 $gCO_2e\ MJ^{-1}$, 7%). Market conditions that favor greater adoption of precision agriculture systems, retention of soil organic carbon, and demand for co-products from ethanol production may lower the CI of corn ethanol further. Continued refinement of models to account for co-products, conservation of soil carbon, and direct and indirect LUC is expected to produce ever more accurate estimates in the future