

# Commercial feasibility of woody biomass production in wheatbelt agriculture

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# Outline

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- \* Expected future trends in farming
- \* Mallee biomass for renewable fuel & sequestration
- \* Meeting the demand for renewable energy
- \* Adapting to changes and chances of climate in farming
- \* Recommended belt systems and suitable regions
- \* Integration of mallees into dryland farming systems
- \* Pattern of growth and biomass accumulation
- \* Annual carbon stock change +/- harvesting
- \* Components of price of biomass from planting to delivery to pool
- \* Profitability of mallees relative to agricultural land use
- \* Cashflow implications of planting mallees
- \* Key drivers of biomass price



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# Expected Future Trends in Farming

- \* Grain and wool growing expected to decline in profitability due to increased climatic variability and lower mean growing season rainfall;
- \* Slightly higher summer rain;
- \* Price of grain is unlikely to remain high;
- \* Livestock may be penalised as majority of e-CO<sub>2</sub> emissions on broadacre farms are from cattle and sheep;
- \* Price of carbon is predicted to increase over time which will in turn favour Mallees;
- \* MRETs (20% of electricity from renewable sources by 2020) will favour the production and use of woody biomass;



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# Mallees for Fuel

- \* Woody biomass a replacement for fossil fuels
- \* Coal a major fuel of electricity generation
- \* 20% MRET by 2020 means 1-2 Mgt of biomass
- \* Fresh mallee biomass
  - \* 45% water
  - \* 55% cellulose, h-cellulose and lignin
- \* Biomass - a feedstock for:
  - \* generation of electricity
  - \* production of transport fuels
- \* Conversion technologies – from possible to preferred
  - \* combustion +/- cofiring with coal
    - \* coal 25-35 GJ/t
    - \* mallee biomass 10-12 GJ/t
  - \* pyrolysis to produce bio-oil, biochar & gas
  - \* gasification –gas for transport fuel or direct combustion
  - \* fermentation of cellulose and h-cellulose

# The raw mallee biomass



**1/3 wood chips, 1/3 leaf, 1/3 twig/bark**

**Available Species: Euc. Loxophleba, Euc. Kochii, Euc. polybractea**



# Meeting the Renewable Energy Demand

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Total demand (green tonnes)	1,000,000
% of paddock allocated to mallees	7%
Required belt area (ha)	46,000
Belt area harvested each year (ha)	15,000
Farm area planted to trees (ha)	600,000
Number of mallee trees planted	66,000,000
.... by way of comparison	
400,000 ha blue gums planted in WA over 10 years	
equivalent to 500 million trees	

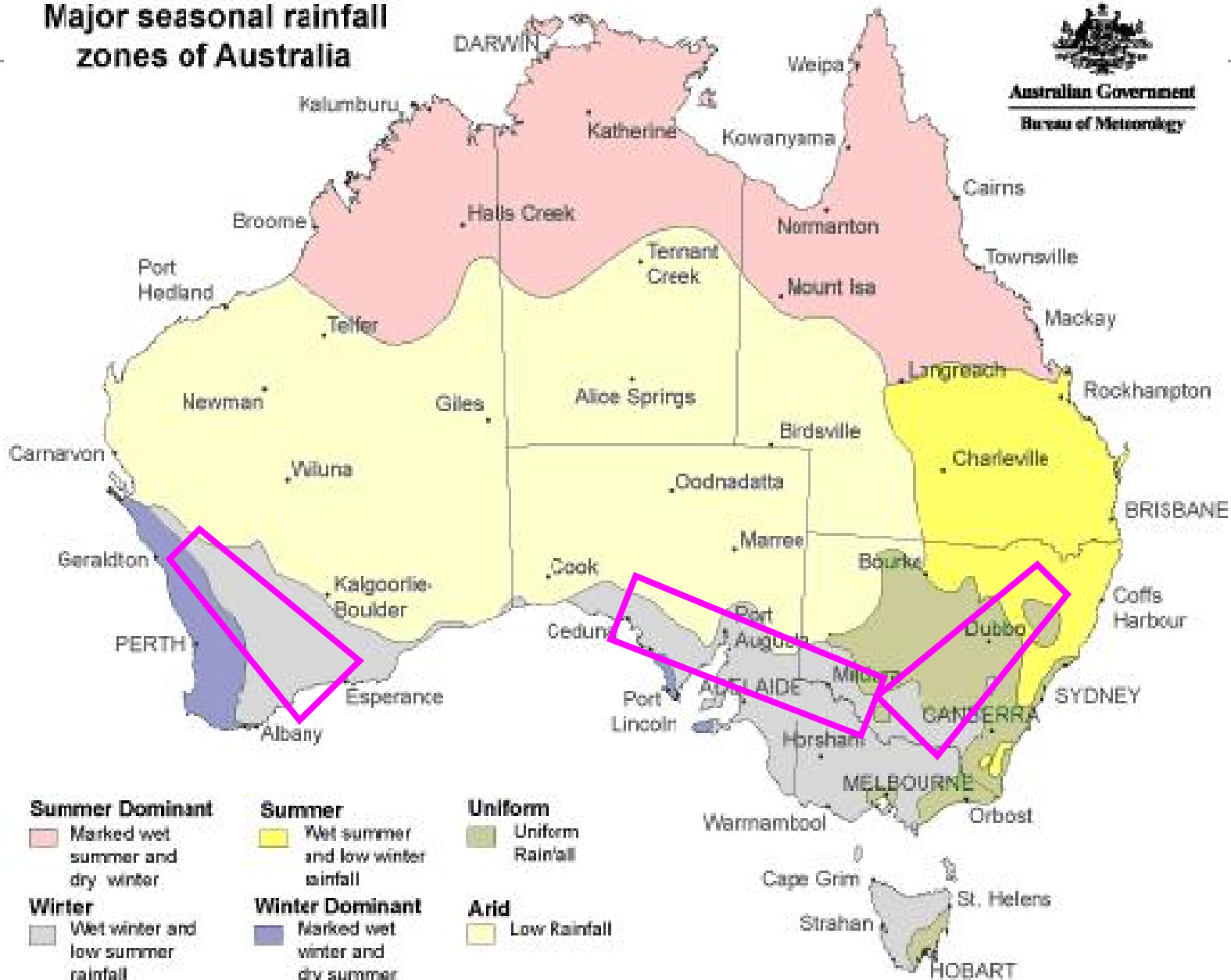


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# Major seasonal rainfall zones of Australia



