



Implications of Expanding Bioenergy Production From Wood in BC: An Application of a Regional Wood Fibre Allocation Model

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<http://web.uvic.ca/~kooten/REPA/WorkingPaper2009-02.pdf>



Canada



Outline of Talk

- Brief Description of model
- Base Case Results
- Scenarios
- Implications





Transport & Fibre Allocation Model

- 10 year recursive model run
- Splits province of British Columbia into the 29 current forest districts.
- Fibre supply and demand characterized over time in each district.
- Transport links (distance and cost) defined within districts, between districts and from district to markets.







Model Summary

Max: Profit

St:

- Resource Constraints
 - Capacity Constraints
- ❖ Exogenously set annual *'ceiling'* on harvest by district, processing capacity, demand parameters – model optimizes fibre streams





Prices in Model

- ❖ All pricing is in \$2005 Cdn.
- ❖ Actual prices used for 2005-2008. Assume 2008 prices hold 2009, then revert to 2001-2005 averages.
- ❖ Electricity priced at \$60 MWhr first 5 years then increases to \$85 for the final 5.





Fibre Supply (I)

- Harvests are split into 3 species groups for each forest district – pine, other coniferous, deciduous. Harvest data used for initial 3 years, then Max AAC used as harvest ceiling for 2008-2014.
- Harvested logs are either processed locally, transported to mills in other regions or exported directly (anything leaving BC is defined as export).

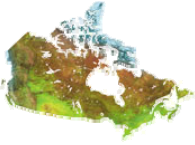




Fibre Supply (II)

- As processing occurs all co-product streams are accounted for – chips, woody residuals and bark.
- Intermediate products used within model (endogenously) to produce pulp, pellets, MDF and energy (in mills or specifically for sale to grid).





Demand (I)

- Demand for logs and “*intermediate*” products can come internally from processing demand in districts (defined by capacity – sawmills, “other roundwood”, plywood, OSB, MDF, chip mills, pellet mills, kraft pulp, mech pulp, mill energy and stand alone energy).
- Also sell “final” products and generate revenue (enter the objective function) – logs, lumber, plywood, pulp, pellets, OSB, MDF and “Other” roundwood products.





Demand (II)

- No exogenous pricing of intermediate products – values determined endogenously based on costs and final product revenues.
- Lumber to US market is “price responsive” through a stepped excess demand function.





Transport Functions

- Transport cost functions take basic form:

$$TC = a + bD$$

Where:

