

The economics of SRC willow and hybrid poplar afforestation biomass production for bioenergy in Ontario, inclusive and exclusive of carbon values

D. McKenney, D. Yemshanov, D. Allen, S. Fraleigh, D. Sidders
Canadian Forest Service, Sault Ste. Marie, ON



Abstract

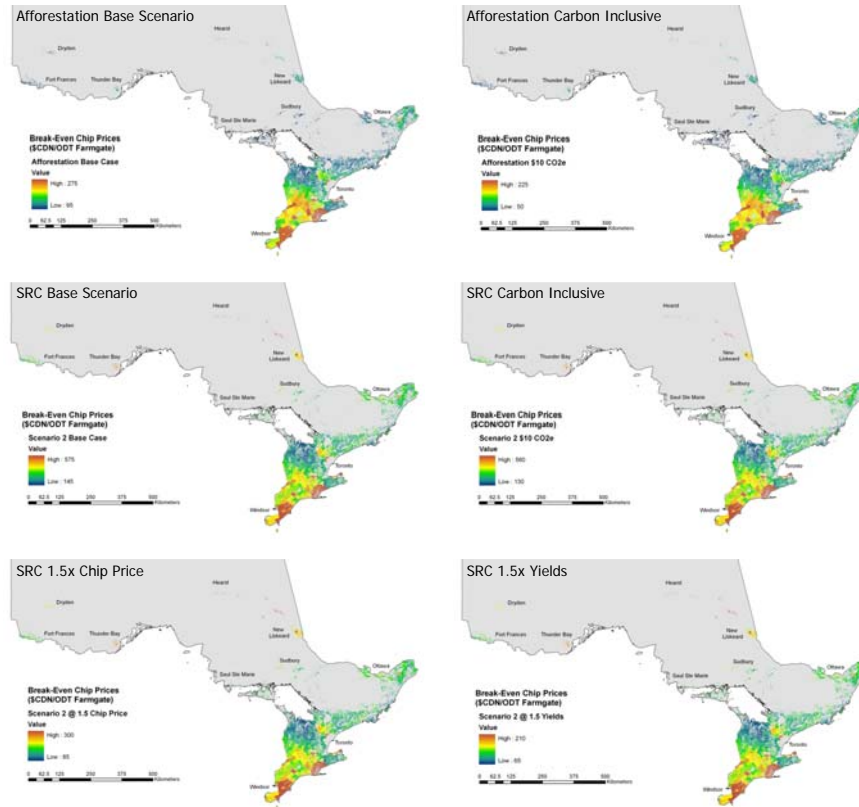
Our work, in collaboration with practitioners in different parts of the country, is aimed at not only quantifying spatial variation potential growth rates but also assessing economic costs and benefits. Here we summarize some scenarios for both hybrid poplar afforestation and short rotation coppice (SRC) production. We present results that represent what we call “current expectations” (base scenario) and “aspirational targets”. “Current expectations” would suggest hybrid poplar afforestation is not particularly attractive while SRC willow may be attractive in some areas where costs are lower. The “aspirational target” scenarios identify important cost and growth conditions that may be required to make this kind of biomass production more economically attractive.

Methods and Data

An economic model has been built to incorporate spatial variation in both biophysical and economic aspects. Economic calculations include net revenues from biomass production, the present value of carbon sequestration benefits and other metrics such as break-even prices for delivered biomass. For a detailed description of the model and its basic assumptions see McKenney et al. 2006 and Yemshanov et al. 2005. Table 1 presents the basic cost assumptions for both SRC and hybrid poplar afforestation. Yield assumptions for model input are approximately 5.7 ODT/ha/yr for afforestation and 10 ODT/ha/yr for SRC. SRC biomass production involves greater initial investment than afforestation but can be expected to provide greater yields over time.



Some Results



Variable	Assumption	Description
Sample Area	Best 100,000 hectares in Ontario	Spatial model averages NPV/IRR
Scenario 1	Establishment (yrs 0-1) - \$3325/ha	A very localized cost description based on an operator in southern Ontario.
	Maintenance (yrs 2-21) - \$640/ha	
	Total (yrs 0-21) - \$3965/ha	
Scenario 2	Establishment (yrs 0-1) - \$3445/ha	Regional costing based upon current afforestation costs across Ontario.
	Maintenance (yrs 2-21) - \$2815/ha	
	Total (yrs 0-21) - \$6260/ha	
Scenario 3	Establishment (yrs 0-1) - \$1670/ha	"National Level" averaged costing.
	Maintenance (yrs 2-21) - \$1400/ha	
	Total (yrs 0-21) - \$3070/ha	
Harvesting	\$25/ODT	This assumes costs for harvesting using the "Bio-Baler" harvester. Includes in-field handling and transportation to farmgate.
Chip Price	\$65/ODT	The market price assumed for all scenarios. This price reflects farmgate prices.
Carbon Value	\$10/CO ₂ e	Reflects a market values for carbon.

