Economics of Segregation based on Internal Wood Properties

Dr. Glen Murphy
GE Murphy & Associates

Dr. John Moore
Scion, New Zealand

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What Do Mills Want?

Obtaining the logs that are best suited for their purpose at the lowest cost possible is of prime importance for most mill managers.

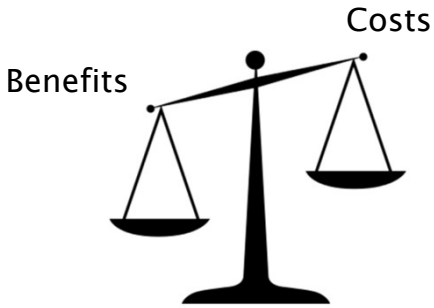
- ✓ Right External Properties
- ✓ Right Internal Properties

Literature Review

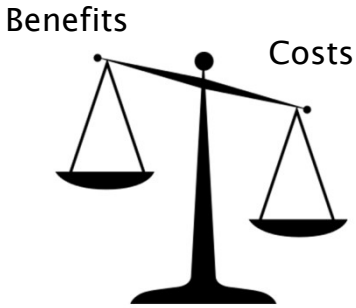
- Many tools and techniques are available for segregating wood based on internal properties
- Few have been implemented commercially - acoustics, density cores and visual indicators are more mature approaches.
- The benefits of segregating stands, stems and logs are not clear due to:
  - High variability in wood properties
  - Poor market signals in terms of price for wood with superior internal properties
  - Poor understanding of costs across the value chain.

Study Aims

To determine if the benefits of segregating stands, stems and logs outweighed the additional costs.



