Marginal Cost Curves for Mitigation Strategies in Canada's Managed Forests

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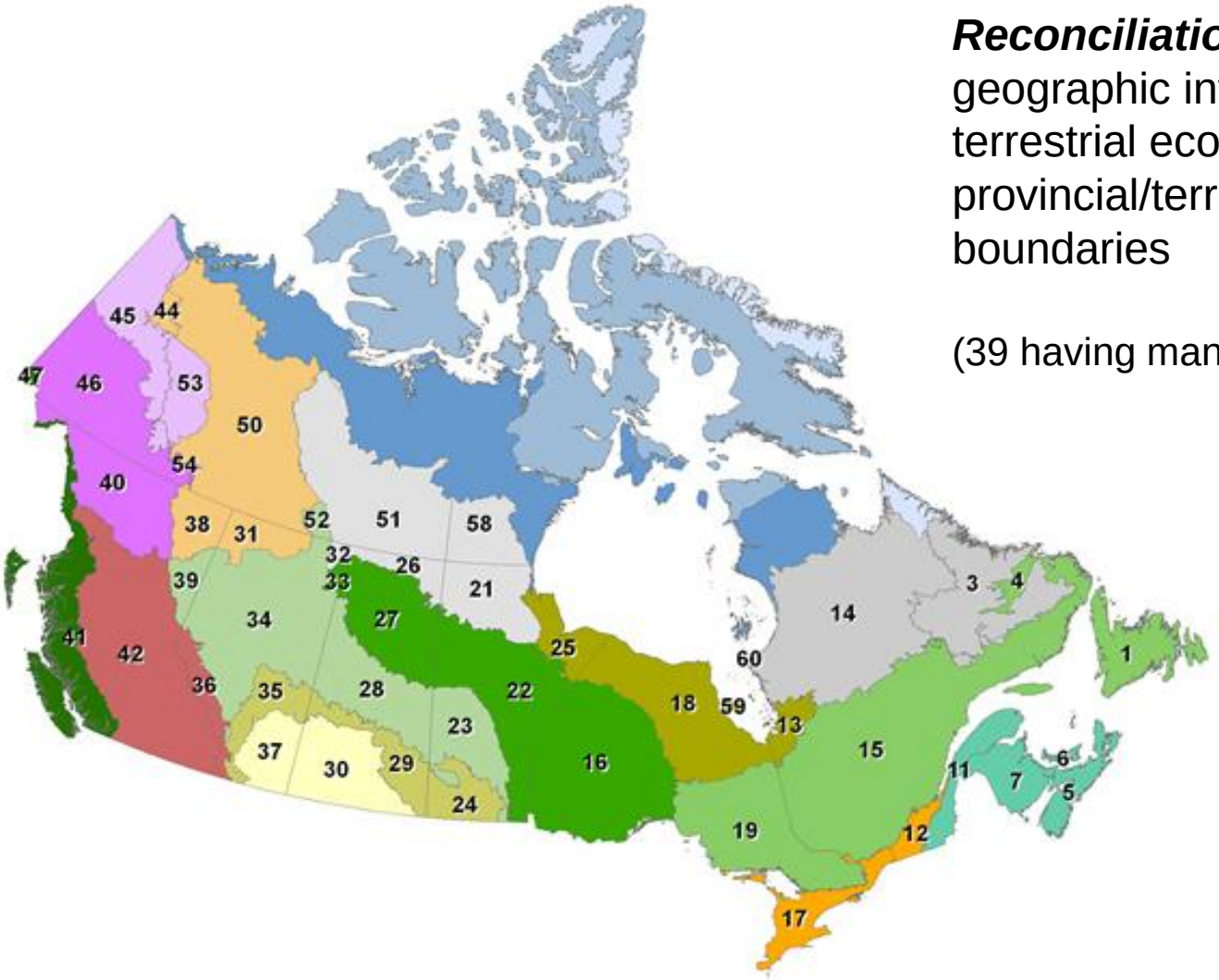
Mitigation strategies

For Phase 1, the following strategies are being analyzed for forest management (FM) and harvested wood products (HWPs), relative to the base case:

