



ZeaChem Life Cycle Analysis

Advanced biofuels have the ability to significantly reduce greenhouse gas (GHG) emissions compared to traditional transportation fuels. This benefit was validated by CH2M HILL through a life cycle analysis (LCA) of ZeaChem’s innovative advanced cellulosic ethanol process. CH2M HILL utilized the Greenhouse Gas (GHG) Regulated Emissions and Energy use in Transportation (GREET) model for the LCA. The purpose of the analysis was to determine the overall GHG reductions of ZeaChem cellulosic ethanol compared to conventional gasoline and traditional corn-based ethanol.

Three life cycle stages were evaluated to assess the overall life cycle of the fuels evaluated: feedstock production, fuel production, and vehicle operation. The feedstock production stage includes emissions associated with the production, recovery, storage and distribution of the feedstock sources. The fuel production stage includes emissions associated with converting feedstock into fuel, transportation of fuel to the end-user, and storage and distribution of fuel. Vehicle operation is the final phase and includes emissions associated with vehicle operation as a result of the combustion of fuel during vehicle operations.

Based on the three life cycle stages, the LCA results indicate significant advantages in overall GHG reductions through the ZeaChem process. The total life cycle impacts of production and use of ZeaChem cellulosic ethanol result in a 94% reduction in GHG emissions versus conventional gasoline. These results are based on farm yield of 10 bone dry tons (BDT) per acre and 135 gallons of ethanol per BDT. Reductions achieved through the ZeaChem process are primarily attributed to the carbon sequestration that occurs during the biomass growing phase. The majority of the GHG advantage in the ZeaChem ethanol process is generated during the feedstock farming stage. ZeaChem’s feedstock strategy is to utilize dedicated energy crops, such as hybrid poplar trees. Dedicated energy crops offer significant environmental as well as economic advantages compared to residuals or biomass waste products. Additional sensitivity analysis of farm yield shows increasing GHG reduction benefit to 97% and 98% when farm yield increases to 15 BDT/acre and 20 BDT/acre, respectively.

Comparatively, corn ethanol delivers a 21% reduction and cellulosic ethanol using corn stover residue generates 86% GHG reduction compared to conventional gasoline. See chart below for summary of results.

Fuel Technology	Greenhouse Gas Emissions Percent Reduction from Gasoline
Gasoline	0%
Corn Ethanol	21-24%
Cellulosic Ethanol with Corn Stover Feedstock	86-89%
ZeaChem Ethanol with Farmed Trees Feedstock	94-98%