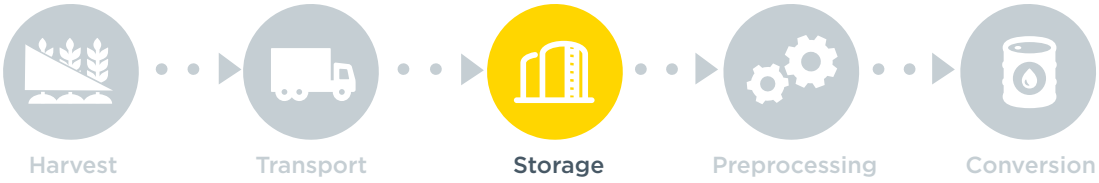
FEEDSTOCK-CONVERSION INTERFACE CONSORTIUM

Techno-Economic Analysis Case Study: Corn Stover Storage Options Considering Variable Degradation Within Bale Stacks

CHANGING THE PARADIGM OF CONVENTIONAL APPROACHES

Conventional Approach	New Information	Improved Approach
Prior studies using average estimates of losses and compositional changes during storage miss the operational impacts of biomass variability.	This new corn stover techno-economic analysis model better represents moisture migration through biomass bale stacks that create zones of varying degradation, which behave differently in preprocessing and conversion operations.	Using this approach, researchers can more accurately estimate costs of storage losses and protected storage, as well as predict the impact of bale-to-bale variability on biorefinery operations.



KEY TAKEAWAY

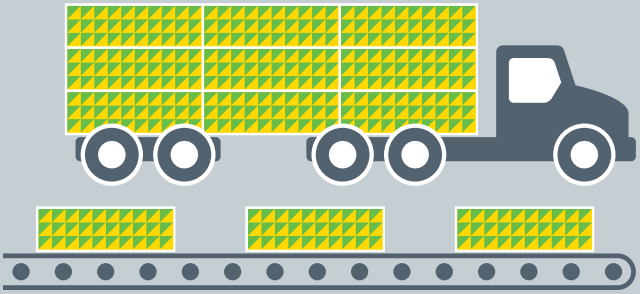
Moisture migration through biomass bale stacks creates zones of varying degradation that behave differently in preprocessing and conversion operations. In this study, Feedstock-Conversion Interface Consortium (FCIC) researchers developed a mathematical model of degradation zones within a corn stover bale stack based on moisture migration over the course of one year. This allows researchers to more accurately predict the variability of incoming feedstock streams due to changes during storage.

Below are the estimated costs of corn stover at a biorefinery gate by storage design, accounting for variable degradation within bale stacks. Cost reductions in preprocessing or conversion of approximately $1–$2/dry ton for tarped stover or $10/dry ton for covered storage would be necessary to justify the higher investment in storage protection.

	Cost of Corn Stover at Biorefinery Gate	
Storage Design	**High Ambient Moisture**	**Low Ambient Moisture**
Uncovered on gravel pad	$72–$74/dry ton	$70–$73/dry ton
Tarped on gravel pad	$73–$74/dry ton	$72–$73/dry ton
Covered, open-sided structure	$82/dry ton	

Old Approach

Assumes average quality parameters and average dry matter loss.



New Approach

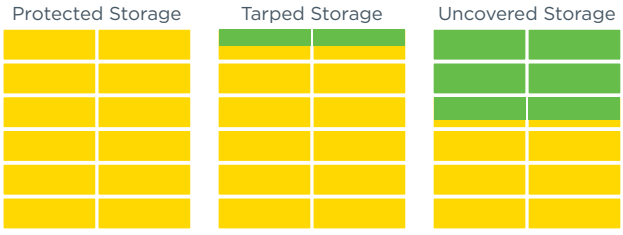
Categorize fractions of delivered biomass by degradation levels.

0%–20% moisture content = mild-moderate degradation

≥20% moisture content = moderate-severe degradation

METHODOLOGY AND LEARNINGS

It is common knowledge that keeping corn stover as dry as possible in storage will reduce losses due to degradation and prevent some unwanted compositional changes. Degradation impacts biorefinery costs in two critical ways: (1) additional feedstock must be procured to make up for dry matter losses during storage and (2) performance in downstream preprocessing and conversion operations is impacted, often negatively. The goal of this analysis is to estimate costs of delivered corn stover and level of degradation caused by changes in long-term storage design. A dynamic simulation model was developed to predict the costs of delivered corn stover considering the mass fraction of feedstock by degradation level. The results of this model gave ranges of biorefinery operational cost improvements needed to justify increased investment in storage. Specifically, cost reductions in preprocessing or conversion of $1–$2/dry ton for tarped stover or $10/dry ton for covered storage would be necessary to justify the higher investment in storage protection. The model can also provide data to characterize the degradation level of incoming biorefinery feedstock streams for preprocessing and conversion TEAs to identify potential operational disruptions caused by the biomass condition.



Two categories of degradation within corn stover bales, mild-moderate and moderate-severe, were considered in the simulation model developed in this study. The amount of moderate-severe degradation within the stack increases with decreasing level of protection.

LEARN MORE

For more information about this case study, contact Erin Webb, Oak Ridge National Laboratory, at **webbeg@ornl.gov**.

ABOUT THE FCIC

The FCIC is a Bioenergy Technologies Office-funded collaboration of industry advisors and nine U.S. Department of Energy National Laboratories. The FCIC is dedicated to the continuous and efficient operation of the U.S. biorefinery industry. For more information, visit **www.energy.gov/eere/bioenergy/feedstock-conversion-interface-consortium** or contact **fcic@nrel.gov**.

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