TC is total transport cost

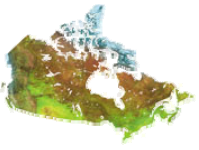
a is fixed cost

b is per km costs

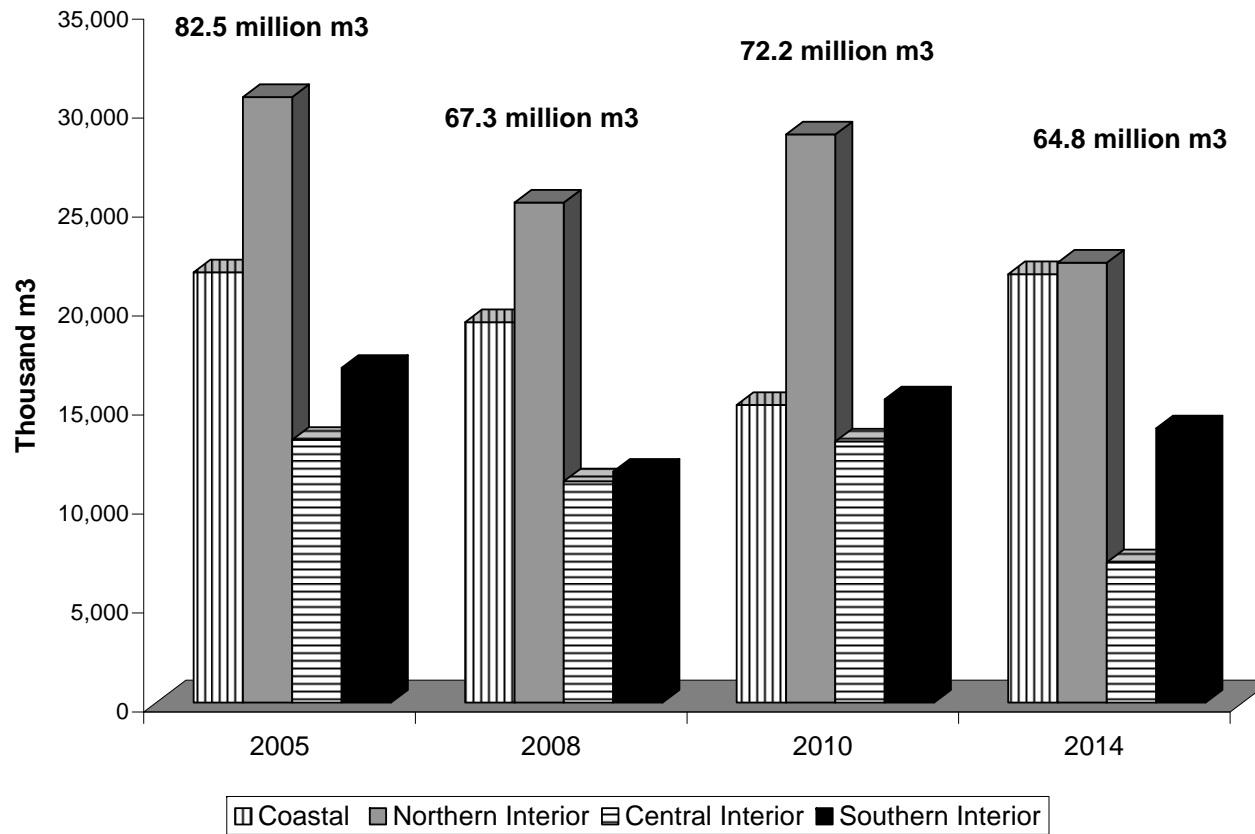
D is one-way distance in km

- We have developed independent functions for logs, lumber, chips and other residuals.
- Cost of fuel in transport has been characterized => can model impact of fuel inflation on transport costs from our 2005 start year





BC Base Case Harvests Over Simulation Period





Base Case Regional Lumber and Pulp Production

Lumber (mmbf)	Coastal	Northern Interior	Central Interior	Southern Interior
2005	2,291	7,527	3,109	3,606
2008	2,057	5,737	2,995	2,344
2010	1,243	6,994	3,308	3,446
2014	2,576	5,042	1,784	3,355
Pulp ('000 t)				
2005	2,066	2,158	662	1,033
2008	1,557	1,746	662	733
2010	1,374	1,374	662	1,015
2014	1,661	1,383	537	788





Changes Over Time - Base

- Share of BC production will move from Northern & Central Interior to Southern Interior and the Coast.
- Largest dislocation in “BC Timber Basket”
- Northern Interior remains the largest producer.