Segregate

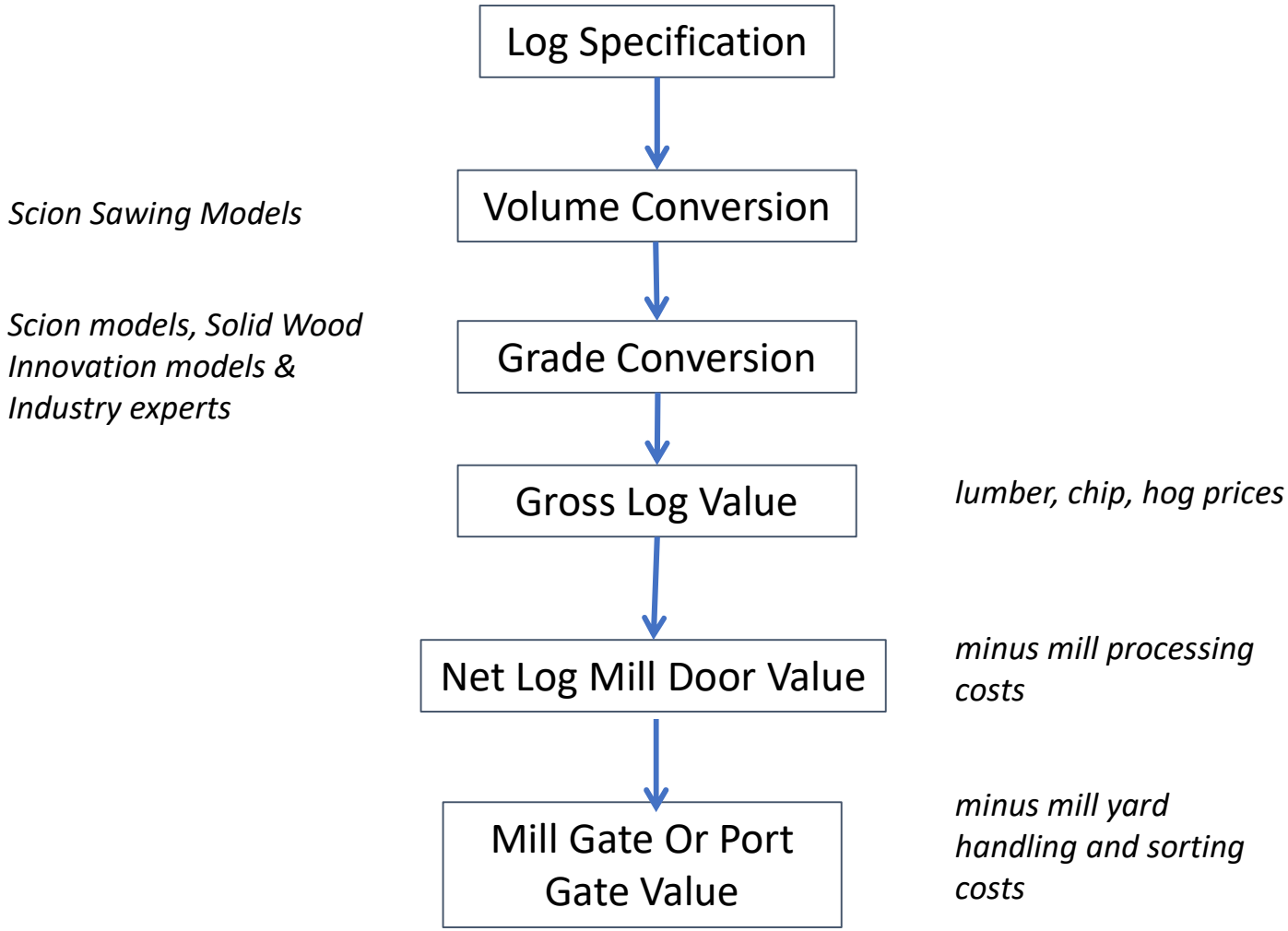


Don’t Segregate

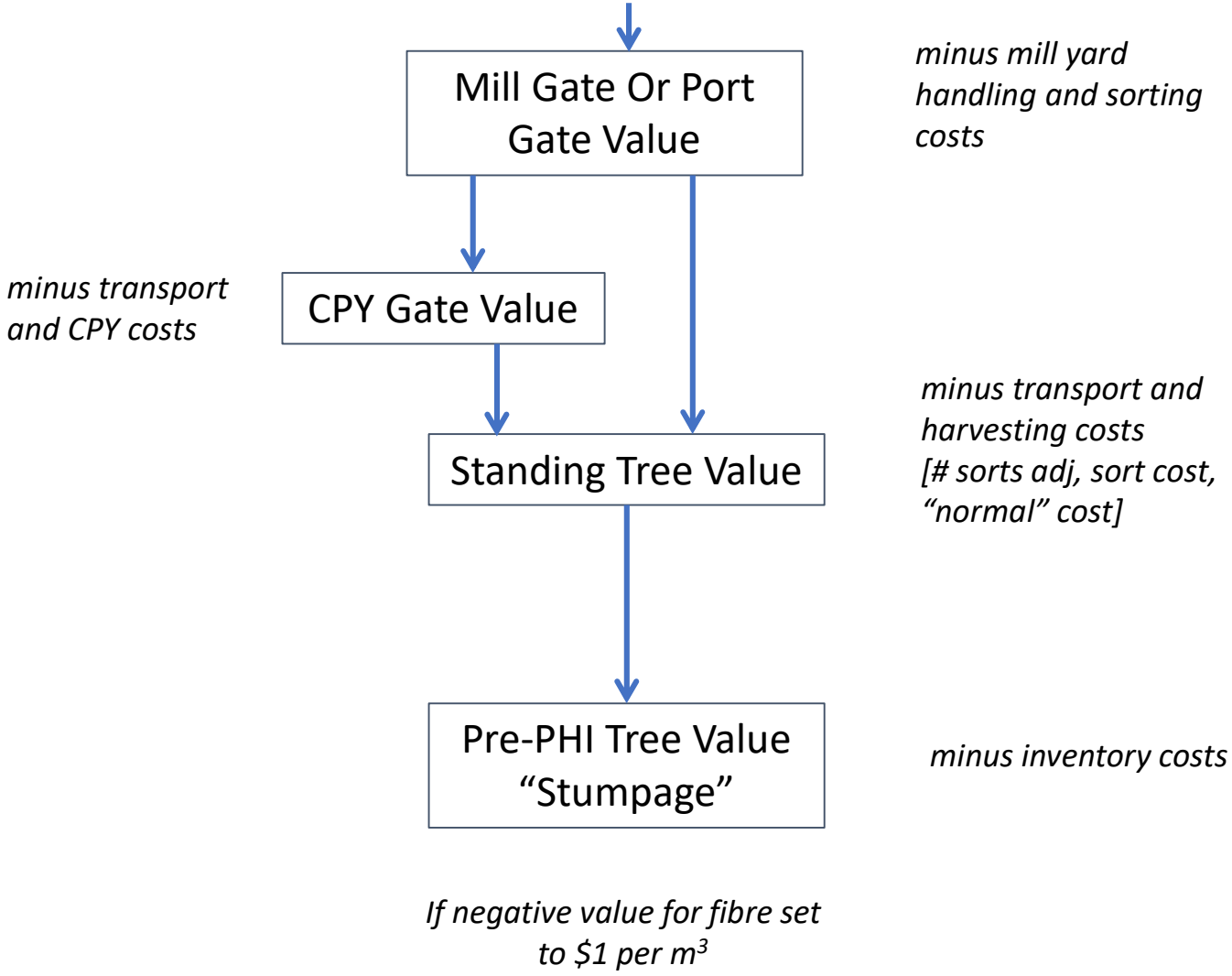
SEGMOD – a techno-economic model

- SEGMOD designed and constructed to determine costs and benefits of segregating logs at various intervention points in the supply chain
- Calculates return-to-log values at each intervention point for user-specified log types
- Optimally bucks tree lists based on in-forest RTL values
- Reports RTL value per hectare at each intervention point
- Facilitates comparison of alternative log segregation strategies.

Log Type RTL Flow Chart



Log Type RTL Flow Chart (cont.)



