Bio-energy from Mountain Pine Beetle Timber and Forest Residuals

Kurt Niquidet

(niquident@uvic.ca)

Brad Stennes

(bstennes@pfc.cfs.nrcan.gc.ca)

and

G. Cornelis van Kooten

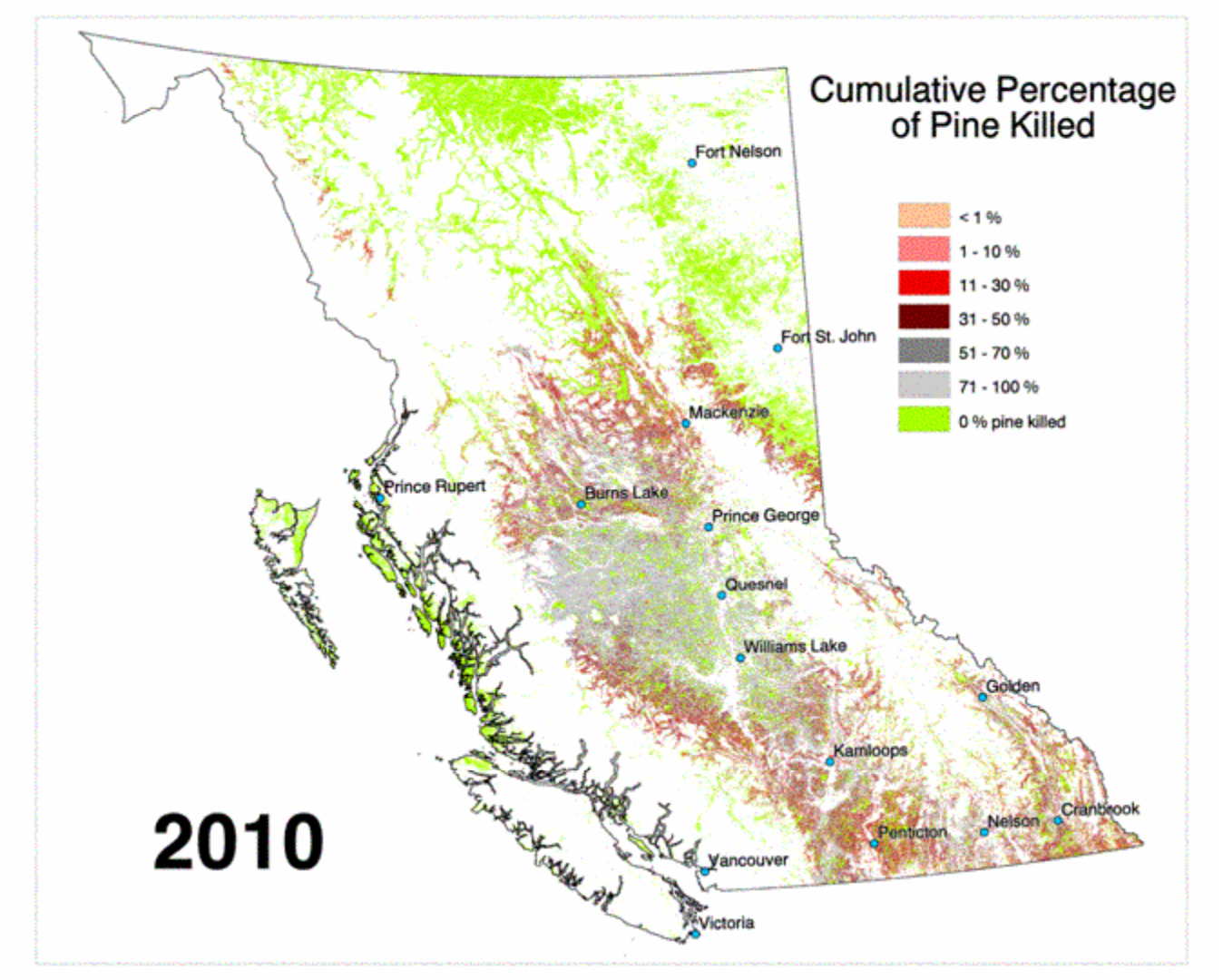
(kooten@uvic.ca)