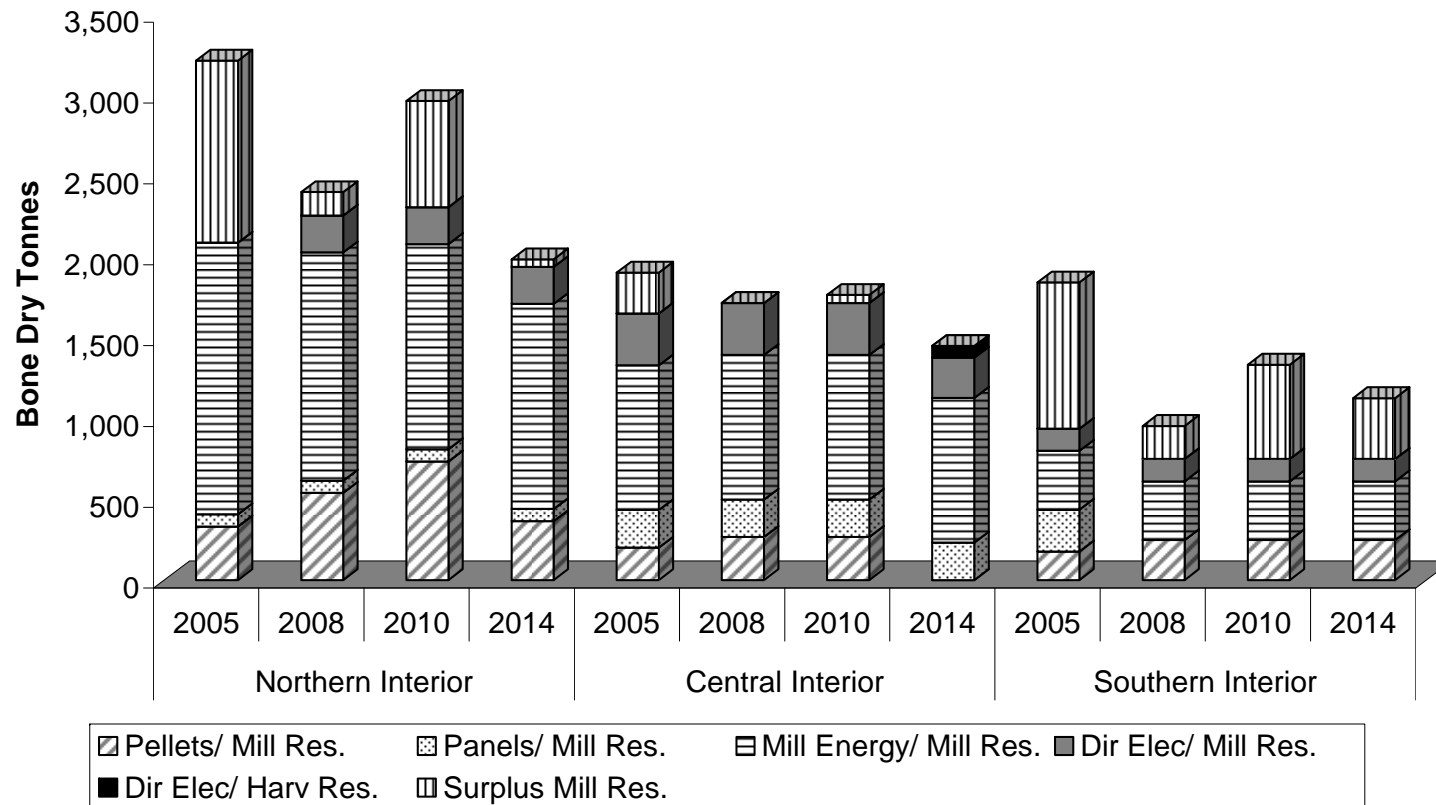
Changes over Time (II)

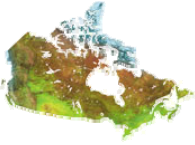
- Reductions in pulp production do not necessarily occur closer to area with large harvest reductions.
 - Reduction in pulp production on coast
 - Quesnel district, with the largest harvest reduction maintains pulp production in model – centrally located wrt to sawmill capacity and therefore chips.





Woody Co-product Use Base Case





Scenarios

- **Base Case** is compared to two scenarios with increasing capacity for energy.
- **Scenario 1:** Several small to medium direct-fired electrical facilities are added in 2010, for total 188 MW added capacity. Also a 175,000 tonne pellet plant.
- **Scenario 2:** Four large biomass fired plants added in 2010 for a total of 800 MW added capacity. One in Northern Interior, One in Central Interior and two in South Interior.