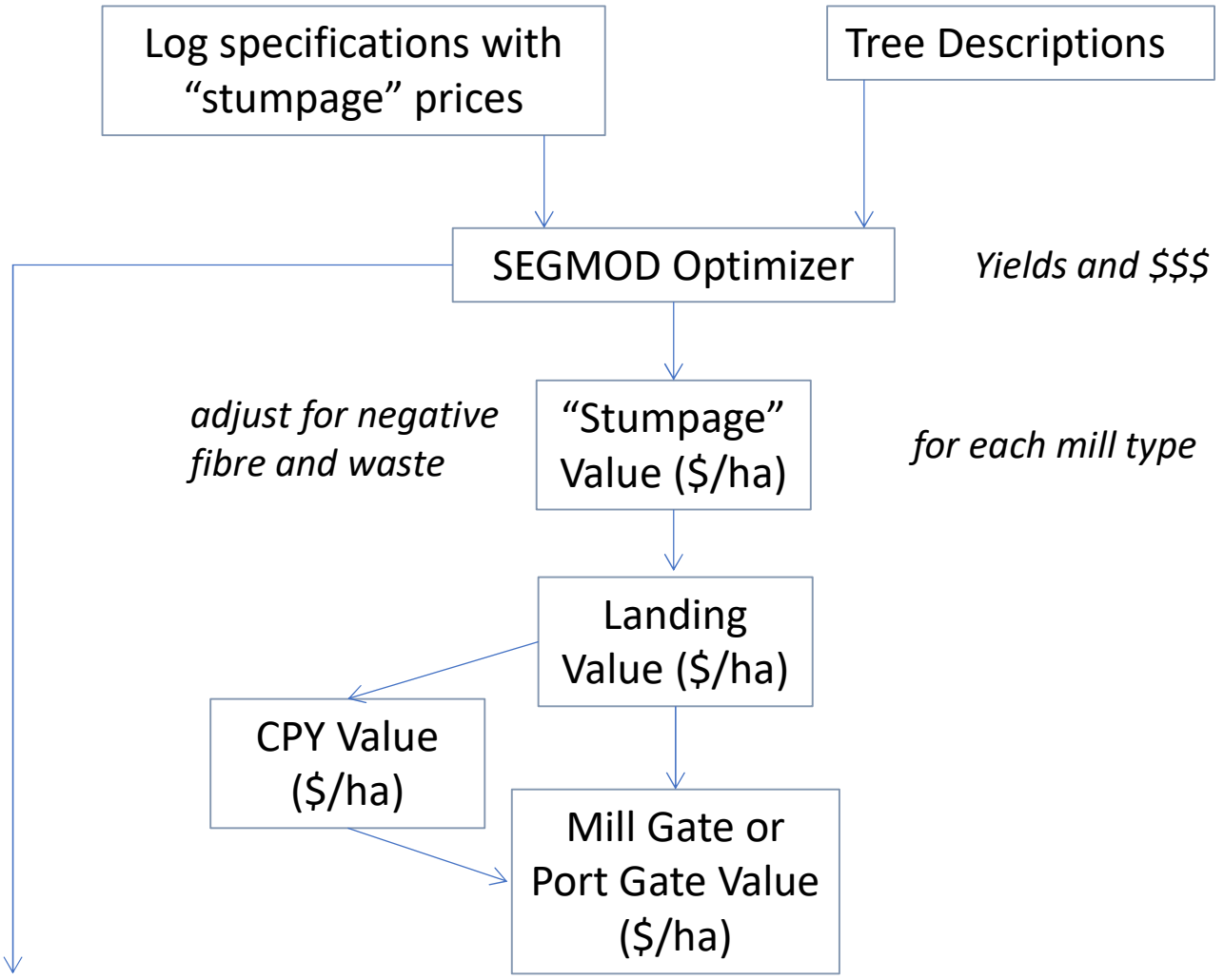
Return-To-Log Values

Mill Door

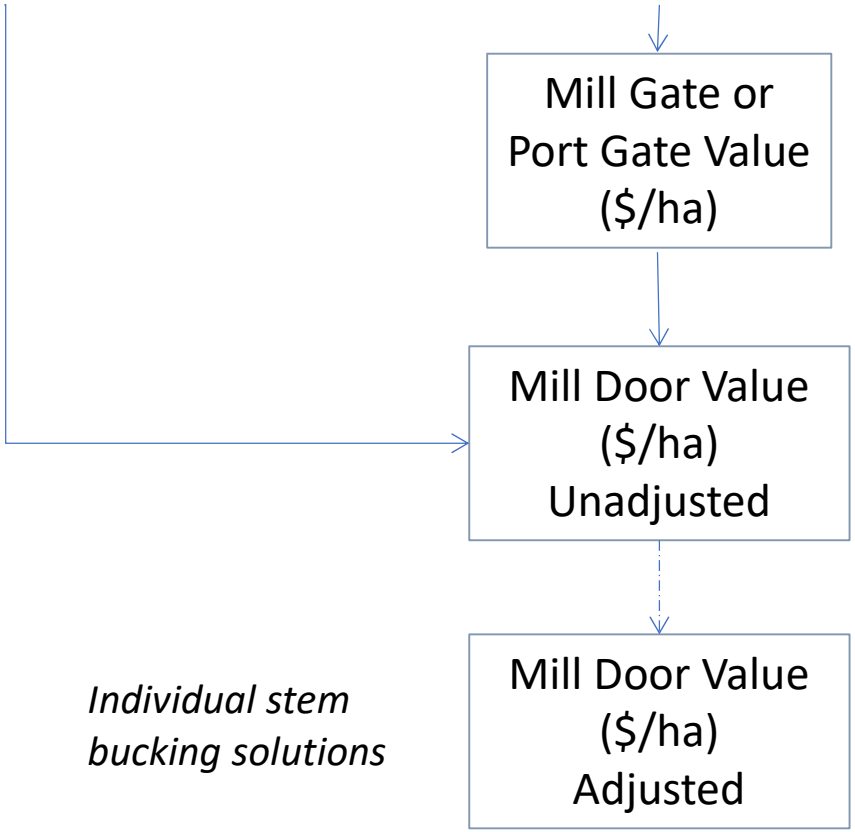
$$RTL = VolConvFact * \left(\sum_{i=1}^{n} SawnProduct\% * SawnProduct\$ - Mill\ Cost \right)$$

