To the Refinery and Back-The Costs of Residue Transportation
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There are many things to consider when removing residue. Most of the previous articles have focused on the soil and yield impacts of harvesting stover. This article will expand on the economics of stover harvest, mainly the transportation to the refinery and how that influences the overall economics of residue removal.

Figure 1 indicates the price that would need to be obtained from a refinery for stover in order for producers to make a profit. If the refinery agrees to do all the handling of the biomass the price required per ton of biomass is only $5.1/ton but if the farmer is responsible for handling (which is most often the case) the price required for the stover is approximately $35-45/ton.

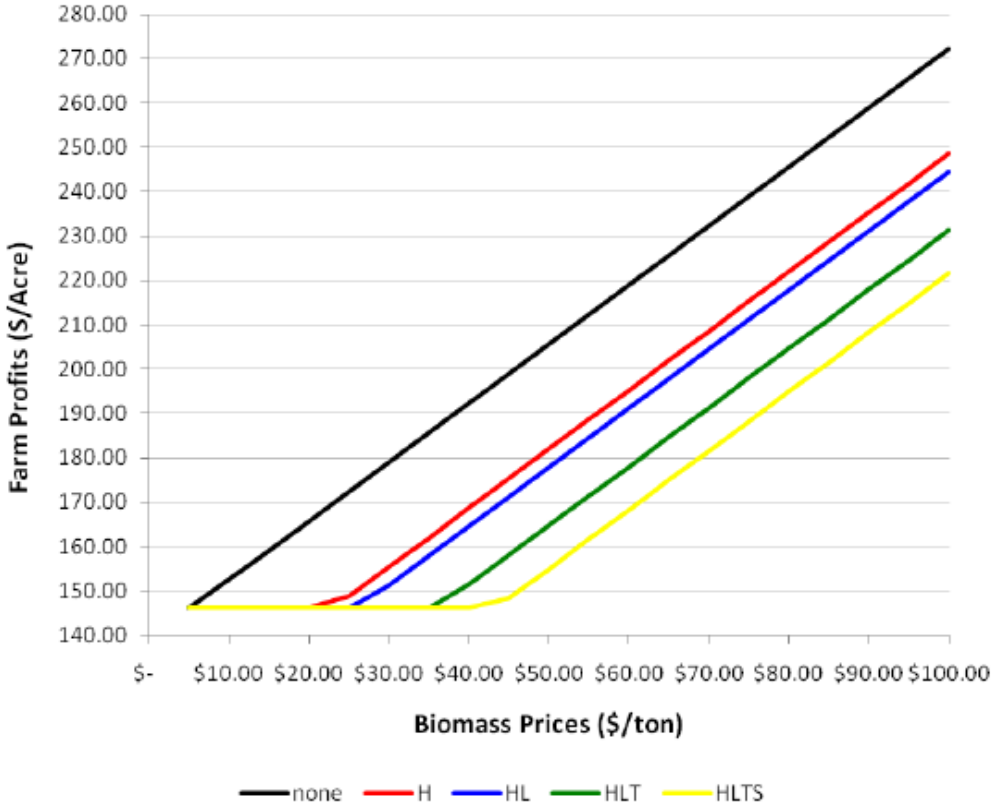

Figure 1: Change in Farm Profits with change in Biomass Prices

None: Farmer is not responsible for harvesting, loading, transport and storage costs

H: Farmer is responsible only for the harvesting costs

HL: Farmer is responsible for harvesting and loading costs

HLT: Farmer is responsible for harvesting, loading and transport costs

HLTS: Farmer is responsible for harvesting, loading, transport and storage costs

(Anand et al. 2010)

Figure 2 would indicate that if the farmer is responsible for harvesting, loading, transporting and, storage costs that the refinery must be within 10 miles of the storage facility in order produce a net profit. If the refinery was located greater than 80 miles away this model indicates that residue harvest would result in a low profit.