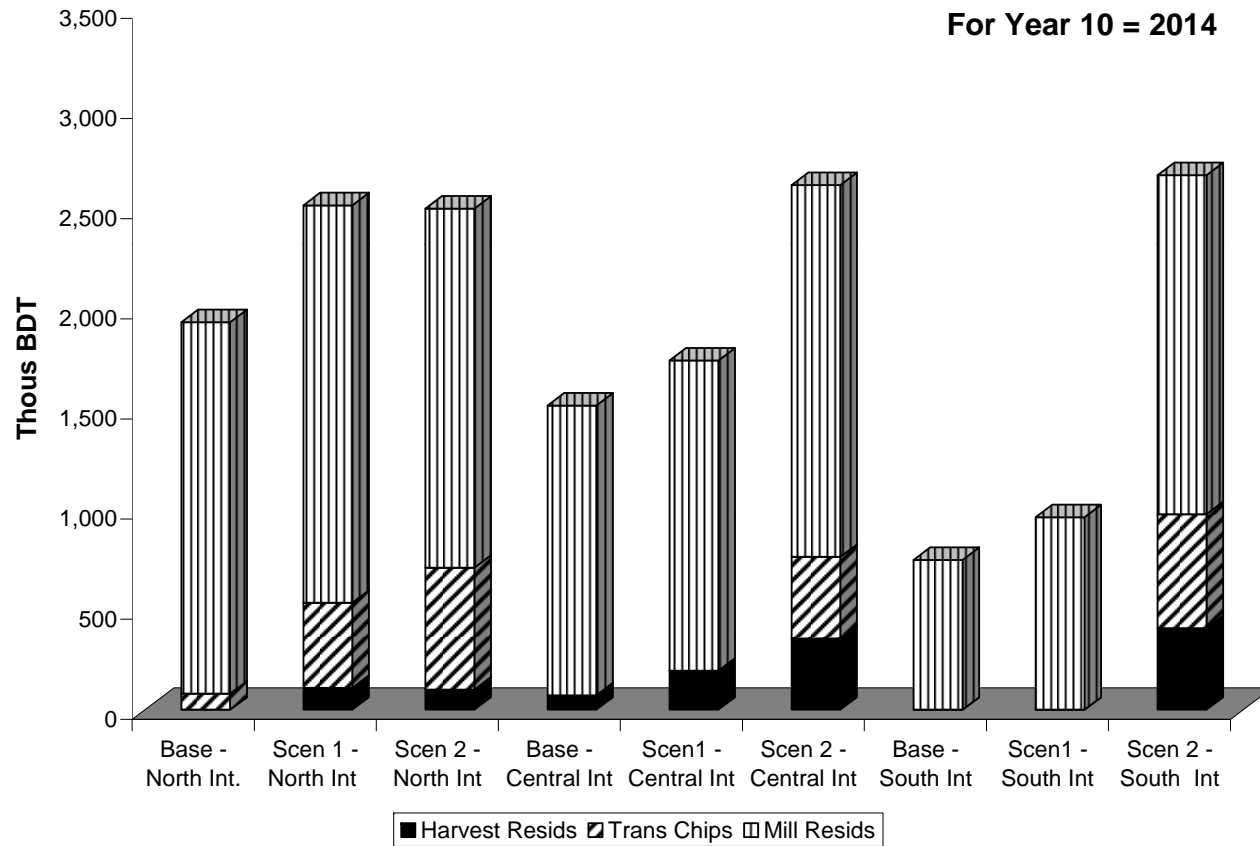


Changes relative to base case

Product	Scenario 1		Scenario 2	
	2010	2014	2010	2014
Harvest ('000s m ³)	+98	0	+957	0
Lumber (mmbf)	+24	0	+261	0
Pulp ('000s tonnes)	-52	-155	-570	-670
Pellets ('000s tonnes)	0	-88	-26	-380
Energy ('000s MWh)	+1,500	+1,480	+6,300	+6,230



Feedstock Supplies





Summary

- Very difficult to examine feedstock supply for energy in isolation from other sectors.
- Current capacity for feedstock can not be met by mill ‘residuals’ alone post-beetle.
- Increasing capacity for bioenergy does affect other sectors using woody fibre
 - Remote locations will divert pulp chips to energy at assumed prices
 - Increasing the value of the co-product streams affects the harvest levels even without direct harvesting
 - Harvest residuals begin to enter the feedstock mix



Thank You

