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Forest biomass supply chain optimisation in Western Australia

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Forest harvesting residues

- Estimated volume: 3 millions tonnes in Australia (Ryan et al. 2002)
- Significant source of biomass vs. site sustainability
- Major factors:
 - Harvesting method/equipment
 - Species, stand age and silvicultural regime
 - Site conditions and stand quality

Case studies in Australia

Cut-to-length



101 t/ha

Whole tree

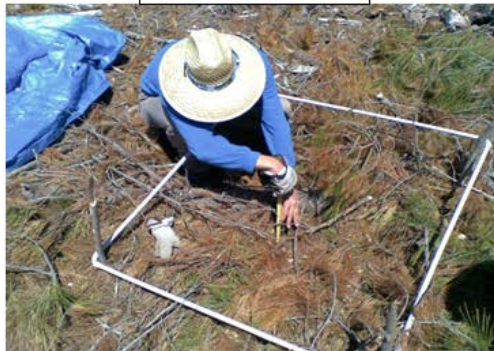


6 t/ha

Biomass recovery



60 t/ha



Natural drying case study in WA

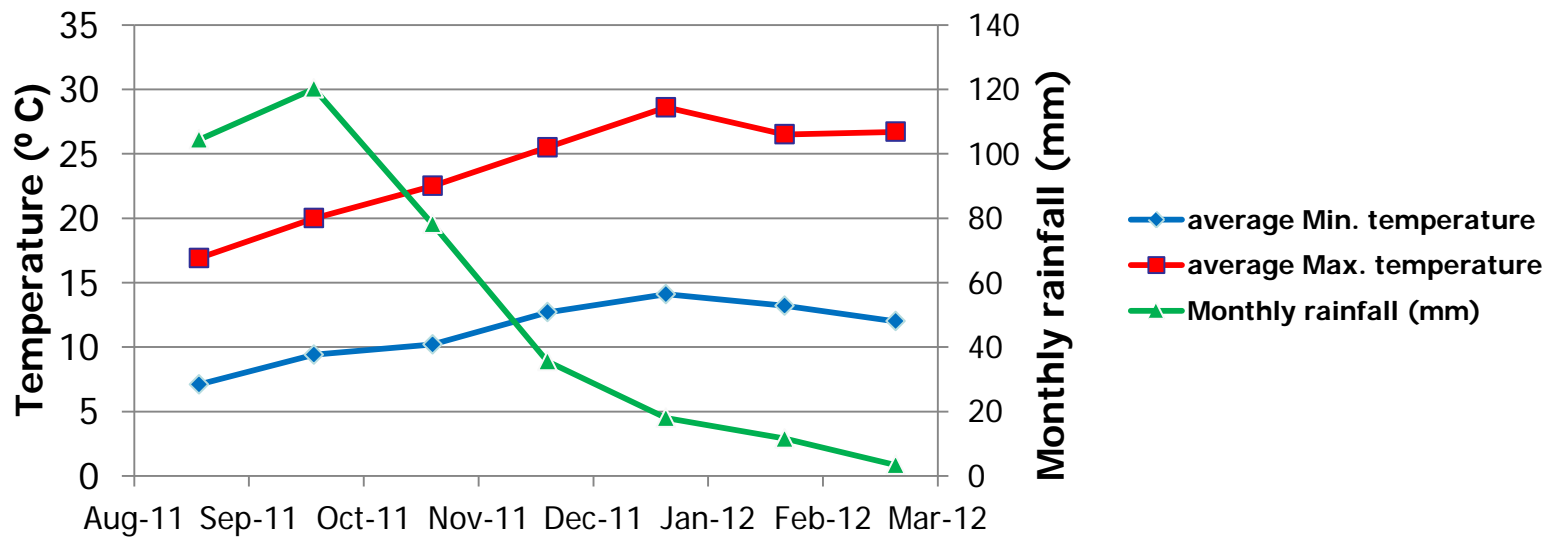
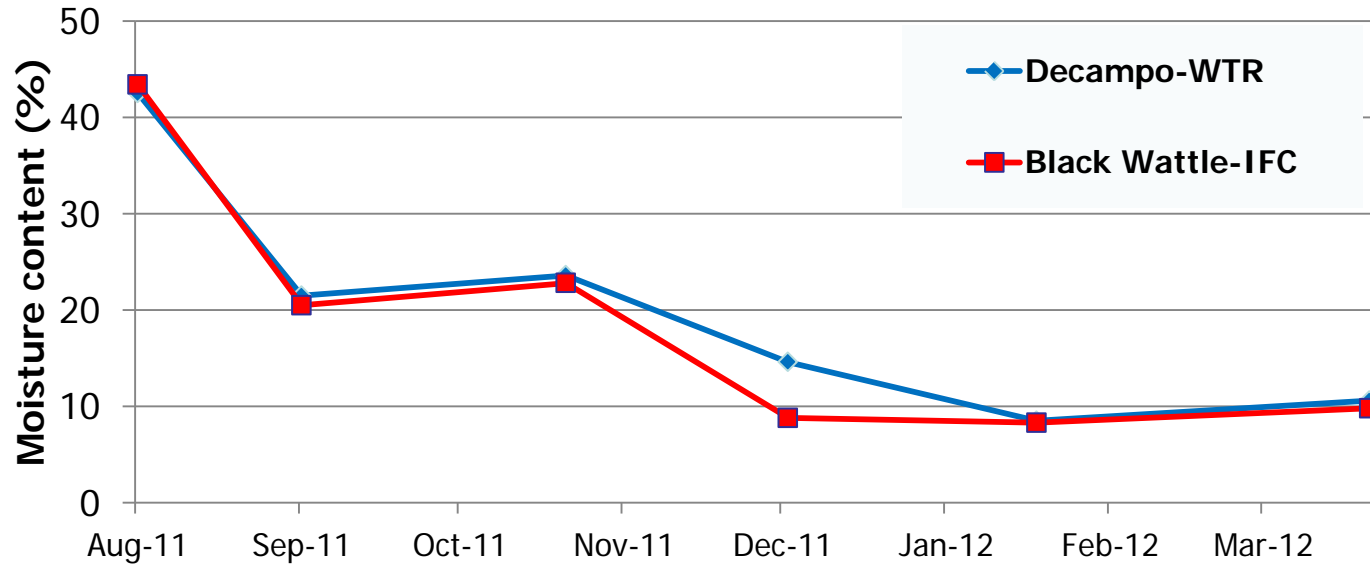