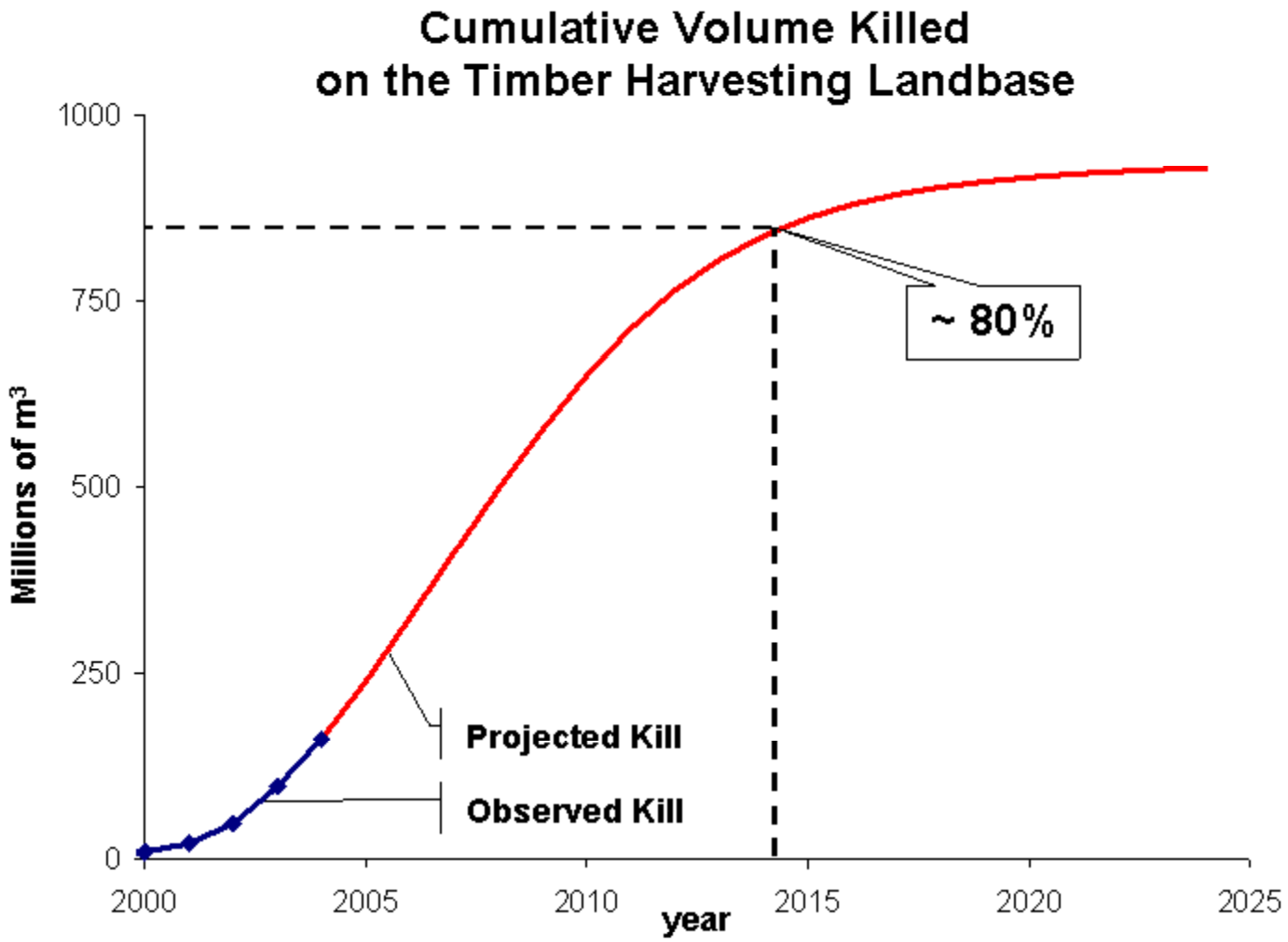
Outline – Bioenergy from MPB

- Extent of the MPB infestation
- Bioenergy plans for MPB
- Feedstock model for Quesnel Forest District
- Results from scenarios
- Conclusions

Mountain Pine Beetle

- Native pest to BC that historically attacked over-mature lodgepole pine.
- Past outbreaks have been stopped by cold winters or fire.
- Checking and decay occurs. Economic ‘shelf life’ varies according to climate conditions.
- Current survey of outbreak 13.5 million ha dead and red.


Cumulative Percentage of Pine Killed
< 1 %
1 - 10 %
11 - 30 %
31 - 50 %
51 - 70 %
71 - 100 %
0 % pine killed
Fort Nelson
Fort St. John
Mackenzie
Prince Rupert
Burns Lake
Prince George
Quesnel
Williams Lake
Golden
Kamloops
Penticton
Nelson
Cranbrook
Vancouver
Victoria
2010


Cumulative Volume Killed
on the Timber Harvesting Landbase
1000
750
500
250
0
Millions of m3
2000
2005
2010
2015
2020
2025
year
~ 80%
Projected Kill
Observed Kill

Roadside ‘waste’

Bioenergy?

- BC Energy Plan relies significantly on MPB
- BC Hydro call for power. Ministry of Forests and Range allocating AAC for bioenergy tenures.

"The economics are not as simple and straightforward as some people think. Everybody presumes that fiber is just readily available in the form that it can be burned. It's there, and we all know it's there, but it takes significant dollars to bring that fiber into a source that will generate electricity."