$$+(1 - VolConvFact) * (Chip\% * Chip\$ + Hog\% * Hog\$)$$

Stand Optimization Flow Chart



Stand Optimization Flow Chart



SEGMOD Features

- Mill Door Values
  - Volume conversion factors based on Scion Sawing Studies
  - Appearance grade recovery factors based on Scion Sawing Studies plus Industry Adjustments
  - Structural grade recovery factors based on SWI Sawing Studies
  - Product prices supplied by user
  - Mill processing costs accounted for
- Mill Yard Costs
  - No Sort
  - Sort at each mill type
- CPY Costs
  - No Sort
  - Structural — Acoustic Sort or Density Sort
  - Appearance — Resin Sort or PLI Sort

SEGMOD Features

- Transport Costs
  - Related to distance to CPY or Mill/Wharf
  - Adjustment for Product Type
  - Potential for truck configuration adjustment
- Harvesting Costs
  - Steep vs Not Steep
  - No Sort
  - Structural — Acoustic Sort
  - Appearance — Resin Sort
  - Adjustment for number of sorts
  - Potential for piece size adjustment
- Inventory Costs
  - No Sort
  - Structural — Acoustic Sort and/or Density Sort
  - Appearance — Resin Sort and/or PLI Sort

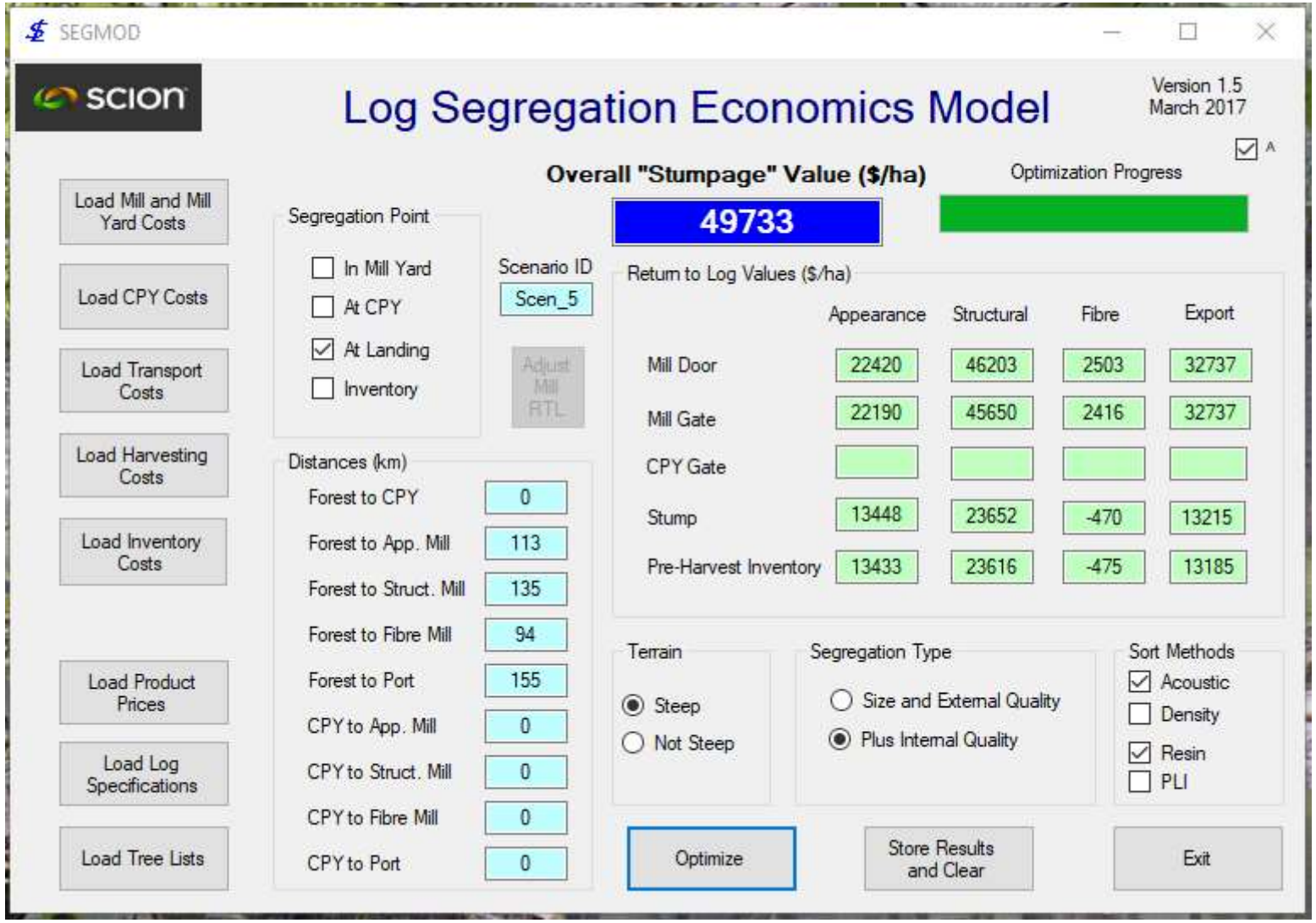
SEGMOD Features

- Tree List supplied by user (decimetre height intervals)
  - Diameter
  - Sweep offset
  - Acoustic Velocity
  - Density
  - Quality Codes

