Direct and indirect greenhouse gas emissions from biomass storage: Implications for life cycle assessment of biofuels

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Isaac was raised in Corvallis, Oregon and attended Whitman College in Walla Walla, Washington, where he graduated with a Bachelor of Arts in Biochemistry, Biophysics, and Molecular Biology in 2005. After moving to Seattle, Isaac worked as a Research Scientist at the University of Washington School of Medicine until 2008, when he entered the Ecological Sciences and Engineering graduate program at Purdue. He has studied the influence of bioenergy crop production and storage on the environmental impacts of biofuels as part of the Laboratory for Renewable Resources Engineering and through an internship at Argonne National Laboratory.

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Ethanol and other biofuels from cellulosic feedstocks are currently the most promising candidates to replace a large fraction of gasoline consumption in the United States and reduce greenhouse gas emissions (GHGs). Gaps in current life cycle assessment models of second-generation biofuels may lead to underestimation of the carbon intensity of these fuels. By incorporating biomass harvest & storage processes into life cycle emissions estimates and measuring methane and nitrous oxide production during biomass storage, this project assesses the likely impacts of feedstock storage on the net GHG emissions from biofuel production.

Updating biofuels life cycle analysis models to include harvest and storage of biomass feedstocks increases estimates of net GHGs by 2.0 - 10.0 gCO_2e/MJ ethanol. Differences between storage methods are significant: materials use and direct emissions of methane may lead to greater emissions during wet storage, while covering dry bales reduced average emissions and variability. Both methane and nitrous oxide production are highly variable during storage, though at low rates which may not substantially affect the carbon intensity of biofuels.

While ethanol from cellulosic feedstocks still provides a greater than 60% reduction in greenhouse gases compared to gasoline, storage processes should be considered when assessing the extent to which biofuels reduce net fossil energy use and climate change emissions.