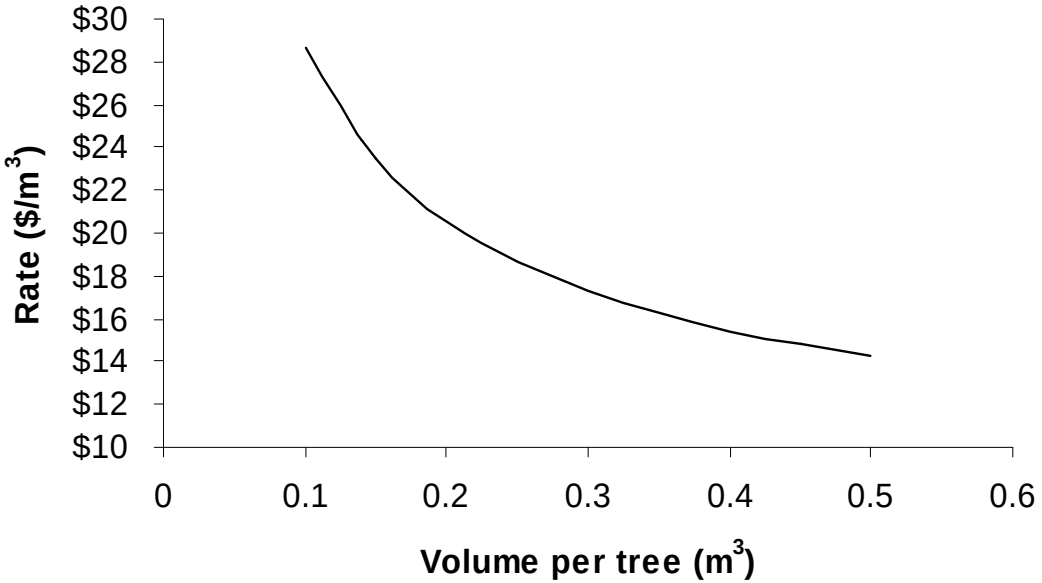
Tom Sitar, Canfor
Financial Post

Bioenergy?

- Kumar et al. 2008 (220 and 300 MW electrical facility), Kumar 2009 (biodiesel), Stennes and McBeath 2006 (cost of feedstock from standing timber)
- Studies use broad averages for transportation and harvesting costs. Do not consider changing feedstock sources across space, quality and time.
- Research Goal: Overcome aggregation bias. Consider marginal costs of extracting biomass and delivering to bioenergy facility over 25 year period.