- **FM1 - base**: increased utilization of harvested biomass, reduced slash burning, and increased salvage + base case HWP mix
- **FM2 - base**: increased protected areas with reduced harvest levels + base case HWP mix
- **FM3 - base**: increased harvesting of live wood + additional harvest volume used for bioenergy, with base case HWP applied to remaining harvested biomass
- **Base - HWP1**: base case FM + HWP mix changed to produce relatively more long-lived products
- **Base - HWP2** : base case FM + HWP mix changed to produce relatively more bioenergy
- **FM1 - HWP1**: FM1 + HWP1

Level of spatial analysis:
LULUCF reconciliation units



Reconciliation units (RU): geographic intersection of terrestrial ecozones and provincial/territorial boundaries

(39 having managed forest)

http://carbon.cfs.nrcan.gc.ca/SpatialFramework_e.html

Marginal Cost Curve (MCC)

- The goal of the economic analysis is development of marginal cost curves showing how *emission reduction* (Mt CO_2e) relates to *mitigation cost* ($/t CO_2e)
  - Marginal costs curves allow comparison of the mitigation costs in the forest sector across provinces/territories as well as with costs in other sectors

- Bottom-up empirical approach was used to develop MCCs

- Economic analysis is being done using the Model for Economic Analysis of Forest Carbon Management (MEA-FCM)

- The MEA-FCM model combines biophysical results for mitigation from the CFS Carbon Accounting team with cost data to derive the marginal cost curves

Emission reduction

Emission reduction (mitigation impact) of a strategy in a RU =
net GHG emissions in the base case
– net GHG emissions with the strategy implemented

- Expressed in million of tonnes of CO2 equivalent (Mt CO2e)
- Only impacts in the forest sector (i.e. forest ecosystem + HWP manufacturing) are considered
- Starting assumption is no discounting of GHG emissions
- Only strategies with a emission reduction of ≥ 0.001 Mt CO_2e in the period analyzed are included in the cost curves

Cost data and assumptions

- Cost estimates were obtained from various sources for:
  - Base case unit costs and prices (e.g. $/m^3) of biomass delivered to mills / bioenergy facilities
  - Base case unit HWP manufacturing costs and prices (e.g. $/m^3)
  - Base case stumpage and other payments to provinces ($/m^3)

- Assumptions were made about:
  - Changes in unit costs as a result of implementing strategies

Emission reduction costs

Emission reduction (mitigation) cost of a strategy in a RU =

Forest sector net revenue in the base case

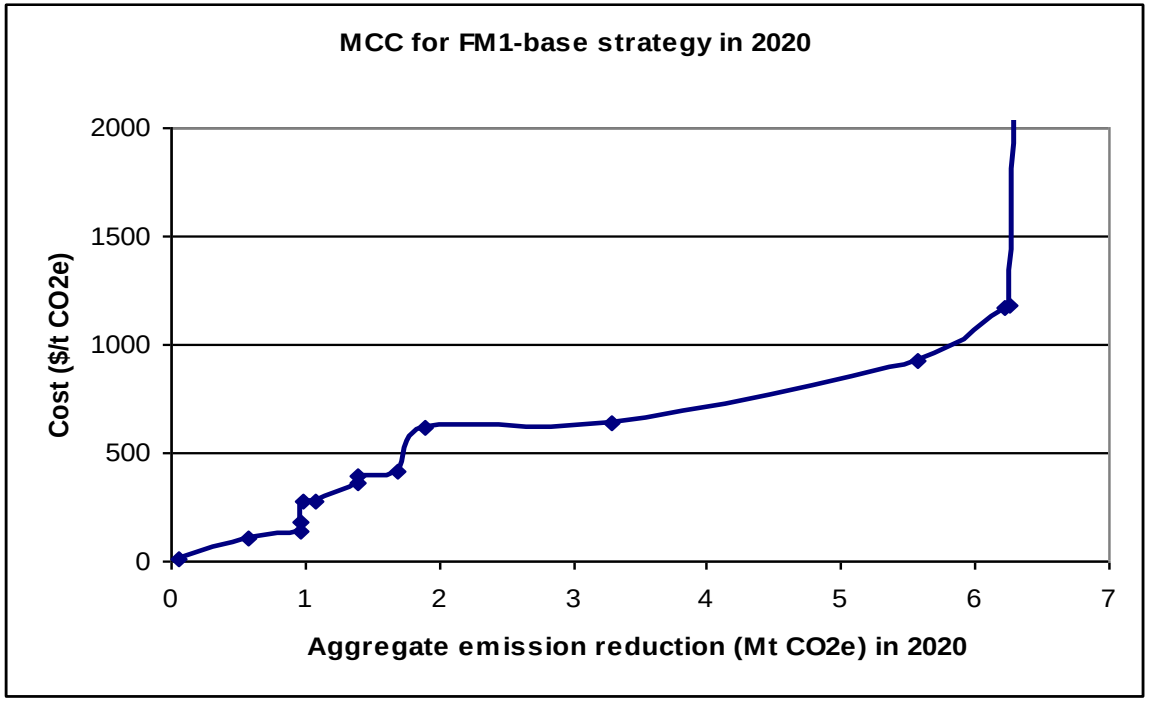
– Forest sector net revenue of the strategy implemented