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Bureau of Meteorology

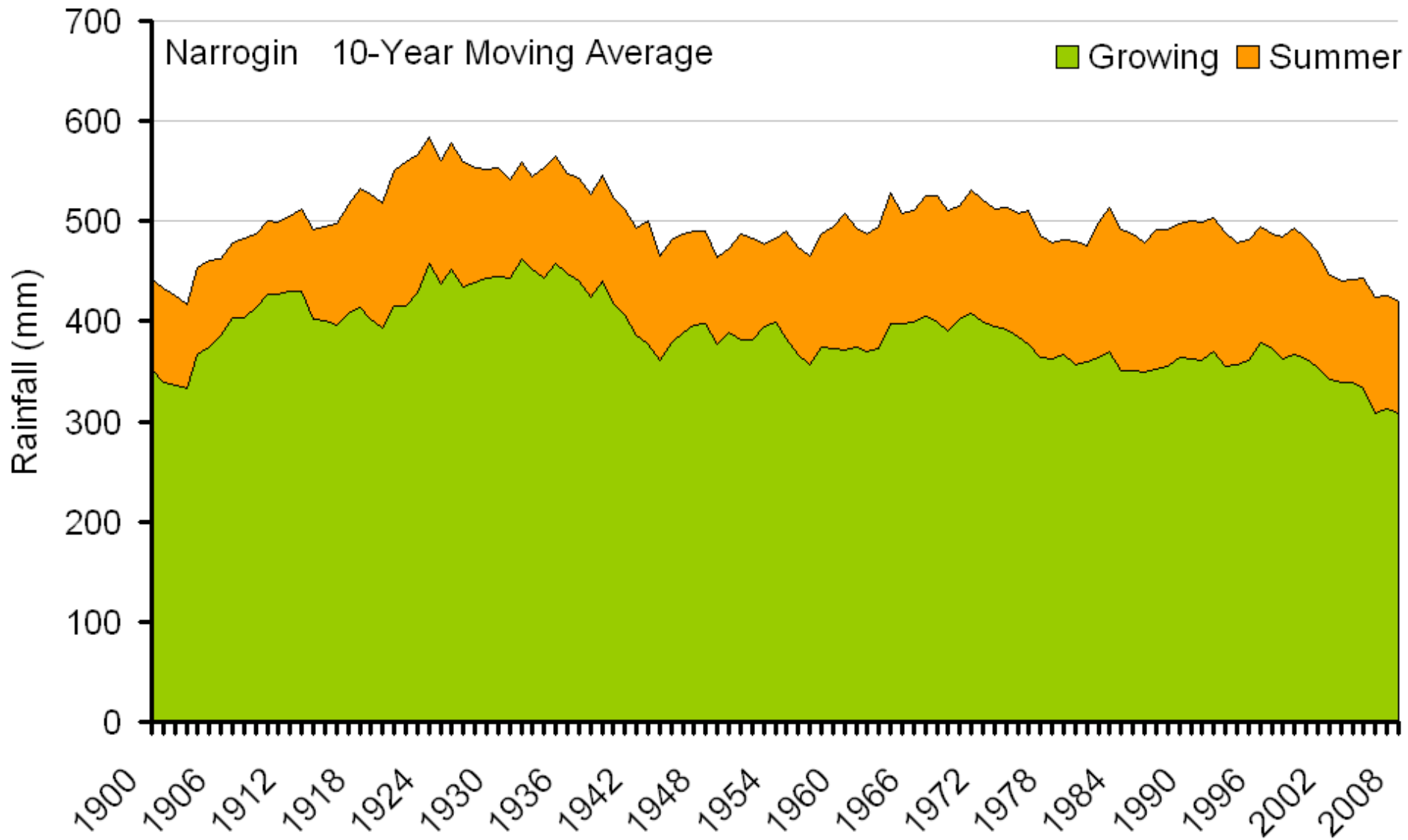


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Regions considered suitable for mallee production