- Optimal bucking using Dynamic Programming procedures. Handles up to 350 stems and up to 40 m break height per stem

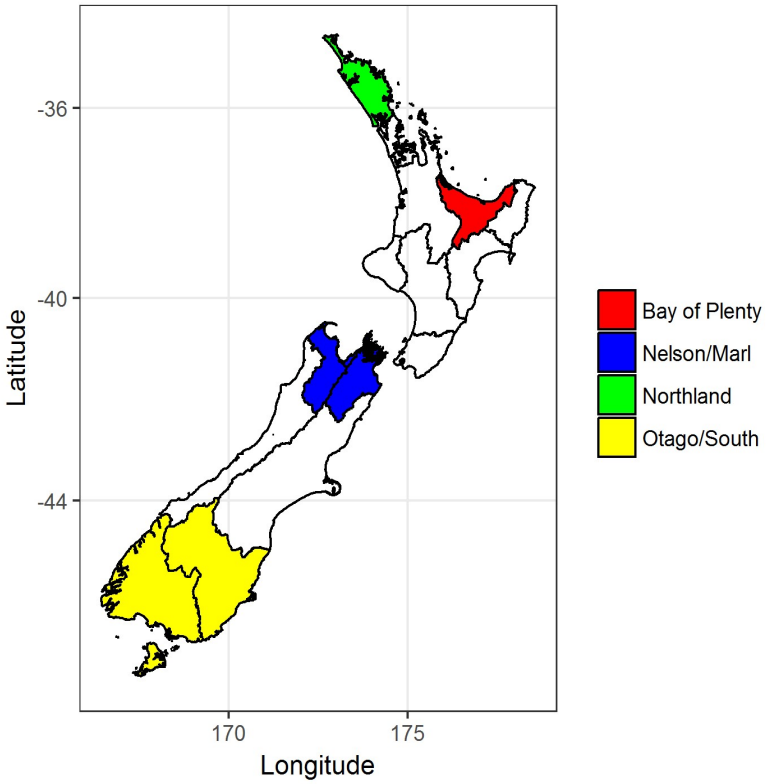
- Reporting includes
  - RTL values ($/ha): total and by product class at each intervention point
  - Average mill gate RTL ($/$m^3$) by product class and mill door by log type
  - Optimal yields by product class (m^3/ha and % of total)
  - Individual stem bucking solution

SEGMOD Demonstration



Four Case Studies

- SEGMOD populated with price, cost and stand data from companies operating in four regions of NZ
- 255 segregation scenarios were modelled
- Variations in segregation approach, stand type, stand location, terrain type, market focus, market horizon
- Number of sorts depended on where and when segregation was done and market focus



Number of Log Types

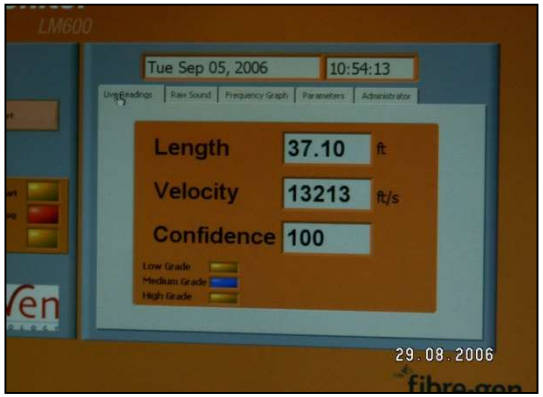
Market Type	Mill type	No Segregation	Stand-Level PHI Segregation	CPY & Landing Segregation	Mill-Yard Segregation
Domestic Focus	Pruned Appearance	1	1	3	1
	Unpruned Appearance	3	5	5	3
	Structural	3	5	7	3
	Fibre	2	2	2	2
	Export	3	3	3	3
"Equal" Domestic and Export Focus	Pruned Appearance	1	1	1	1
	Unpruned Appearance	2	4	4	2
	Structural	3	3	4	3
	Fibre	1	1	1	1
	Export	6	6	6	6