Stand level model

- Logging costs (10 cm top) versus ‘piece size’. $1.25/litre diesel price

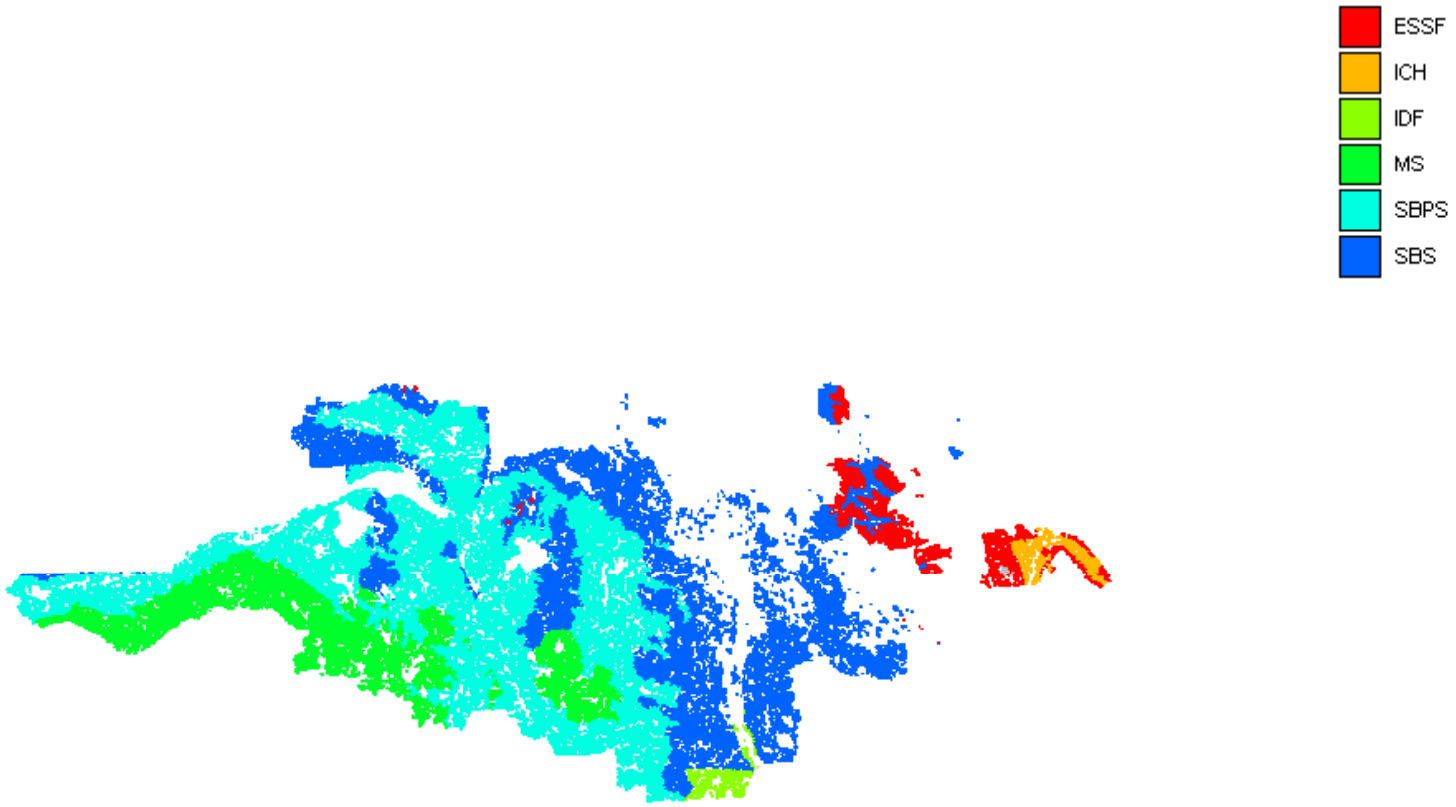


- Trucking cost based on cycle time. $ 2.22/m^3/hr
- Roadside chipping costs based on volume per ha

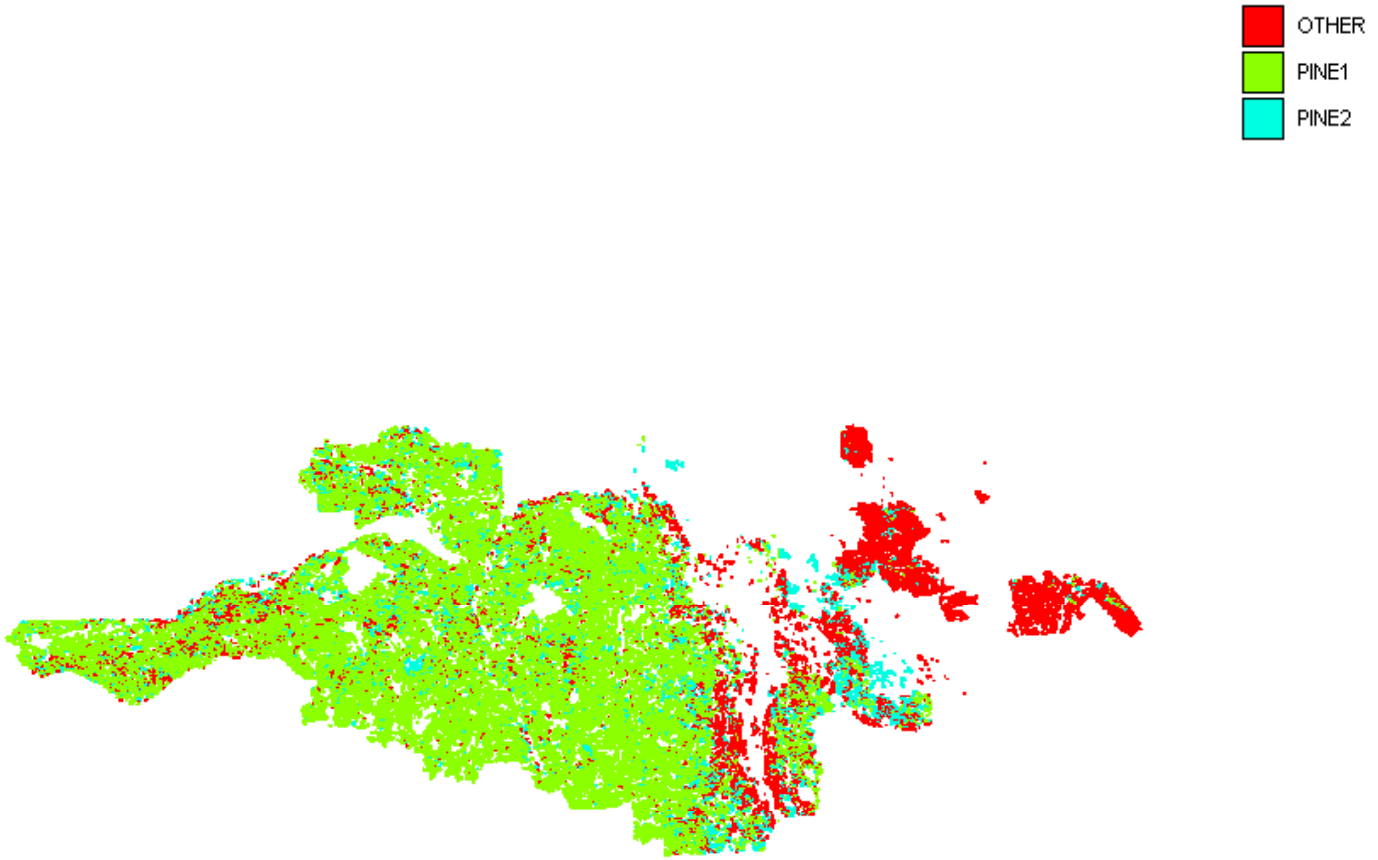
Model for Quesnel Timber Supply Area

- 921,527 ha timber harvesting landbase. Inventory data from MoFR.
- Three stand types: 1) biogeoclimatic zone, 2) species group, 3) cycle time zone. Broken into 5 year age classes (0 – 140+).
- Harvested stands produce three products: sawlogs, bioenergy logs, hog fuel (tops and branches)
- Stands decay through time according to climatic zone. Decreasing proportion of sawlog through time.