# The changes and chances of climate





# Design of mallee plantings

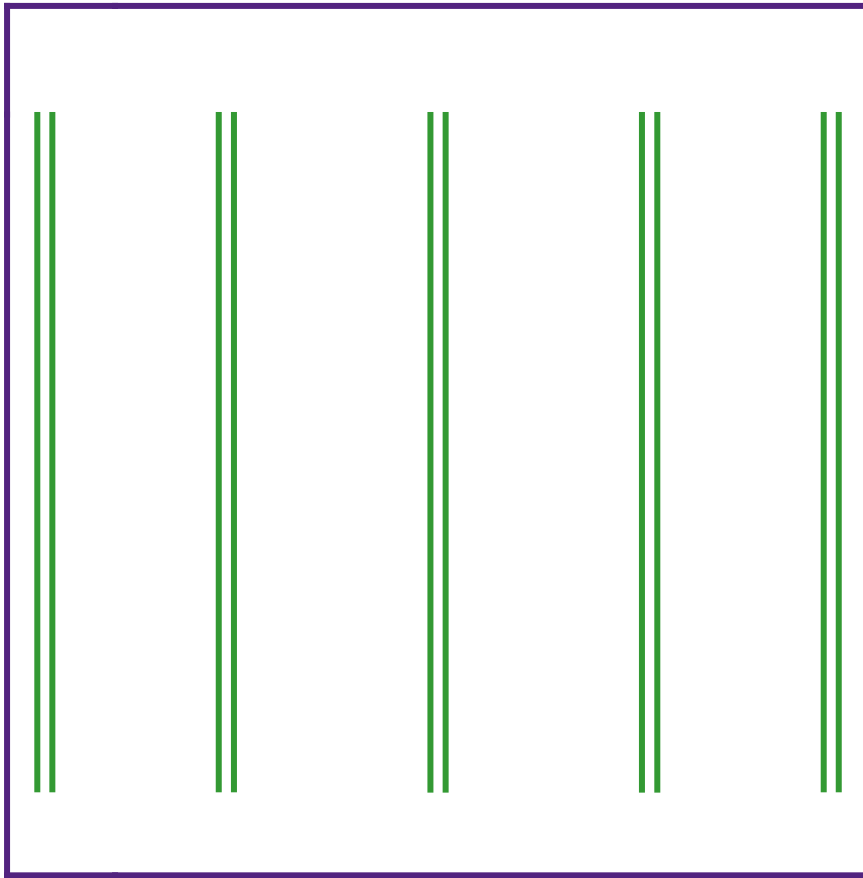
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- \* Objective of design of mallee plantings is to:
  - \* maximise capture of rainfall
  - \* to intercept as much surface water flow as possible
  - \* enable efficient harvest at 60-80 t/hr
- \* Distributed design option
  - \* belts aligned on contour
  - \* with wide alleys for agricultural machinery - 40 to 100 metres wide
  - \* enables water capture and surface water management
  - \* trees occupy 7% of land as disperse belts
- \* Perimeter design option
  - \* planted along fence lines of every second paddock
  - \* enables use of non-arable land
  - \* utilises water on land occupied by fences, gates, tracks and firebreaks
  - \* fits easily to existing farm plans



# Distributed belt layout

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% of paddock in trees	7%
Area of belt (ha/km)	0.7
Harvest cycle (years)	5, 3, 3
Harvests (gt/ha)	40-70
MAI (gt/ha/year)	10-25

Harvest frequencies and biomass yields are contingent on rainfall and soil type



# Mallee belt layout

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Open paddock

Competition zone

Tree  
Belt

Competition zone

Open

Distance between belts is a multiple of widest cropping machine.

Cropping area between belts is called the 'alley'

Full yield potential

Mallee roots extend laterally and cause some reduction in crop yield (related to soil type, stage of harvest cycle)