- Forest sector net revenue = (biomass price – biomass harvesting cost) + (HWP price – HWP manufacturing cost)
- Forest sector net revenue is expressed in 2009 Canadian dollars
- Discount rate assumptions are:
  - Financial discount rate = 7%
  - Emission discount rate = 0%

Example of results

Marginal Cost Curve for FM1-base in 2020

"Aggregate" emission reduction in 2020 over RUs, relative to the discounted cost of strategy implementation in 2012-2020



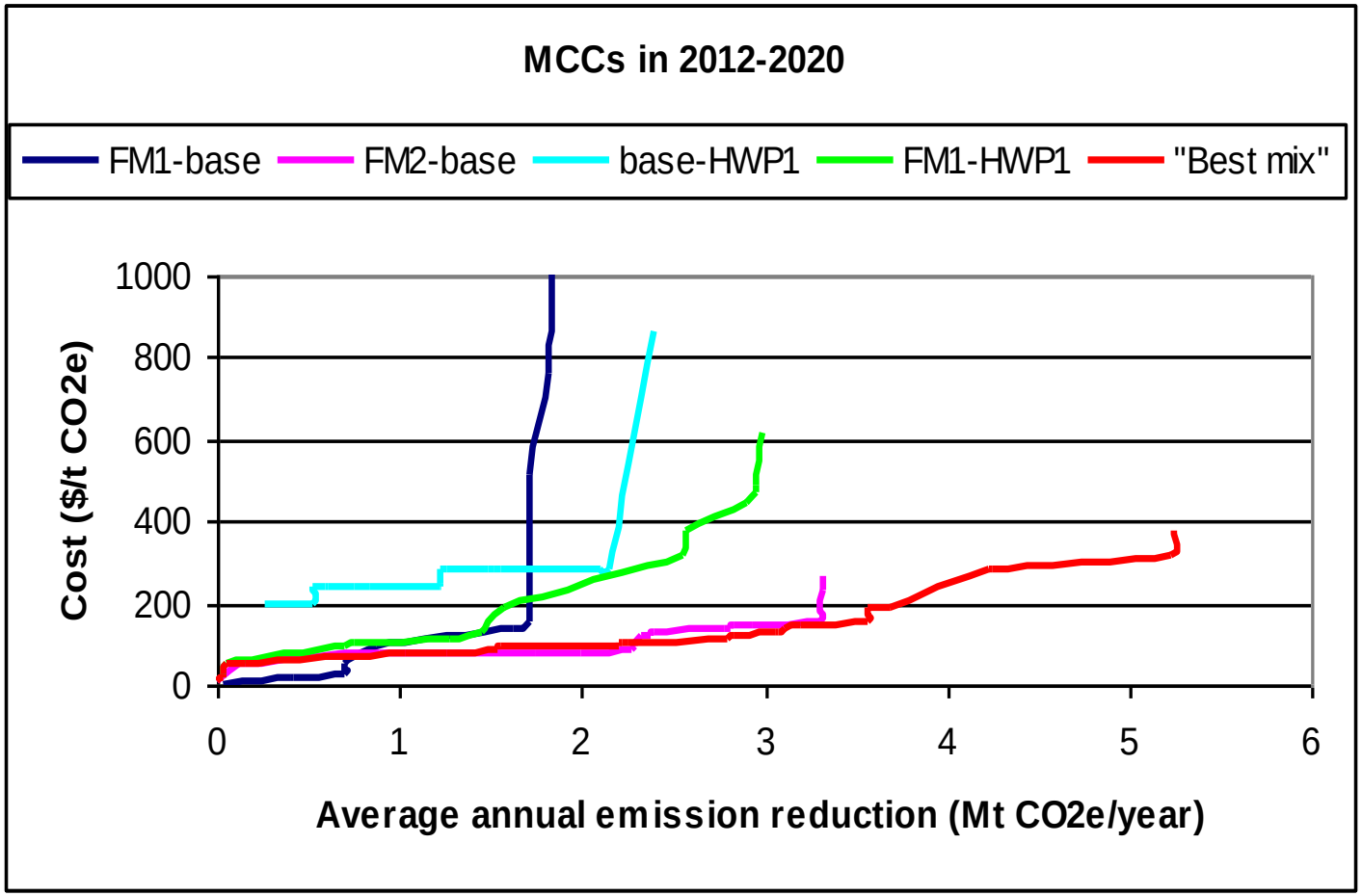
RU	Emission reduction in 2020 (t CO2e)	Cost ($/t CO2)
A	0.064	11.62
B	0.511	108.30
C	0.389	138.05
D	0.011	184.14
E	0.016	272.08
F	0.086	274.51
G	0.314	365.25
H	0.002	398.42
I	0.292	417.78
J	0.206	613.67
K	1.395	637.90
L	2.294	929.74
M	0.642	1169.05
N	0.031	1185.84
O	0.033	2043.52