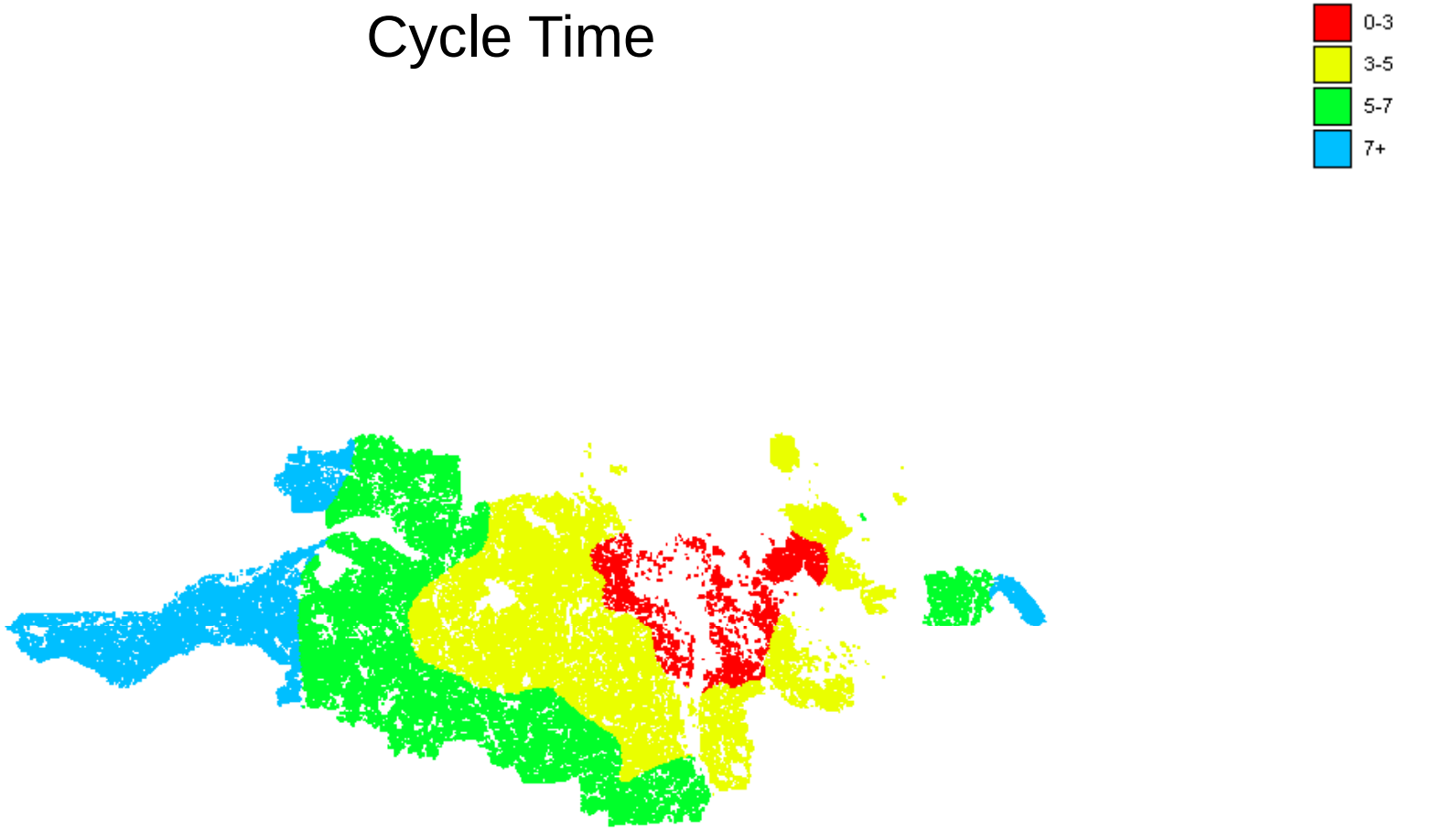
Biogeoclimatic Zones



Species



Cycle Time



Model for Quesnel Timber Supply Area

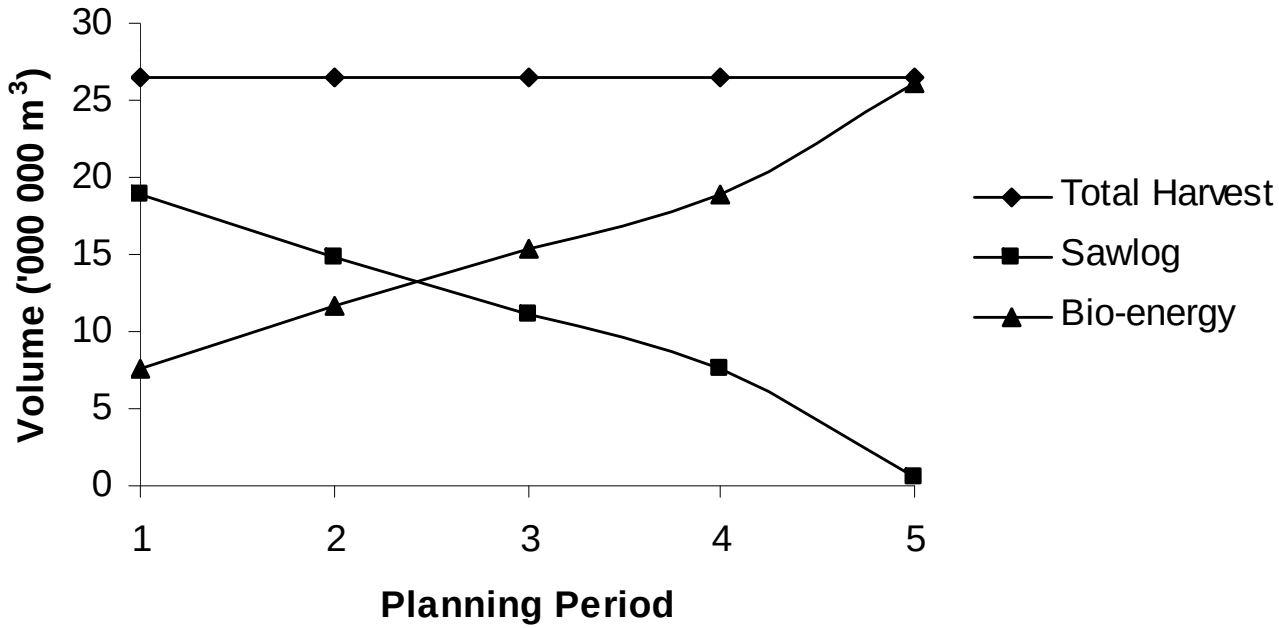
- Restrict harvesting to pine1 stands >60 years old, pine2 stands >80 years old. Liquidate over planning period.
- Stands assigned extraction (age and biogeoclimatic zone) and delivery costs (cycle time).
- Silviculture costs vary by biogeoclimatic zone and development/admin costs fixed across stands ($8/$m^3$).

Logging Costs

	Biogeoclimatic zone					
Age	ESSF	ICH	IDF	MS	SBPS	SBS
60-64	$ 27.30	$ 22.16	$ 26.16	$ 30.20	$ 27.30	$ 24.28
65-69	$ 24.28	$ 20.58	$ 25.16	$ 30.20	$ 26.16	$ 23.50
70-74	$ 23.50	$ 20.14	$ 23.50	$ 26.30	$ 25.16	$ 22.80
75-79	$ 23.50	$ 20.14	$ 23.50	$ 26.30	$ 25.16	$ 22.16