2m | 3m | 2m

Up to 20m

7m

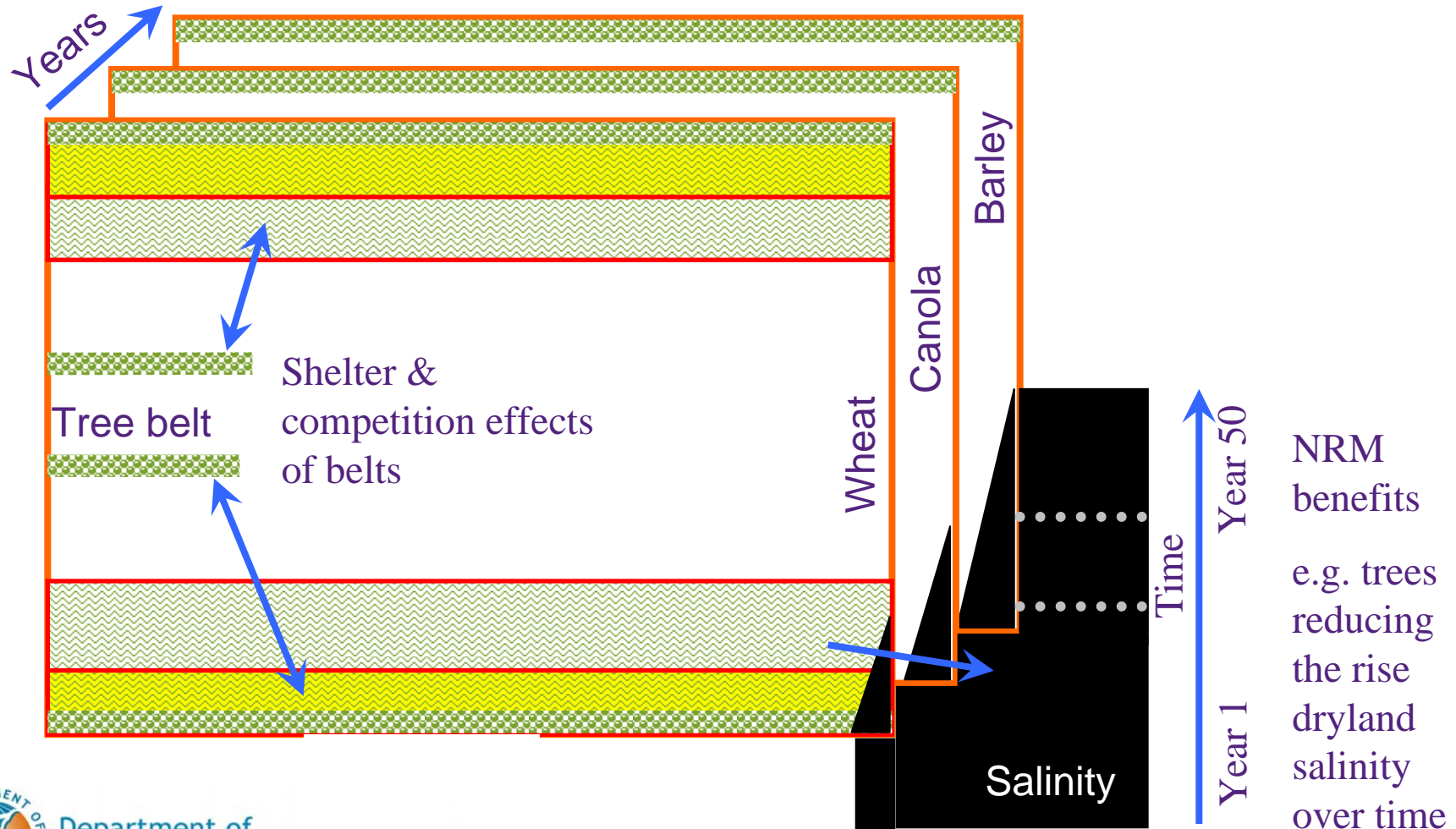


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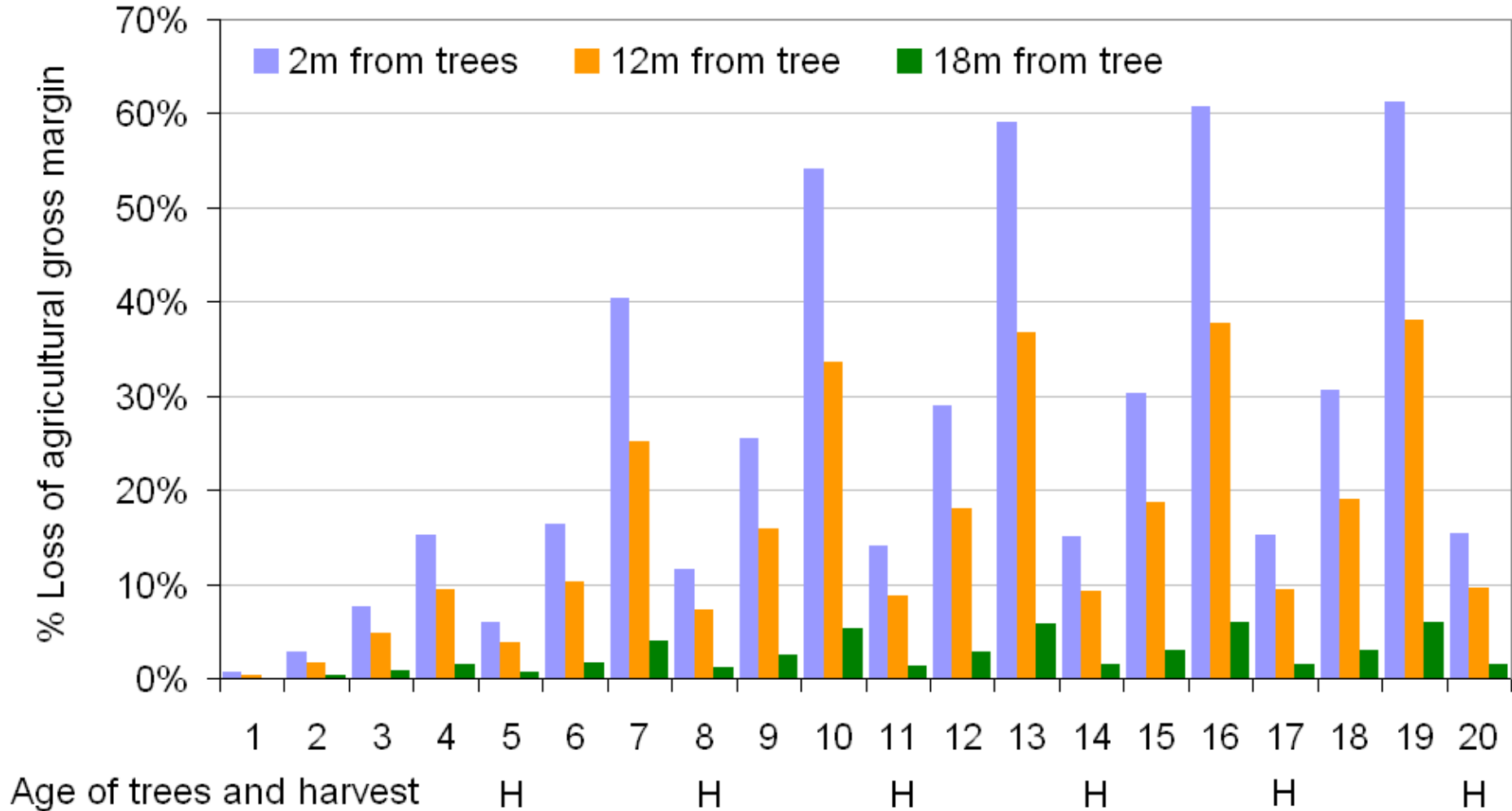
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# Assessing place of mallees on farms with temporal and spatial interactions to calculate cashflow and profitability consequences





