Supporting Information for:

Prospects of biocarbon and biocomposite in sustainable biobased industries

Poritosh Roy[1*,] Arturo Rodriguez-Uribe [2], Amar K. Mohanty[1,2] and Devashish Pujari[3*], Mike Tiessan[4] , Atul Bali[4], Manjusri Misra[1,2]

[1]School of Engineering, University of Guelph, Ontario, N1G 2W1, Canada

[2]Department of Plant Agriculture, University of Guelph, Ontario, N1G 2W1, Canada

[3]DeGroote School of Business, McMaster University, Canada

[4]Competitive Green Technologies, Leamington, Ontario, Canada

*Corresponding author: poritosh@uoguelph.ca (P.Roy), pujarid@mcmaster.ca (D. Pujari)

Table SI-1 Material composition of compounding process of this study.

Product name	Material composition, % (mass)				
	PP	Biocarbon	Miscanthus fibre	Talc	Colorant
Biocomposite	70	23	7	-	-
Talc composite	68	-	-	30	2

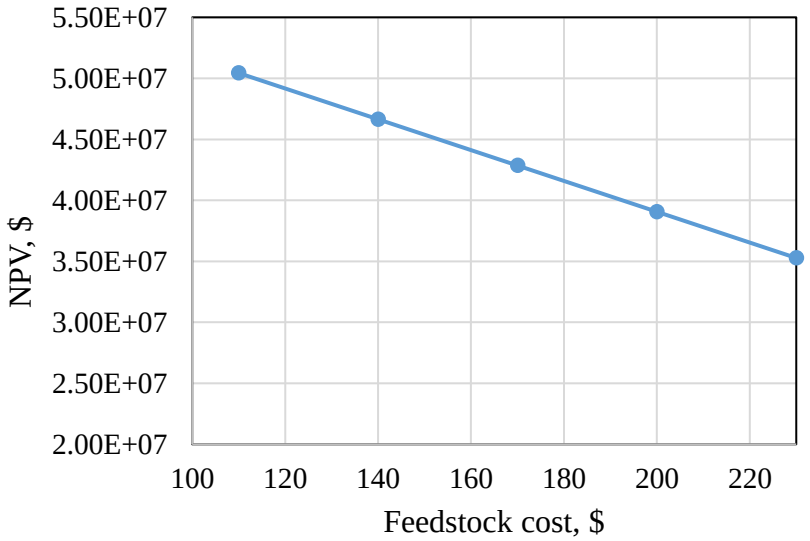


Figure SI-1 Effect of miscanthus price on NPV of pyrolysis plant

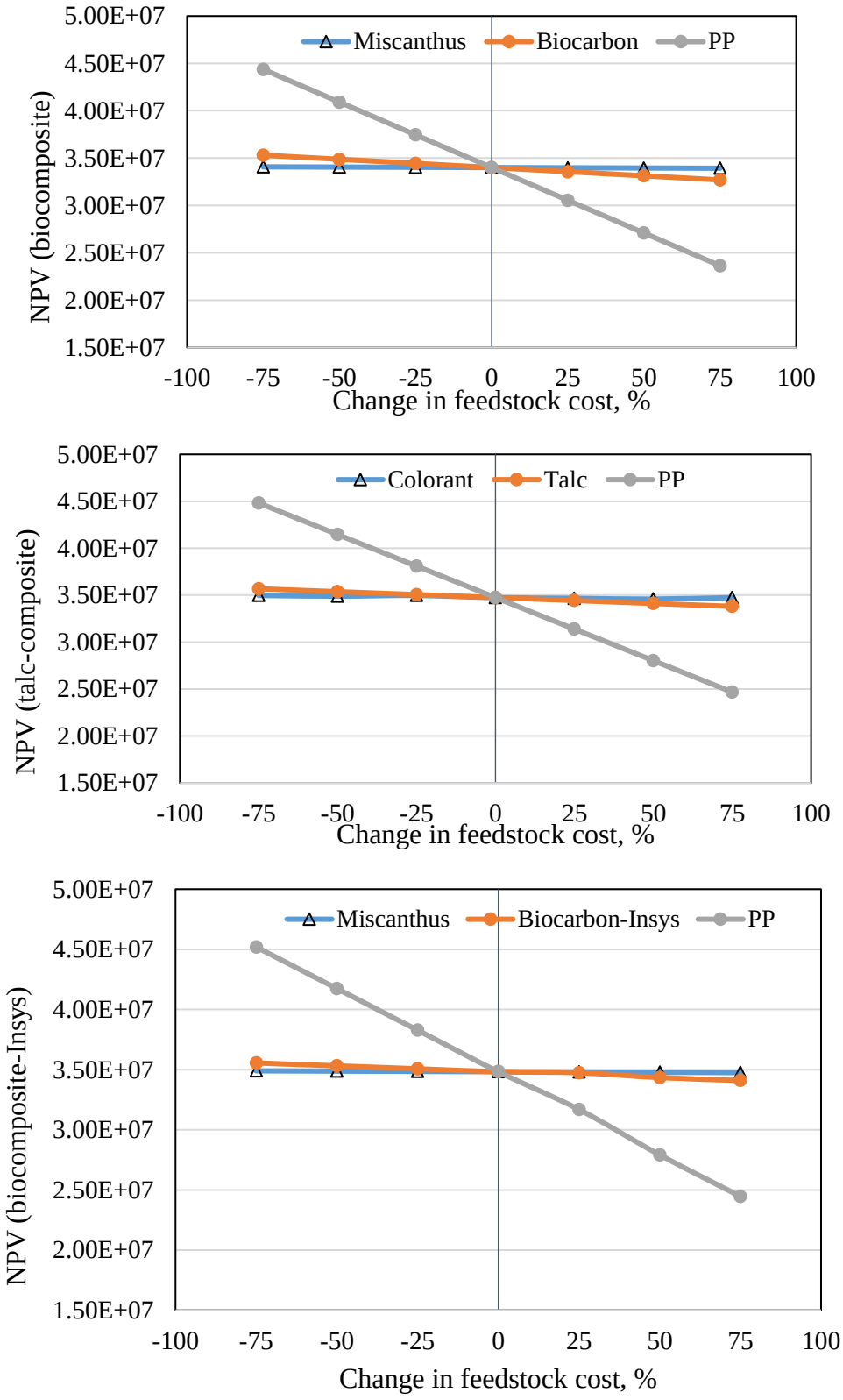


Figure SI-2 Effect of the change in material cost on the NPV of composite manufacturing plants.

Table SI-2 Land area in different regions of Canada (km^2).

Region	*Total	*Forest	*Farm	^Marginal land
Alberta	661848	277180	210953.93	35814.3
British Columbia	944735	579100	28354.58	6636.7
Manitoba	647797	189680	77185.70	12808.5
New Brunswick	72908	60910	3952.28	3557.2
Newfoundland and Labrador	405,212	107300	361.95	645.7
Northwest Territories	1346106	283520	-	-
Nova Scotia	55284	42400	4030.44	728.0
Nunavut	2093190	8150	-	-
Ontario	1076395	537580	53864.53	3282.4
Prince Edward Island	5660	2650	2508.59	69.7
Quebec	1542056	733600	34629.35	1610.3
Saskatchewan	651036	200430	260026.05	29667.7
Yukon	482443	78840	-	-
Canada	9984670	3101340	6758674	94818.7

*(StatCan, 2015); ^(Liu et al., 2012) (Marginal land: land classes 4–6)

Table SI-3 Marginal land classes in Canada.

Land class	Description	Limitations
Class 4	Soils are low to medium in productivity for a narrow to wide range of common field crops. Restrict the choices of crops, methods of conservation, and very careful management practice.	Severe
Class 5	Soils are not capable for sustained production of annual field crops. Restrict their capability to producing perennial forage crops, and improvement practices are feasible.	Very severe
Class 6	Soils may provide some sustained grazing for farm animals, but grazing seasons may be very short. Unsuitable for cultivation, but can be used for unimproved permanent pasture.	Extremely severe