80-84	$ 21.59	$ 18.99	$ 22.80	$ 27.30	$ 24.28	$ 21.59
85-89	$ 19.73	$ 17.53	$ 22.16	$ 26.16	$ 22.80	$ 20.58
90-94	$ 19.35	$ 16.64	$ 21.59	$ 26.16	$ 22.80	$ 19.73
95-99	$ 18.66	$ 16.25	$ 20.58	$ 25.16	$ 21.59	$ 18.66
100-104	$ 18.66	$ 15.74	$ 19.35	$ 24.28	$ 20.58	$ 17.79
105-109	$ 17.79	$ 15.30	$ 18.66	$ 23.50	$ 20.14	$ 17.29
110-114	$ 17.53	$ 14.90	$ 17.79	$ 22.80	$ 20.14	$ 16.84
115-119	$ 17.06	$ 14.66	$ 17.06	$ 22.16	$ 19.35	$ 16.25
120-124	$ 16.64	$ 14.44	$ 16.64	$ 21.59	$ 18.66	$ 15.74
125-129	$ 16.44	$ 14.33	$ 16.25	$ 20.58	$ 18.35	$ 15.30
130-134	$ 16.08	$ 14.04	$ 16.08	$ 19.73	$ 17.53	$ 14.90
135-139	$ 15.74	$ 13.86	$ 15.74	$ 19.35	$ 17.06	$ 14.78
140+	$ 15.74	$ 13.86	$ 15.74	$ 19.35	$ 17.06	$ 14.78