# Competition trees impose on agriculture





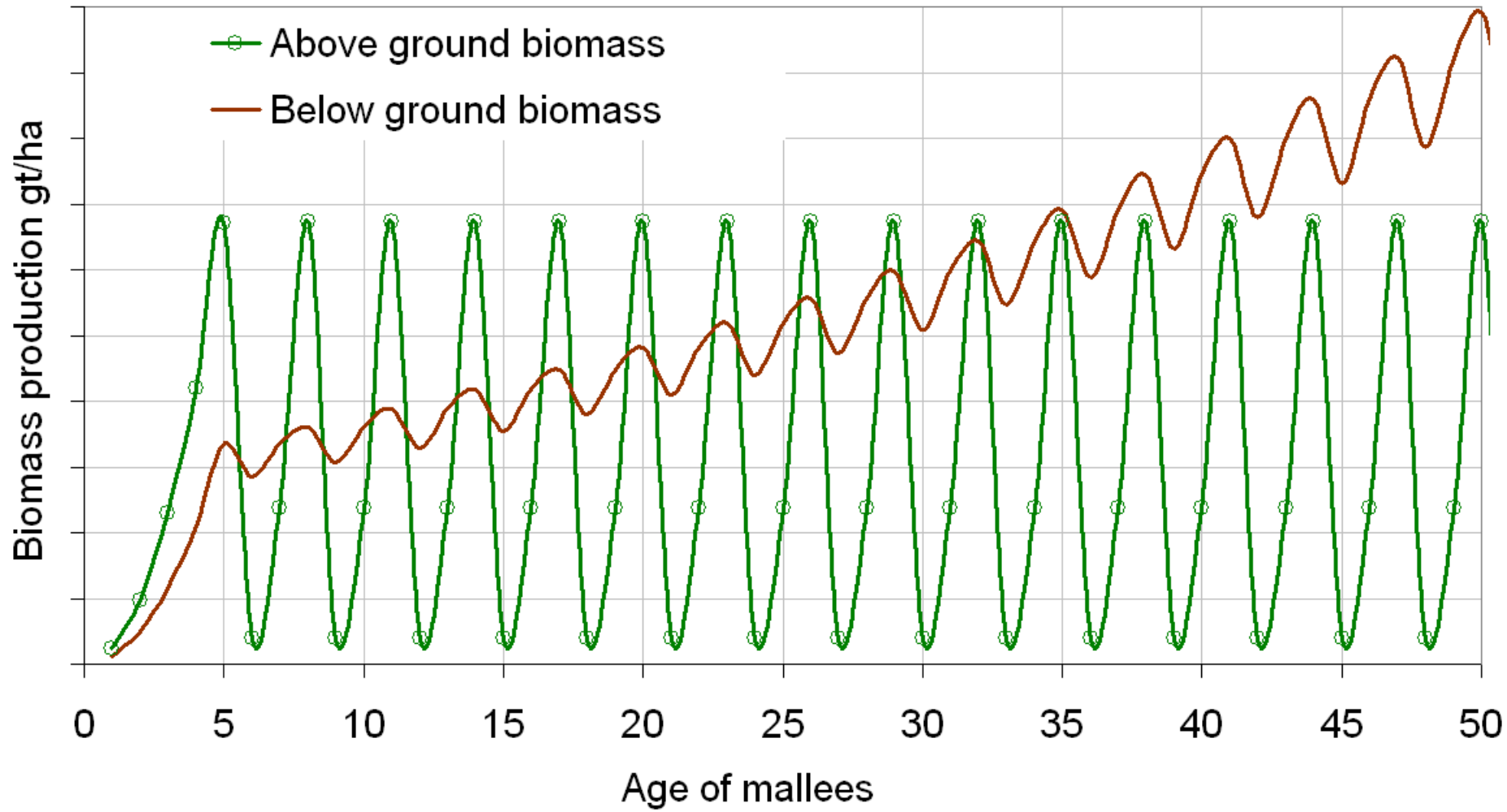
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## Mallee harvest cycle lengths

Rainfall	1-row belt	2-row belt	4-row belt
300-400	5, 4, 4	8, 6, 6	12, 10, 10
400-500	4, 3, 3	6, 4, 4	8, 6, 6
500-600	3, 3, 3	5, 3, 3	7, 5, 5