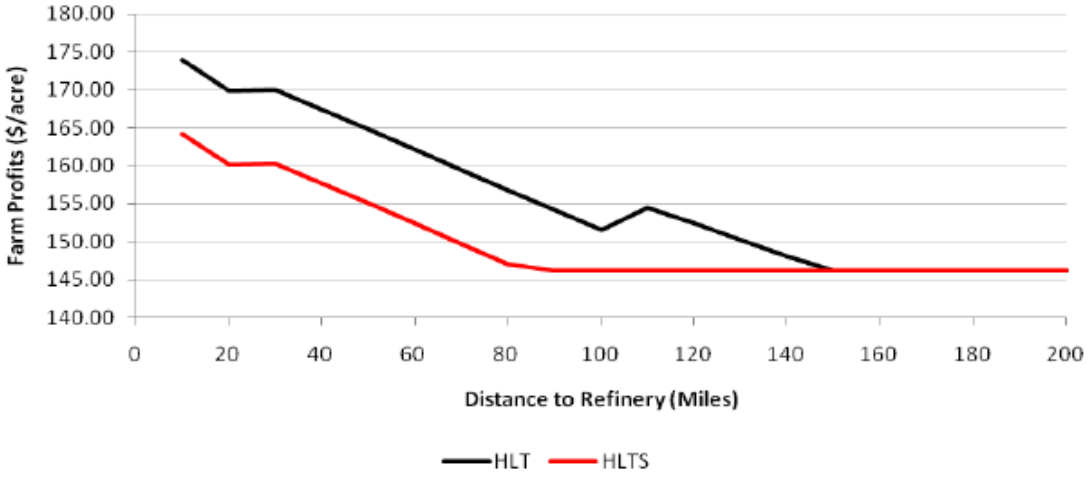

Figure 2: Change in farm profits with change in distance to refinery

None: Farmer is not responsible for harvesting, loading, transport and storage costs

H: Farmer is responsible only for the harvesting costs

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(Anand et al. 2010)

An extensive study was conducted in the United States and the results can be taken into consideration when used in Ontario. In terms of operational costs, they should be similar to the situation in Ontario. Table 1 provides the breakdown of the costs of residue removal.

Table 1: Biomass costs for Corn Stover Removal

Operation	**COST***		
Shredding	10.63	$/acre	
Raking	6.8	$/acre	
Baling	12.67	$/acre	
Wrapping	4.6	$/ton	
Moving	4.57	$/ton	
Loading	3.1	$/ton	
Storage	7.31	$/ton	
Transportation	0.303	$/ton/mile	w/in 25 miles of plant
0.198	$/ton/mile	26-100 miles from plant	
0.16	$/ton/mile	>100 miles from plant	

*U.S. Dollars

(Anand et al. 2010)

Let's do an example of 100 acre field with 1.5 ton/ac/yr of corn residue baled and removed.

Operation	Cost*	Total Cost*
Shredding	$10.63/ac	$1063
Raking	$6.8/ac	$680
Baling	$12.67/ac	$1267
Wrapping	$4.6/ton	n/a
Moving	$4.57/ton	$686
Loading	$3.1/ton	$465
Storage	$7.31/ton	$1097
Transportation	0.303 $/ton/mile (<25 miles)	<$1136
	0.198 $/ton/mile (26-100 miles)	$772-$2970
	0.16 $/ton/mile (100+ miles)	>$2970

* U.S. Dollars

So if the farmer conducts all the harvest procedures themselves the total cost for a 100 acre field would be about $6394 if the field was within 25 miles of a refinery. Let say that stover is worth $50/ton then $7500 would be the gross total but only $1106 would be the net profit from that 100 acre field ($11/ac). Keep that cost of nutrient removal was not accounted for and that each situation is different. This is a profile of where the costs are distributed. With this cost profile, one must check that it is worth the time and energy to go through the effort of biomass harvesting.

Perlack and Turhollow (2002) examined the transportation process from a slightly different view, the refinery. They determined that transport costs account for 33-40% of total delivered costs and collection accounts for 30-35% of the total delivery costs for a refinery. Perlack and Turhollow (2002) determined that hauling bales directly from the field is less expensive than staging the bales at the field edge and hauling with trucks and flatbed trailers.

Considering the costs of collection and transportation of the residue, typically absorbed by the farmer, more research pertaining to alternative harvest/collection, handling, and transport technologies and systems need to be investigated to reduce the costs of these processes. With more efficient process developed bioenergy will become more attractive and competitive.

Notes:

Perlack, R.D. and Turhollow, A.F. 2003. Feedstock cost analysis of corn stover residues for further processing. Energy. 28:1395-1403.

Anand, M., Bergtold, J.S., Archer, D., Duffy, P., and Rapers, R. Economic and environmental impacts of corn stover removal for biofuel production: a farm level case study. Retrieved from: *www.sedsi.org/history/2010/proceedings/proc/p091007005.pdf*