Residues from processing whole trees at the roadside (WTR)



Residues from in-field chipping (IFC)

Drying curve



Residues supply chain

- ABP management area: 45000 ha
- Left-slash: 53 GMt/ha
- Biomass recovery: 50%
- Monthly energy demand: 5000 MWh
- Interest rate: 7%
- Trip distance: 80 km
- Moisture content: 20%-35%

Optimized plan

	Harvesting	Storage	Chipping	Transport	Total
\$/GMt harvested	5.0	0.4	12.3	11.8	29.4
\$/MWh	2.1	0.2	5.3	5.1	12.67

Minimum total cost 760,483 \$ for total energy of 60,000 MWh

BIOPLAN v1.1
Developed by Dr. Mauricio Acuna (University of Tasmania)
in collaboration with METLA and University of Eastern Finland

Scenarios for Analysis

- SUPPLY CHAIN I (Whole trees chipped at roadside) **GO TO**
- SUPPLY CHAIN IIA (Delimbed wood stems chipped at energy plant)
- SUPPLY CHAIN IIB (Logging residues chipped at roadside)

Parameters & conversion factors

- Table 1 - Tonnes harvested
- Table 2 - m3 harvested (solid)
- Table 3 - Tonnes for chipping
- Table 4 - m3 solid for chipping
- Table 5 - m3 loose (chips)
- Table 6 - Truck loads
- Table 7 - Energy content (MWh)
- Table 8 - Harvesting & Forwarding costs
- Table 9 - Storage costs
- Table 10 - Chipping costs
- Table 11 - Transportation costs
- Table 12 - Drying curves