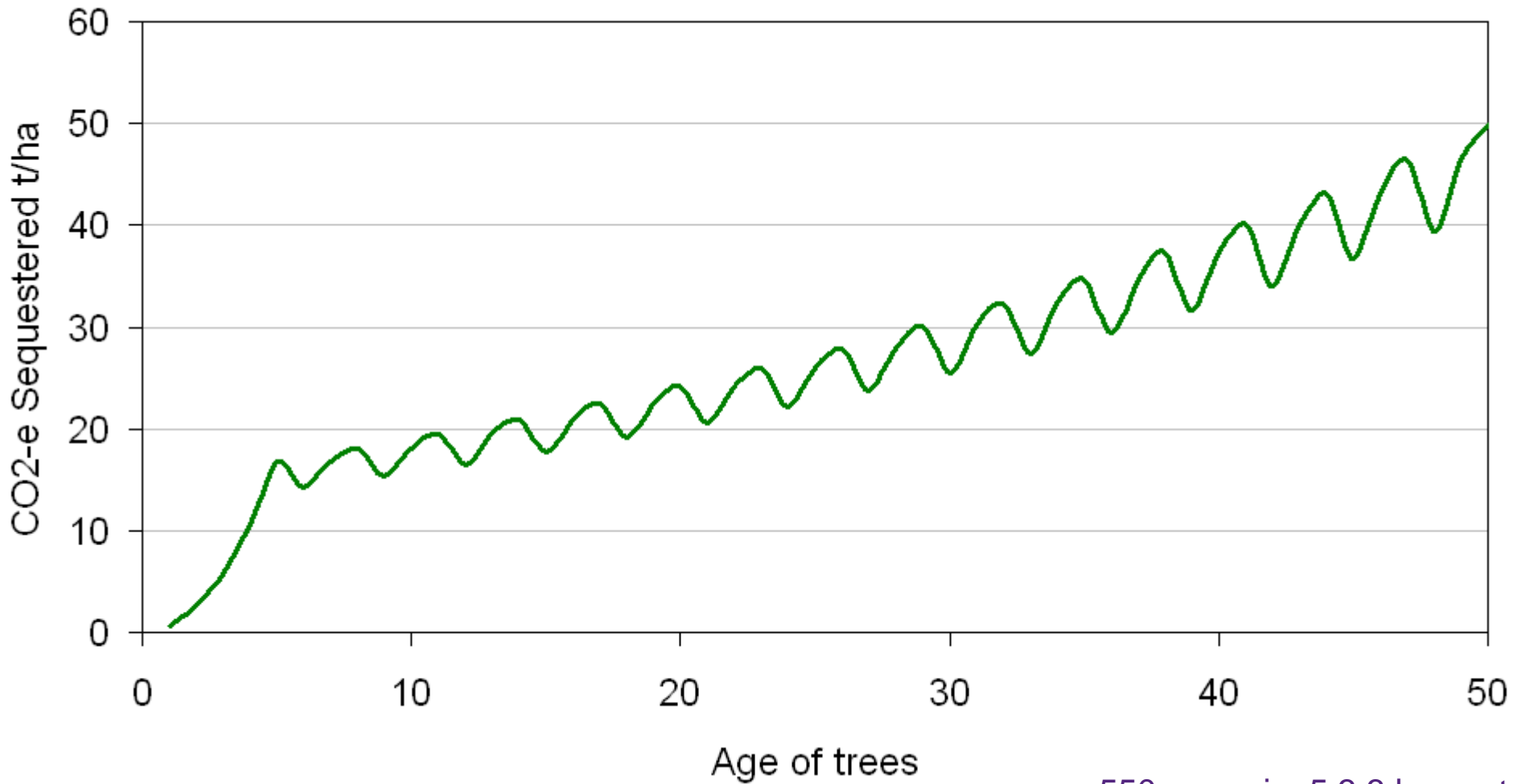


# Biomass growth in harvested mallee belts





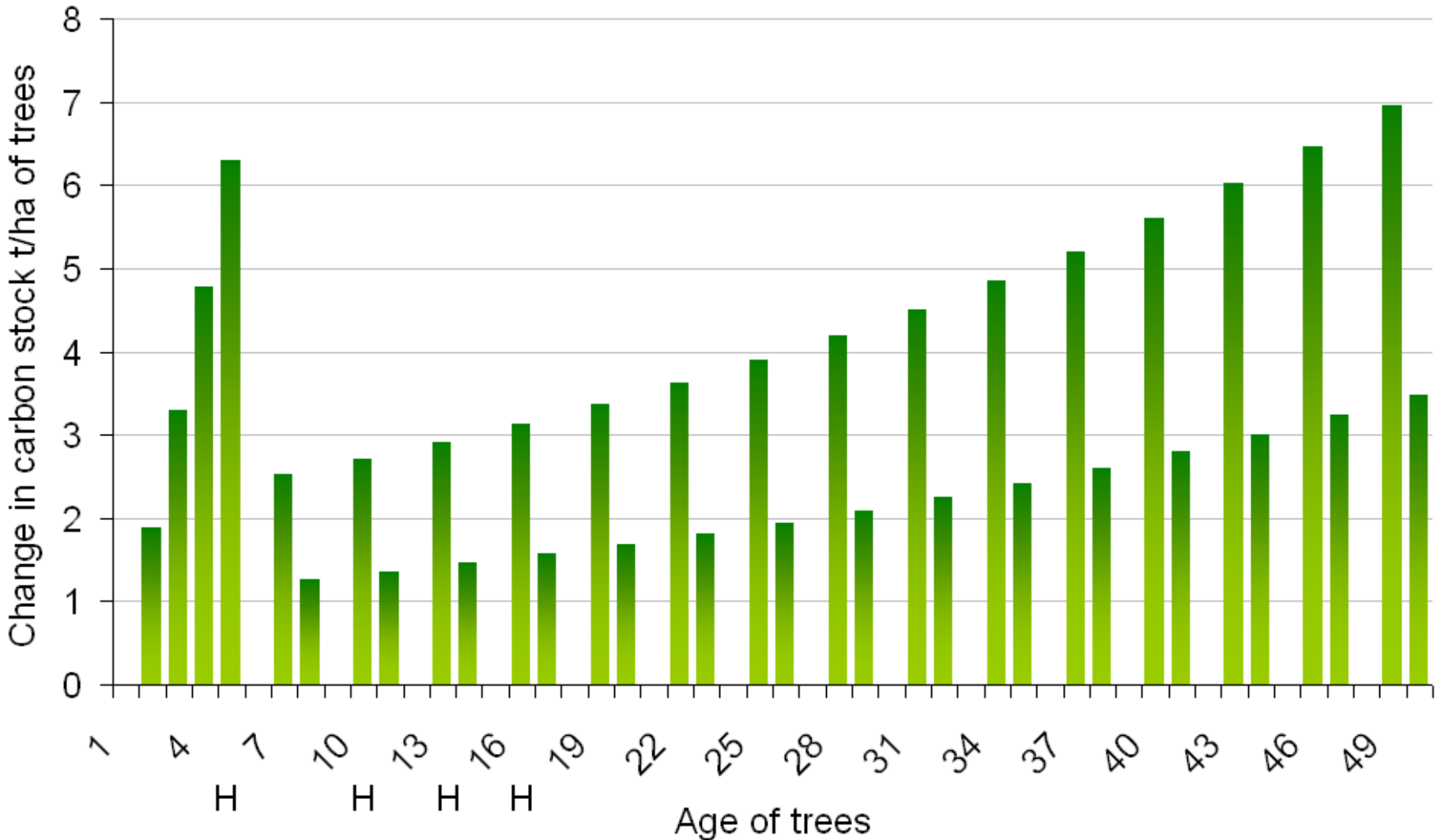
# Carbon sequestered below ground



550 mm rain, 5,3,3 harvest



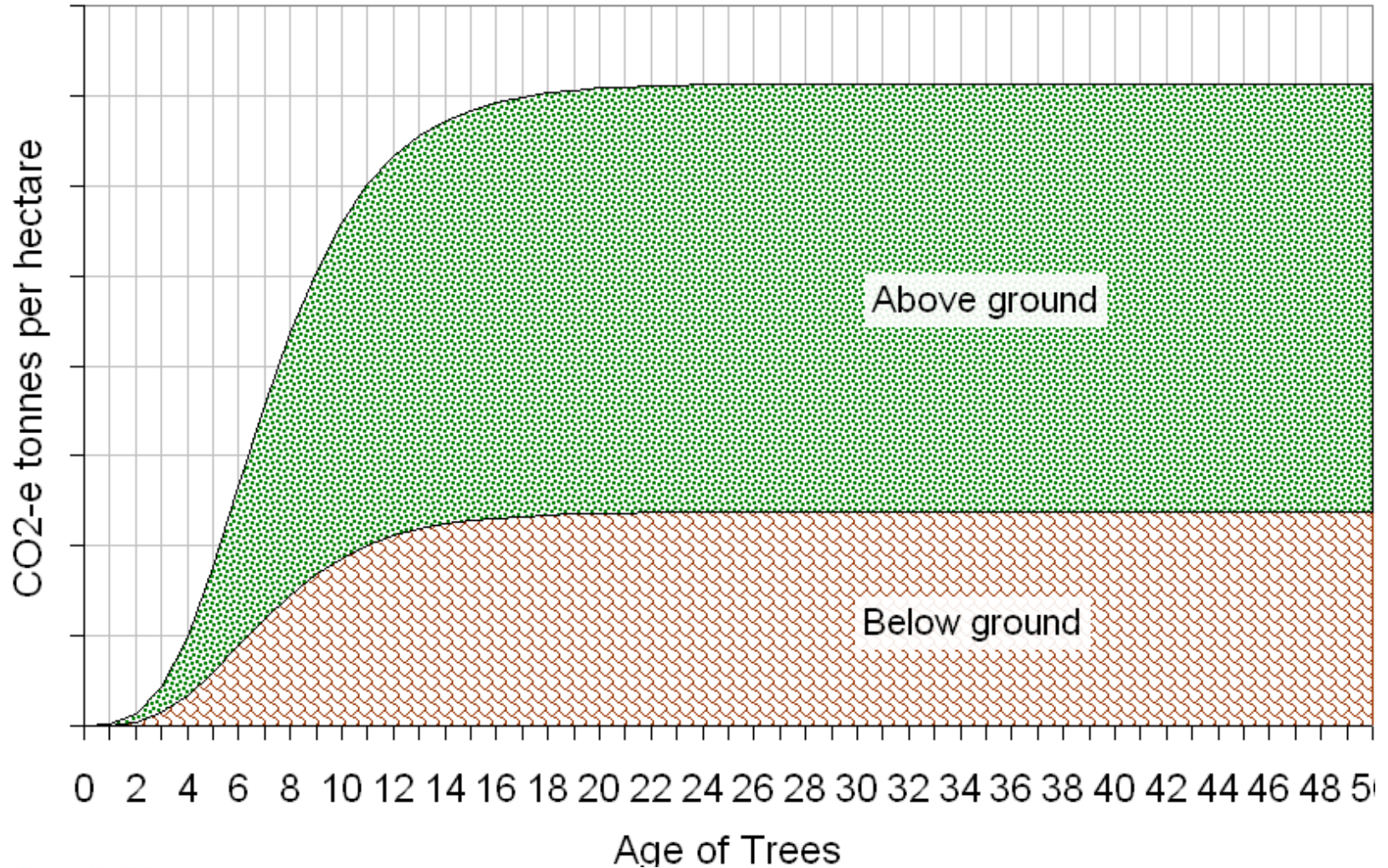