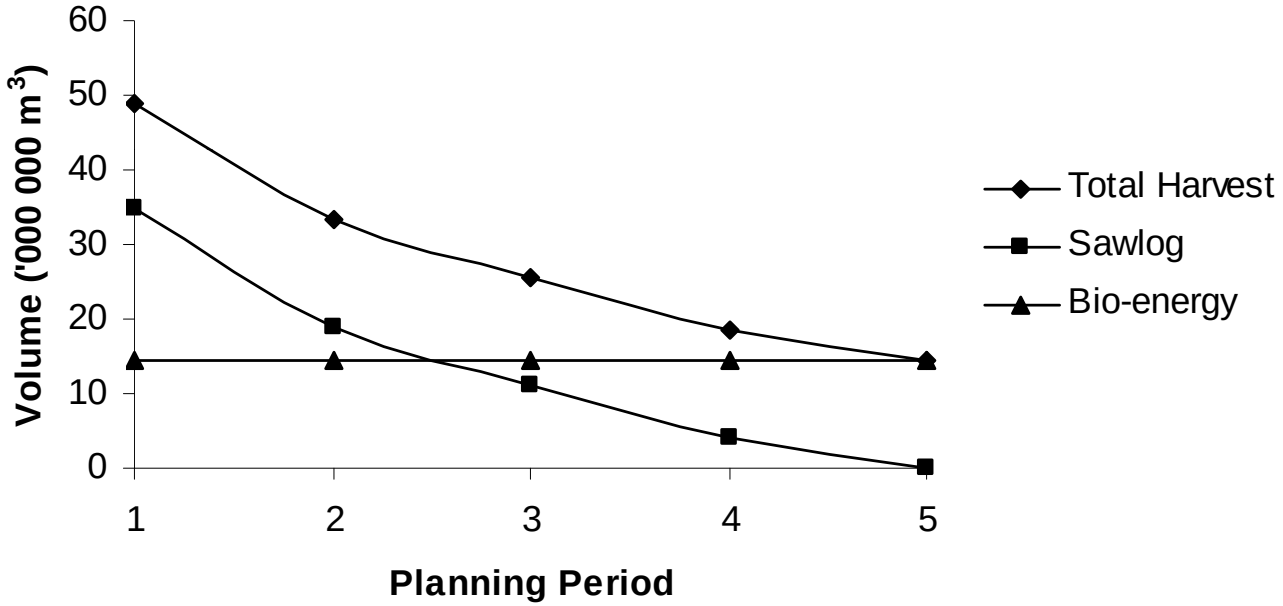
Scenario I

- volume maximization subject to even flow of harvesting



Scenario II

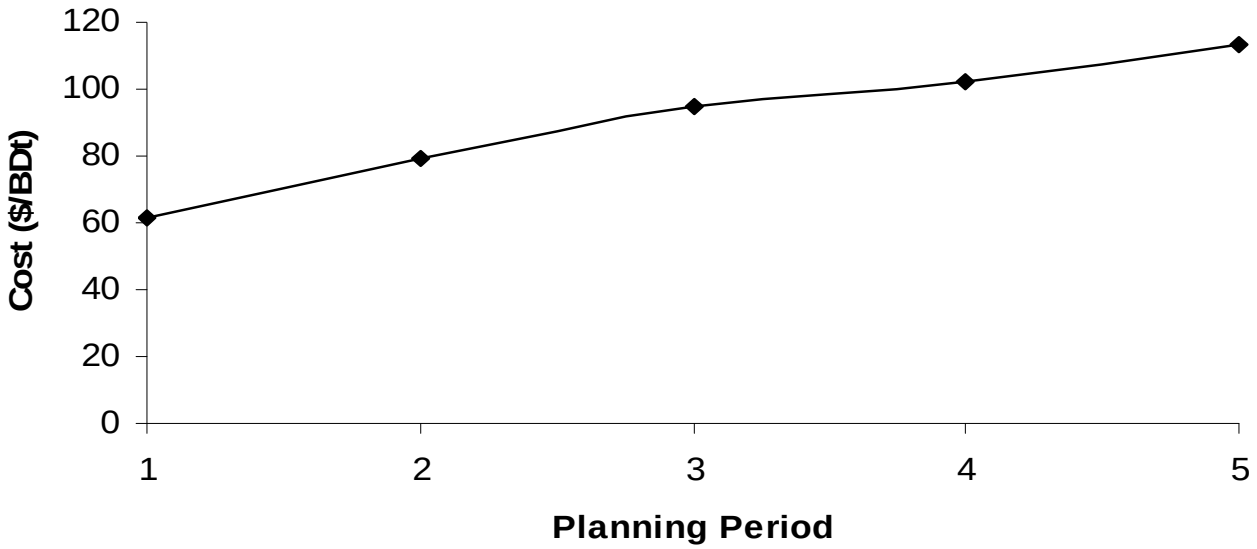
- Volume maximization subject to even bio-energy flow