Structural Grade Sorting

Acoustics and Density Cores

Standing Tree ✓

Mechanized Processing ✓



In Mill Bucking

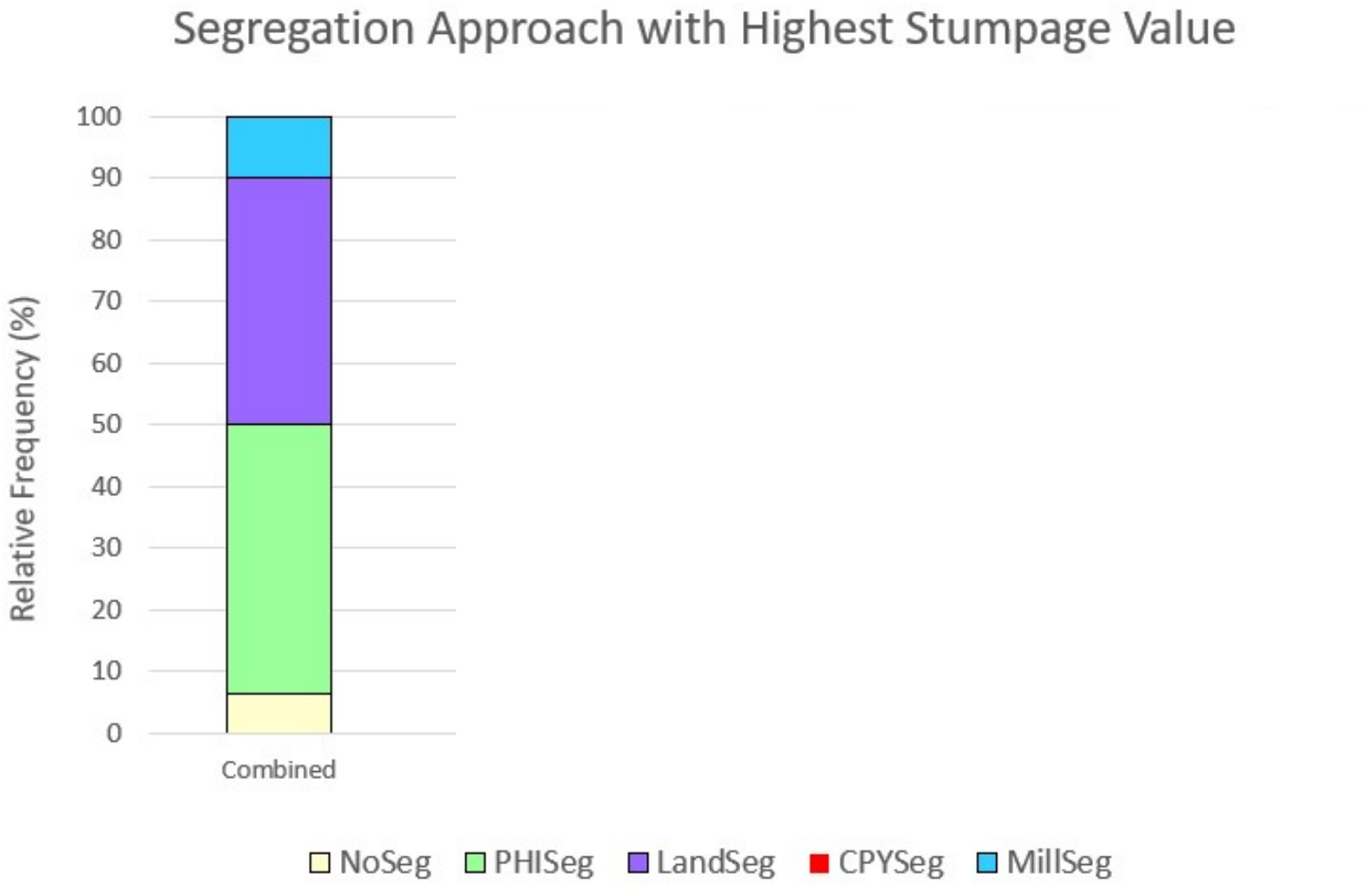
Mill Yard ✓

Appearance Grade Sorting

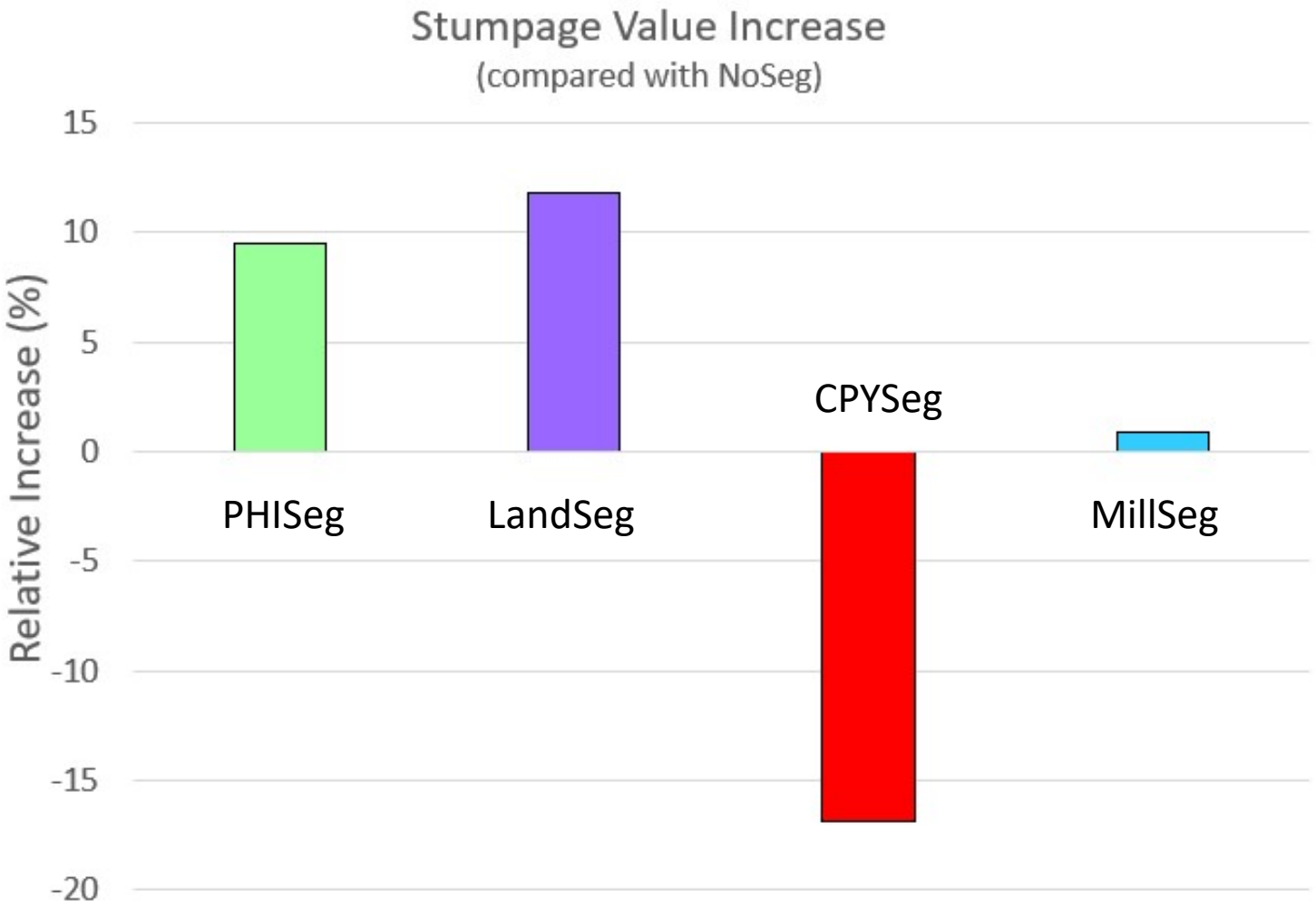
✓

Resin (Visual) and Pruned Log Index

Results: Highest Stumpage Value



Results: Stumpage Value Increase

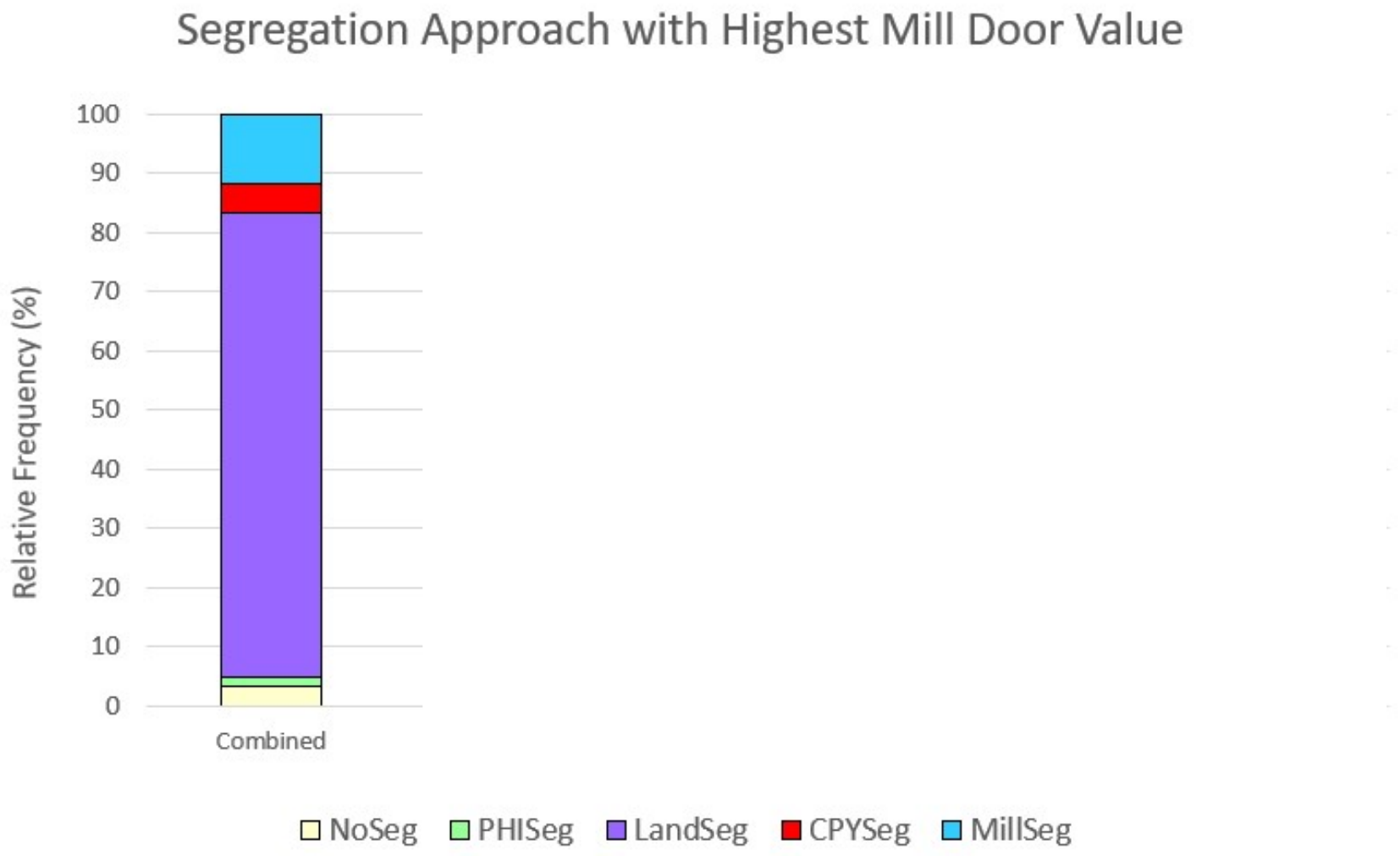


Results: Stumpage Value Sensitivity