Comparing strategies in 2012-2020

- Strategies
  - FM1-base, FM2-base, base-HWP1, FM1-HWP1 and Best-mix strategy result in emission reductions
  - “Best mix” strategy: for each RU, the strategy with the largest emission reduction is chosen (“best” strategy for that RU)

- Axes on the graph (next page)
  - Horizontal axis: average annual emission reduction in 2012-2020 aggregated over RUs with emission reductions ≥ 0.001 Mt CO_2e
  - Vertical axis: discounted cost ($/t CO2) of implementing each strategy over 2012-2020

Comparing strategies in 2012-2020 (cont'd)



Strategies have very different marginal cost curves

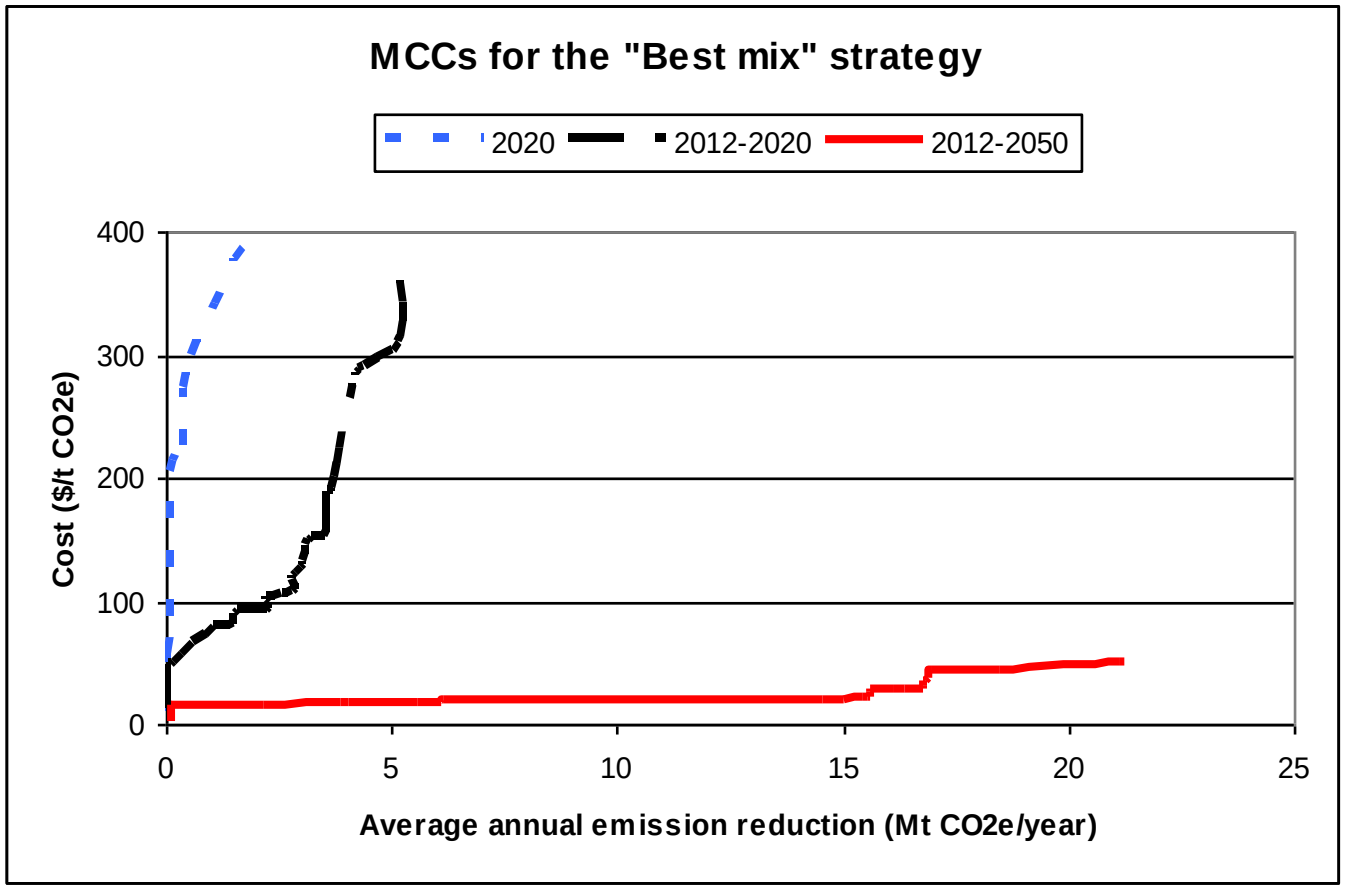
Within strategies, costs per tonne vary substantially across RUs

Comparing costs for different time periods

- Time periods
  - 2012-20 – what is the short term marginal cost of mitigation?
  - 2020 – what is the marginal cost of mitigation in 2020, taking into account the costs over 2012-20?
  - 2012-2050 – what is the long term marginal cost of mitigation?

- Axes on the graph (next page)
  - Horizontal axis: average annual mitigation (emission reductions) in the period
  - Vertical axis: discounted cost ($/t CO2) of implementing each strategy over the period

Comparing costs for different time periods (cont'd)



Long term costs are much lower than short term costs

Mitigation policy that focuses only on short term goals could make different mitigation choices than when long term goals are also considered

Best Mix = for each RU, the strategy with the largest emission reduction is chosen

Summary

- Strategies have important impacts on forest sector net revenue
- The strategy that achieves the most mitigation
  - varies across the country
  - is not necessarily same in the short and long terms
- Strategies that focus on FM tend to be cheaper than those that include HWPs, but they yield less mitigation
- In terms of $/tonne, mitigation investments are much less costly in the long term than in the short term

Summary (cont'd)

- Things to keep in mind about the analysis
  - The scale of analysis is RU level – results do not necessarily apply at the local level and in specific situations (e.g. harvesting for energy in northern communities)
  - The Best Mix is based only on the strategies analyzed – different strategies or different implementation levels could change the Best Mix mitigation and cost results
- Comparison of results to other cost studies needs to be done very carefully
  - Need to understand differences in time periods and assumptions