Optimisation model

Constraints

GO TO MODEL CONSTRAINTS

- 1. Energy demand at plant
- 2. Even production whole trees
- 3. Even production stemwood
- 4. Even production logging residues
- 5. Moisture content whole trees
- 6. Moisture content stem wood
- 8. moisture content logging residues

Model Solution

OBJECTIVE FUNCTION **\$6,222,744**

SOLVE MODEL **GO TO RESULTS**

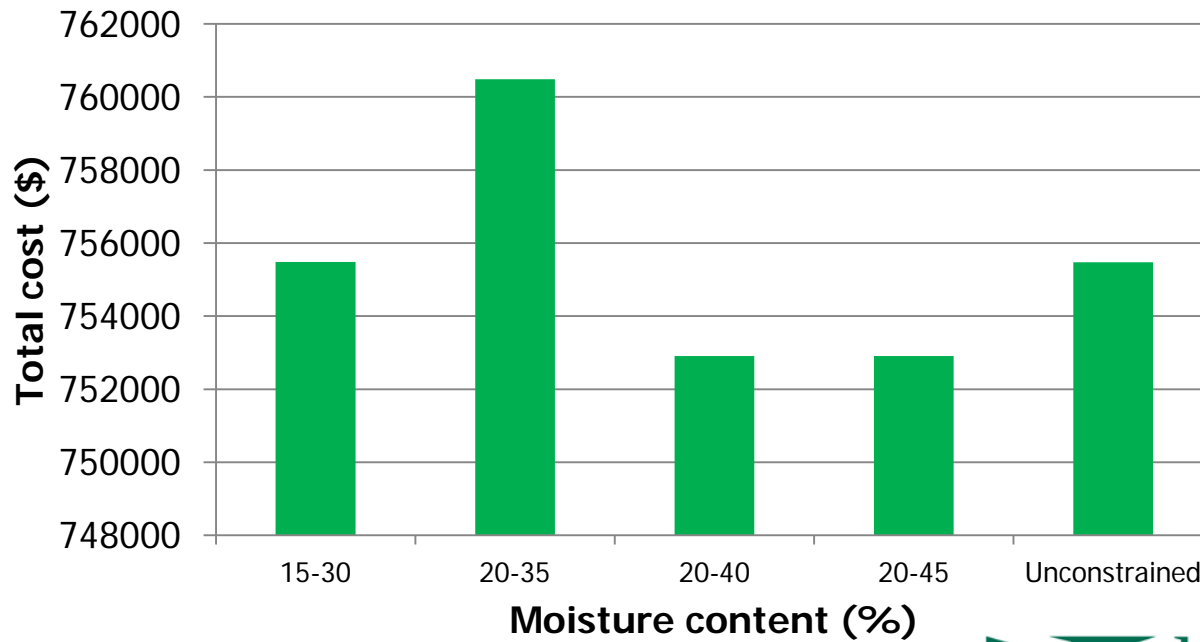
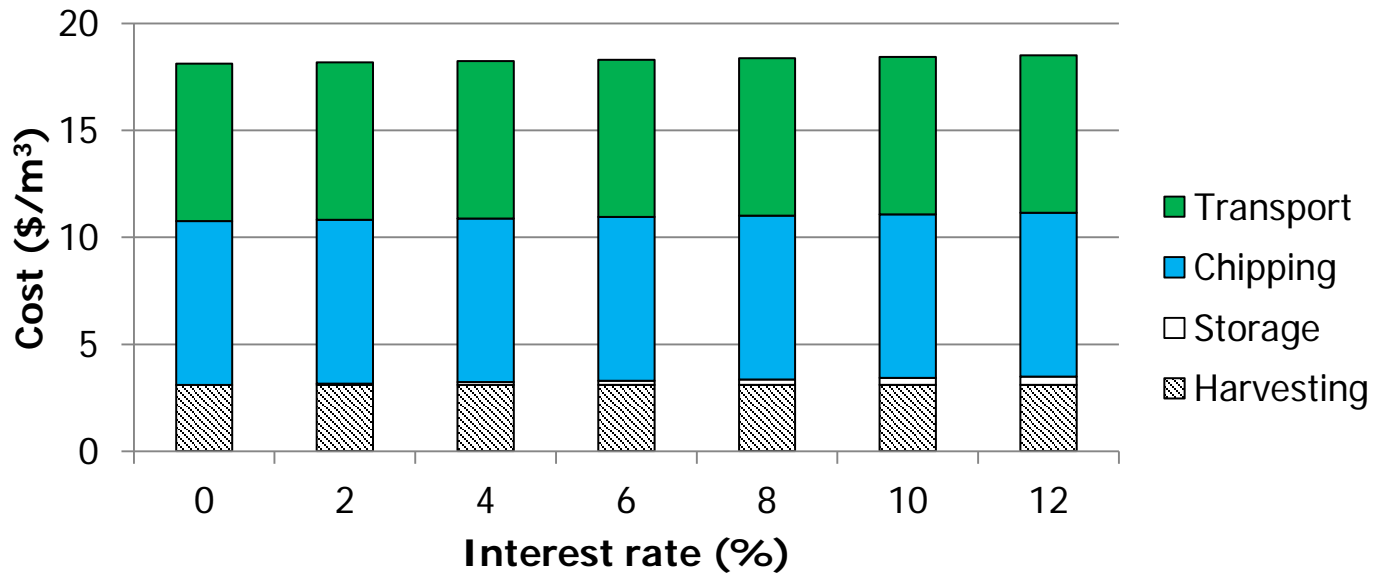
Whole tree supply chain from thinnings with chipping at the roadside