# Change in carbon stock below ground





# Carbon stocks in unharvested plantings

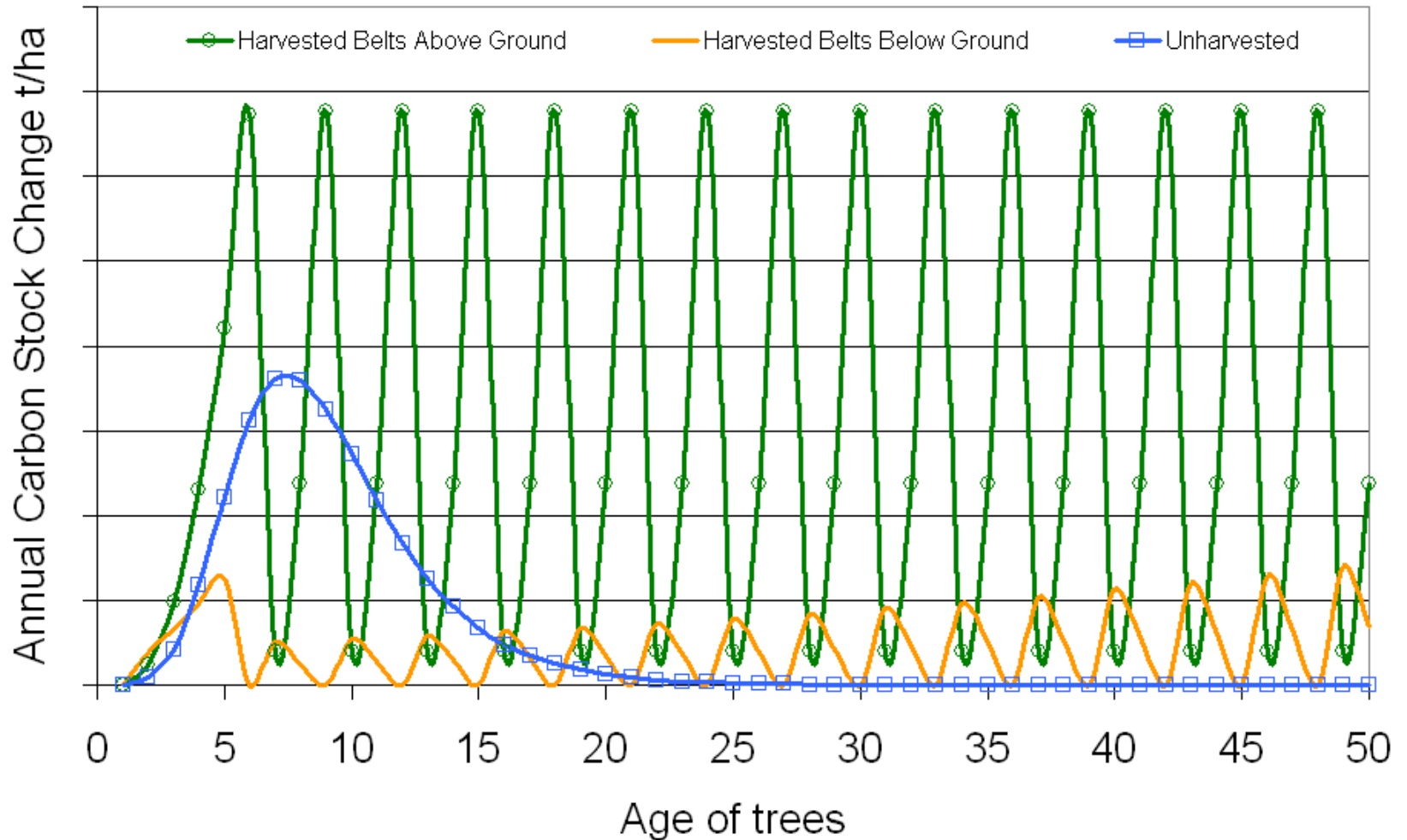
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# Annual Carbon Stock Change