Table 1. Key assumptions in economic analysis.

This table summarizes some of the major costs and assumptions associated with establishment and management of SRC and afforestation in Ontario.

Table 2. NPV, IRR and aspirational target results.

This table presents the results and sensitivity analyses of three SRC scenarios and one afforestation scenario.

Real Discount Rate	Scenario	Scenario 1	Scenario 2	Scenario 3	Afforestation
		Cost 21yrs (SCDN) >			
		3665	6260	3070	3820
	NPV (RR%)	NPV (RR%)	NPV (RR%)	NPV (RR%)	
2%	Base Scenario	2762 (8.1)	770 (3.8)	-2317 (0.0)	736 (3.2)
	1.5x Chip Prices	7926 (19.1)	9834 (13.8)	2747 (4.9)	3960 (6.6)
	1.5x Yield	6300 (16.3)	4300 (10.8)	1321 (3.3)	2762 (5.6)
4%	Base Scenario	1671	-76	-3361	-420
	1.5x Chip Prices	5764	4018	733	1767
	1.5x Yield	4232	2795	-200	956
8%	Base Scenario	259	-1124	-4640	-1624
	1.5x Chip Prices	3067	1685	-1832	-596
	1.5x Yield	2221	839	-2677	-978

Discussion

Table 2 provides a basic set of results for SRC and afforestation scenarios. At a 4% real discount rate, SRC baseline scenarios for the most economically attractive 100,000 hectares in Ontario suggests NPV ranges from \$1671/ha to -\$3361/ha and IRR ranges from 9.1% to 0%. The afforestation scenario output demonstrates \$420/ha and 3.2% for NPV and IRR, respectively. Large variations in establishment costs across the three SRC scenarios provide price points for economically attractive and un-attractive investments. Break-even chip prices (at farm-gate) for lower cost scenario's range dramatically across Ontario and can be attributed to varying opportunity costs and yields. Break-even chip prices inclusive of carbon value (\$10/CO₂e) are approximately \$20 less for SRC and \$45 less for afforestation.

Gains in physical yields and biomass price as depicted in the aspirational target scenarios reduces the unit cost of production quite dramatically. Whether this would be sufficient to attract large scale private investment is a matter for discussion. The use of biosolids on biomass production sites may offer another joint product opportunity. Initial analyses suggest high net present values due to avoided land fill costs and reduced transportation charges.

Concluding Comments

Afforestation and SRC offer alternative economic opportunities for land-owners. Unit costs of production are presented here that provide a number of interpretations for both the practical up-take of this type of technology, policy development and also possible research priorities.

References

- Yemshanov D., McKenney D.W., Fraleigh S., Allen D., Preto F., 2010. An economic assessment of the use of short-rotation coppice woody biomass to heat greenhouses in southern Canada. *Biomass and Bioenergy*. In press.
- Yemshanov D., McKenney D.W., Halton T., Fox G., 2005. Investment Attractiveness of Afforestation in Canada Inclusive of Carbon Sequestration Benefits. *Can. J. Agricultural Economic*. 53: 307-323.
- Yemshanov D., McKenney D.W., 2008. Fast-growing poplar plantations as a bioenergy supply source for Canada. *Biomass and Bioenergy*. *Biomass and Bioenergy*: Vol 32:185-197.
- Ramial E., Yemshanov D., Fox G., McKenney D., 2009. A Bioeconomic Model of Afforestation in Southern Ontario: Integration of Fiber, Carbon and Municipal Biosolids Values. *J. of Environmental Management and Assessment*. 90: 1833-1843.
- McKenney D. W., Yemshanov D., Fox G., Ramial E., 2006. Using bioeconomic models to assess research priorities: a case study on afforestation as a carbon sequestration tool. *Can. J. For. Res.* 36: 886-900.



Natural Resources
Canada

Ressources naturelles
Canada