Class 7	Has no capacity of arable culture or permanent pasture	Unsuitable

Source: (OMAFRA, 2015)(Liu et al., 2012)

SI-4 Job creation

Pyrolysis plants:

Yearly miscanthus production in Canada would be about 15.8 million tons if miscanthus productivity on the marginal lands is assumed to be 8.4 t/ha/year (Kludze et al., 2013) when 20% of marginal land is used for miscanthus cultivation. We assumed that half of the produced miscanthus might be available for the bioindustry, thus about 7.9 million tons miscanthus can be used for pyrolysis process, which requires 480 pyrolysis plants. The plant is operated in 3 shifts; each shift requires an engineer and an operator. Plant capacity is 50 t/day; yearly operation 330 days.

Therefore, required number of pyrolysis plants =(7915800)/(50*330)=480

Jobs creation = 480*(2*3) = 2878

Biocomposite plants:

It is estimated that 1241 composite manufacturing plants are required to produce 1.2 million tons of composite materials can be produced utilizing 10% of biocarbon (277053 t). The plant is operated in 3 shifts; each shift requires an engineer and an operator. Plant capacity is 3 t/day; yearly operation 330 days.

Amount of composite material can be produced = 277053/0.23= 1204578 t; PP and additives were reinforced with biocarbon (23% biocarbon in composite)

Number of composite plants = 1204578/(3*330) = 1217

Jobs creation = 1217*2*3=7300

Therefore, total jobs can be created in bioindustry =(2878+7300) =10179

Reference

Kludze, H., Deen, B., Dutta, A., 2013. Impact of agronomic treatments on fuel characteristics of herbaceous biomass for combustion. Fuel Process. Technol. 109, 96–102. https://doi.org/10.1016/j.fuproc.2012.09.043

Liu, T., Ma, Z., McConkey, B., Kulshreshtha, S., Huffman, T., Green, M., Liu, J., Du, Y., Shang, J., 2012. Bioenergy production potential on marginal land in Canada. 2012 1st Int. Conf. Agro-Geoinformatics, Agro-Geoinformatics 2012 660–663. https://doi.org/10.1109/Agro-Geoinformatics.2012.6311729

OMAFRA, 2015. Classifying Prime and Marginal Agricultural Soils and Landscapes: Guidelines for Application of the Canada Land Inventory in Ontario [WWW Document]. Ontario Minist. Agric. Food Rural Aff. URL http://www.omafra.gov.on.ca/english/landuse/classify.htm (accessed 1.31.16).

StatCan, 2015. Land area by province and territory [WWW Document]. Stat. Canada. URL http://www.statcan.gc.ca