- 2.86 million m^3/year – 187 MW capacity plant

Scenario II – cont'd

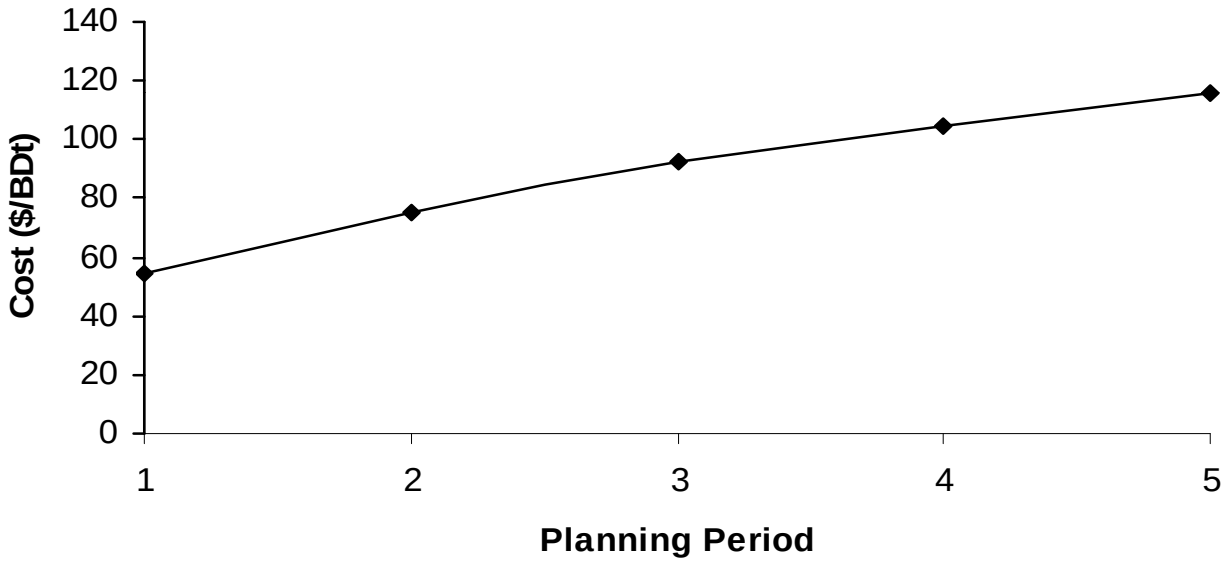
- Increasing average delivered feedstock costs $61.12/BDt ($0.044/kWh) to $113.31/BDt ($0.081/kWh).



- Capital costs $0.06 - $0.08/kWh

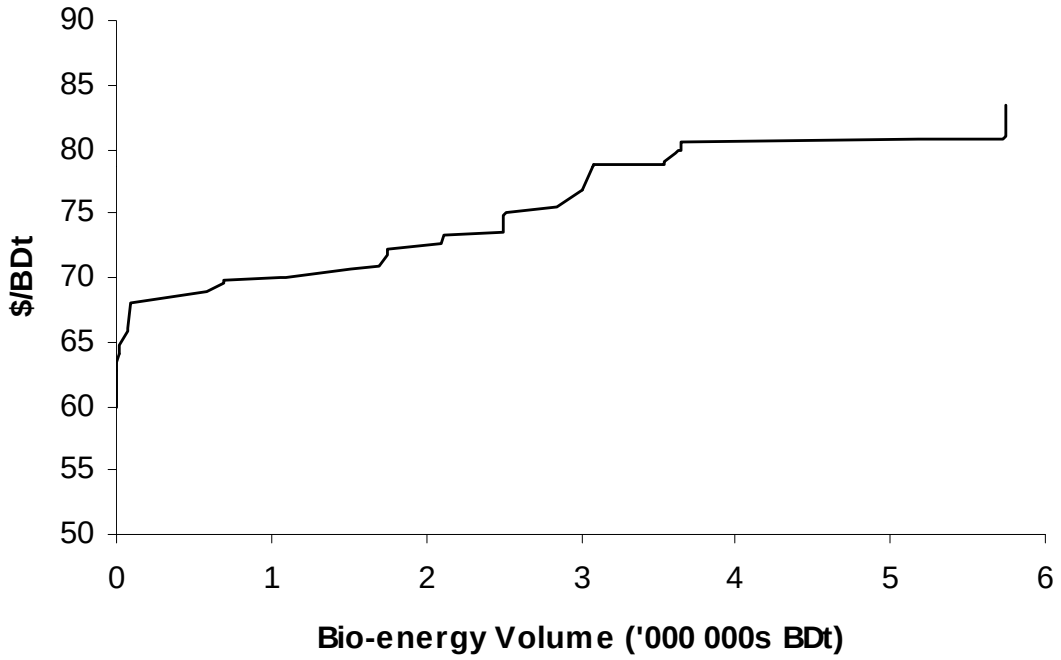
Scenario III

- Cost minimization subject to bio-energy target



Scenario III cont'd

- Marginal Costs ($/BDt) period 2



Conclusions

- Bioenergy from MPB will not be able to compete with traditional power sources; significant subsidies required.
- Carbon neutral? Harvest levels well above growth rates. Net carbon liability under tax and subsidy scheme.
- Displace coal or is it hydro and wind?
- Nigh et al. 2008 CJFR study – well stocked advanced regeneration of climax species in understory of MPB infested stands.