# Cashflow implications

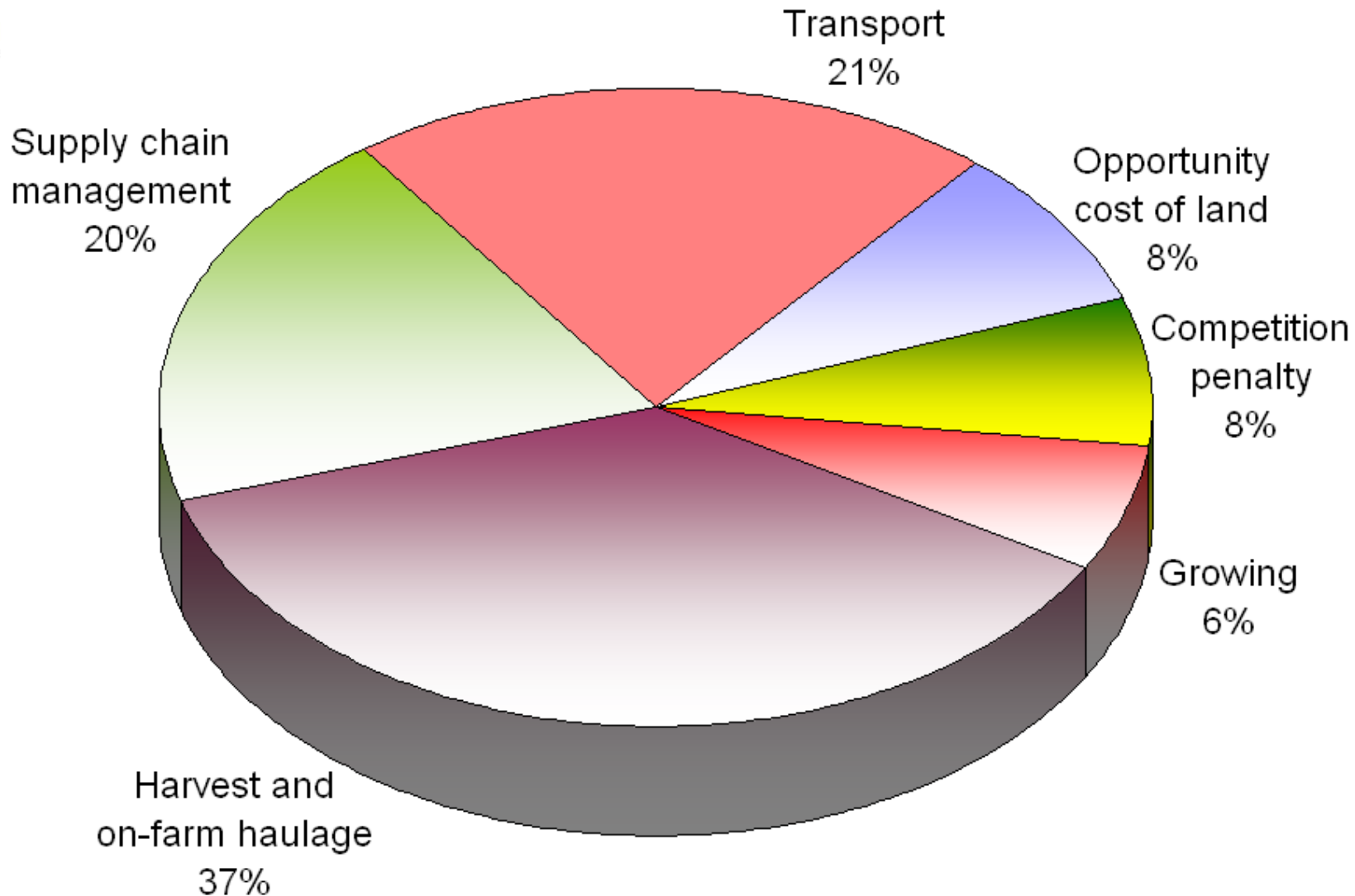
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# Components of Biomass Price





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# Key drivers of biomass price

Cause	Effect	% change in price
1% rise in harvested biomass yield of belts	Land & comp cost	-9%
	Growing cost	-9%
	Harvest cost	-1%
	Final price	-2%
1% rise in cost of establishment and maintenance of belts per ha	Growing cost	0.2%
	Final price	0.01%
1% rise in opp cost of agric (i.e. if agric was 1% more profitable)	Land & comp cost	1%
	Final price	0.2%
4-row belts instead of 2-row belts (wider tree belts 13m vs 7m)	Land opp cost	99%
	Competition cost	34%
	Growing cost	-8%
	Harvest cost	-6%
	Final price	8%
Halving land loss due to salinity	Final price	-4%
Payment for carbon* sequestered in below ground biomass (mallee roots)	Final price	-11%



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\* Carbon is valued at \$25/t of sequestered CO<sub>2</sub>-e at start up