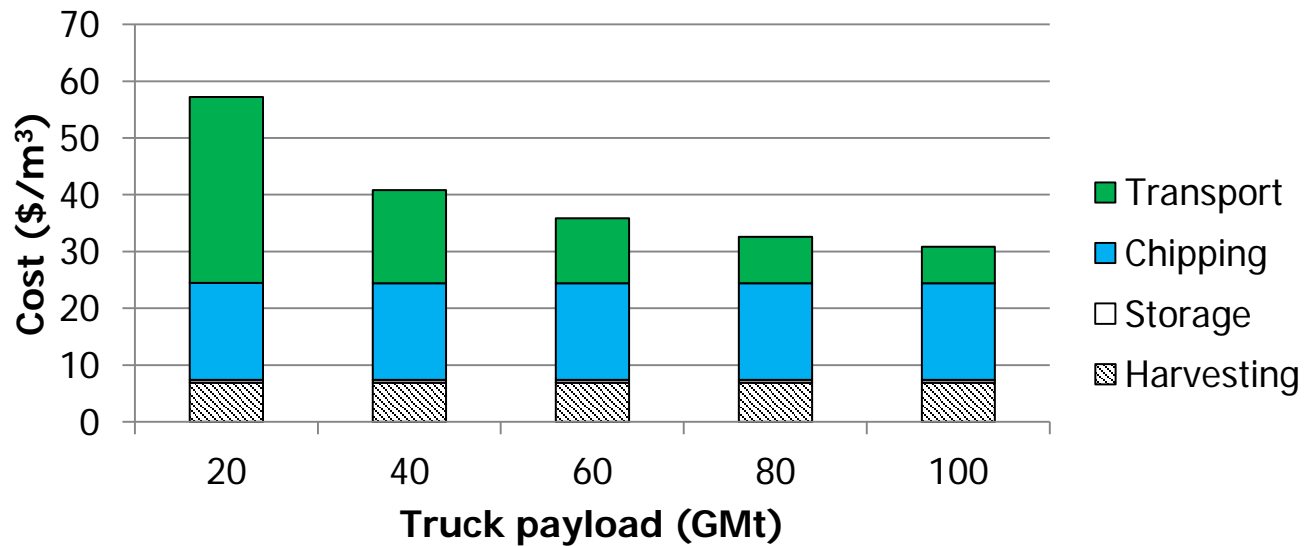
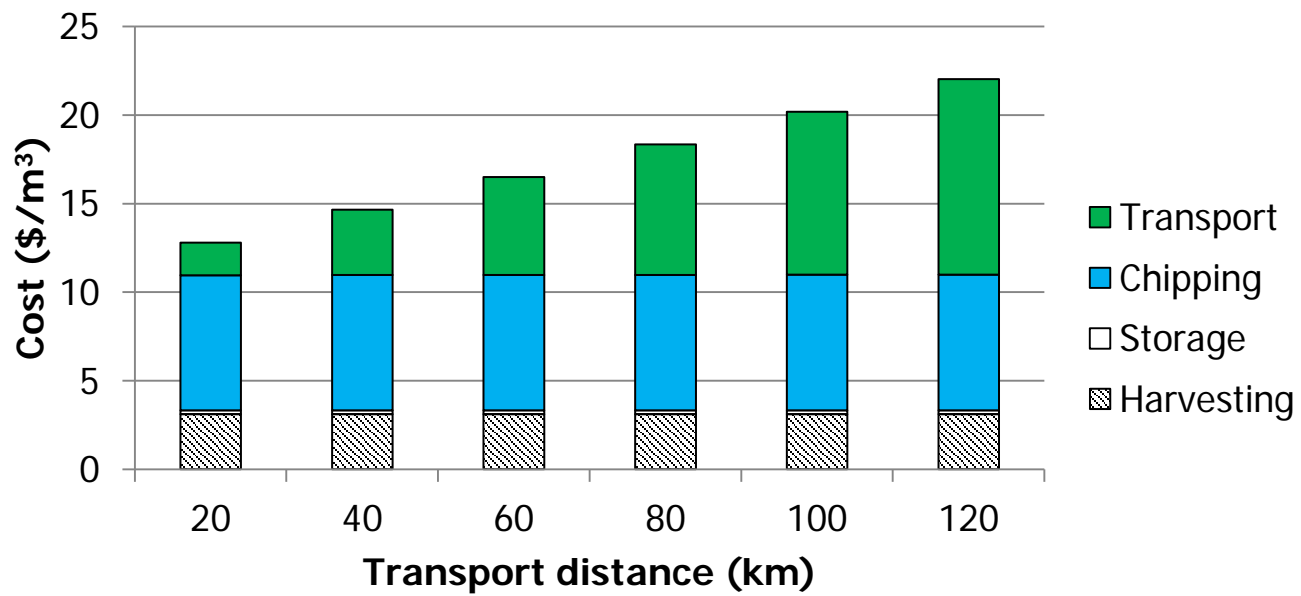
Source: bioenergy.org METLA

WB1 Status Model data Summary of Results

Harvesting volumes, truck loads and energy produced

	Tonnes harvested (Year 1)	Tonnes harvested (Year 2)	Tonnes chipped (Year 2)	Truck loads (chips)	Energy (MWh)
January	1131	1131	1489	49	5000
February	1110	1110	1511	50	5000
March	1089	1089	1541	50	5000
April	1089	1089	1509	49	5000
May	1070	1070	1459	49	5000
June	1032	1032	1482	49	5000
July	1032	1032	1576	49	5000
August	1032	1032	1588	50	5000
September	1110	1110	1593	50	5000
October	1089	1089	1636	50	5000
November	1050	1050	1640	50	5000
December	1110	1110	1714	52	5000
Total	12945	12945	18736	596	60000





Conclusions

- Harvesting residues: significant source for bioenergy.
- Reduction of biomass harvest costs.
- Best technology/work method for biomass recovery.
- Natural drying: efficient method for moisture reduction.
- BIOPLAN: Optimizing supply chain will reduce the operating cost.

Thank you!

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