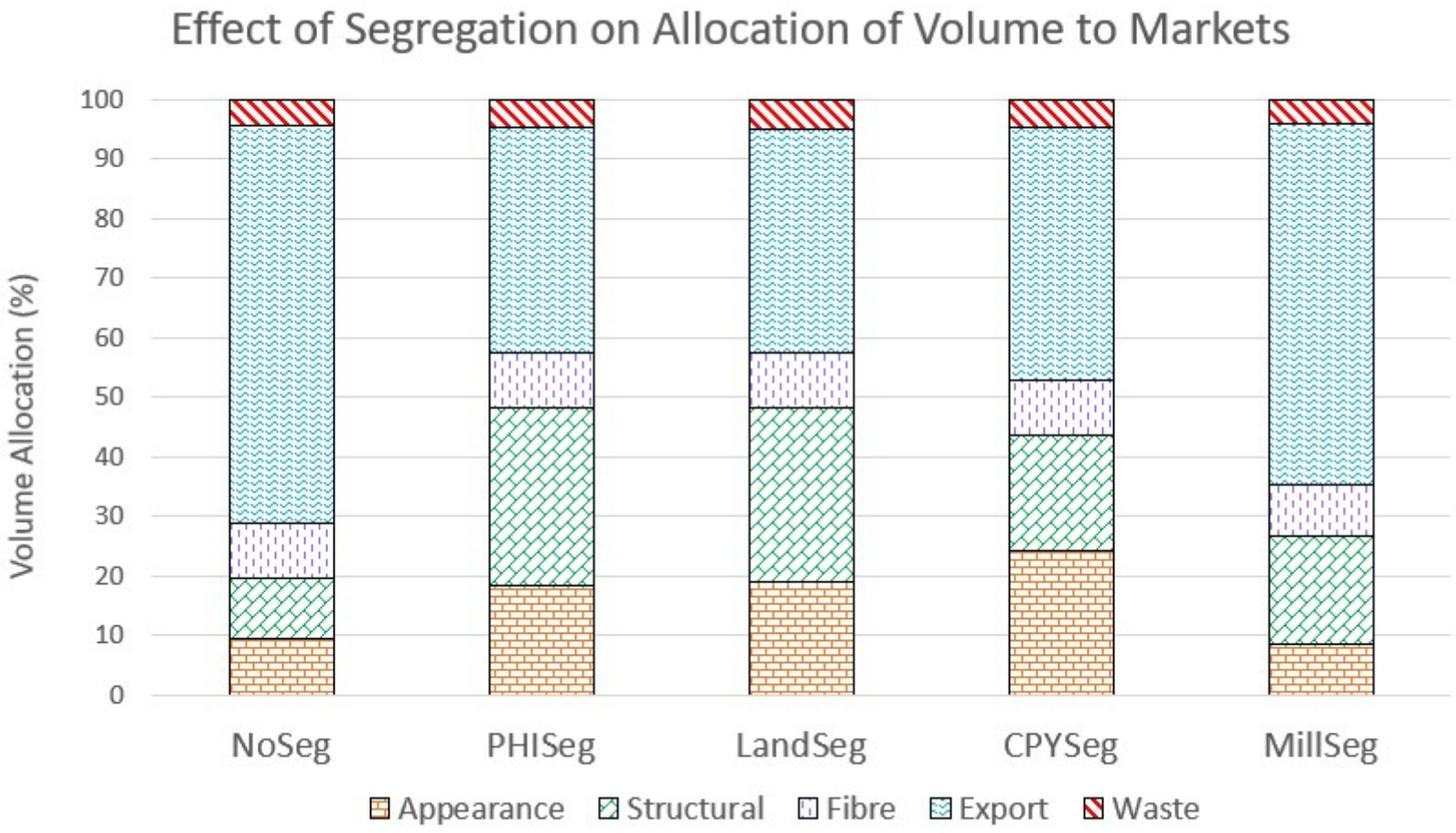
Key Variable	Variable Option	Segregation Approach		
		PHISeg	LandSeg	MillSeg
Terrain type	Steep	✗	✗	✗
	Not steep	✗	✗	✗
Stand type	Pruned	✗	✗	✗
	Unpruned	✗	✗	✗
Market type	Domestic focus	✓	✓	✓
	"Equal" domestic and export focus	✓	✓	✓
Market horizon	Current	✓	✓	✗
	Long term	✓	✓	✗

✓ Significant difference, at the alpha = 0.05 level, between variable option pairs within segregation approach columns.

Results: Highest Mill Door Value

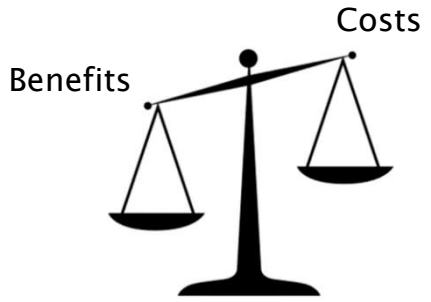


Results: Allocation to Markets



Conclusions

The economic benefits of segregating stands, stems and logs, based on wood properties, outweighed the additional costs for forest and mill owners in most of the scenarios evaluated.



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