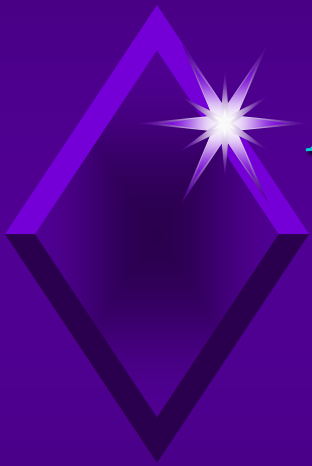
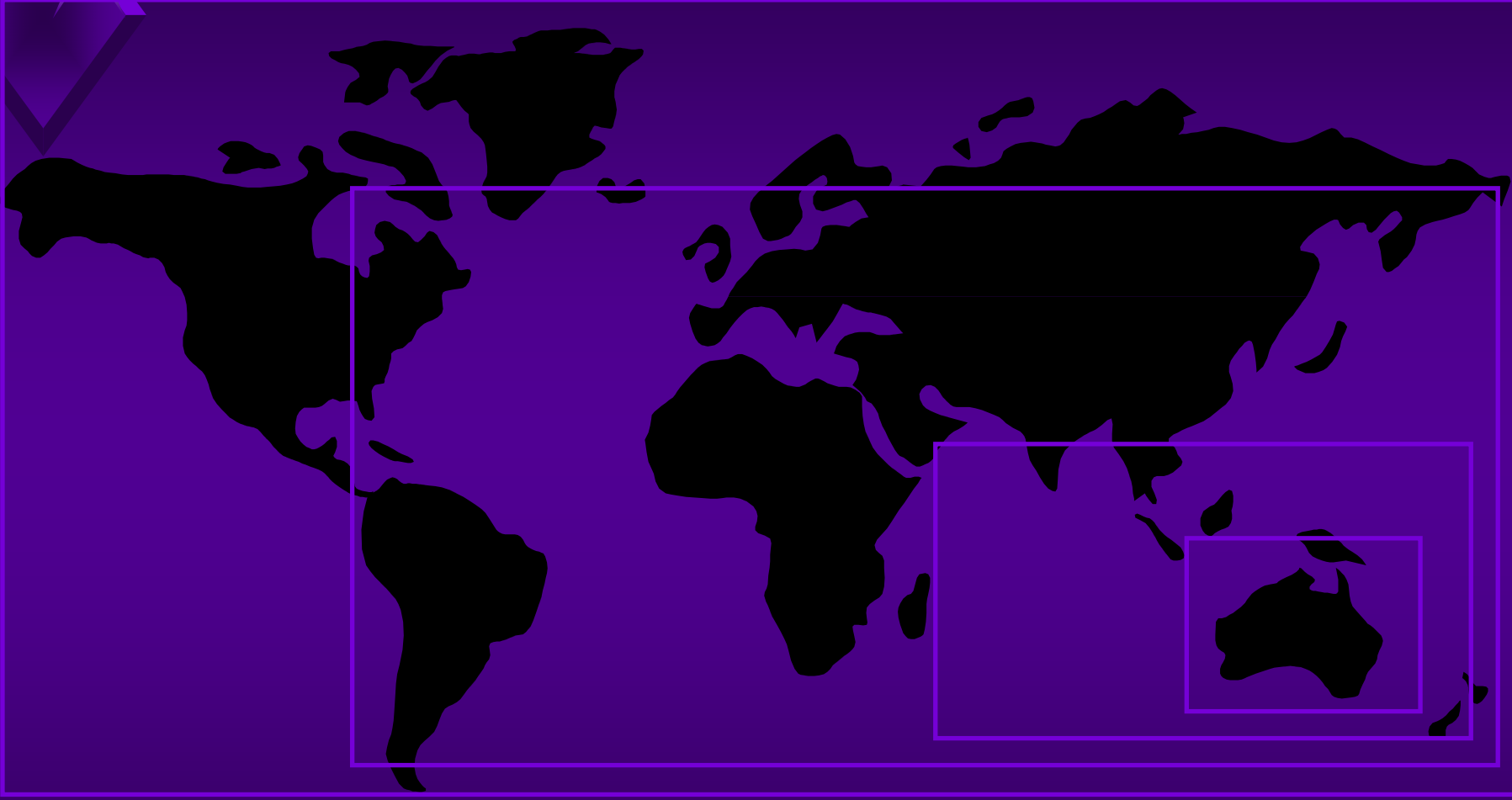
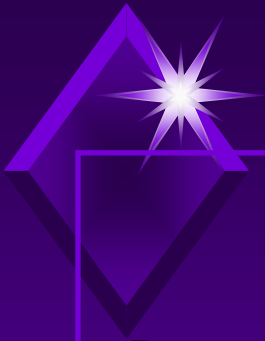
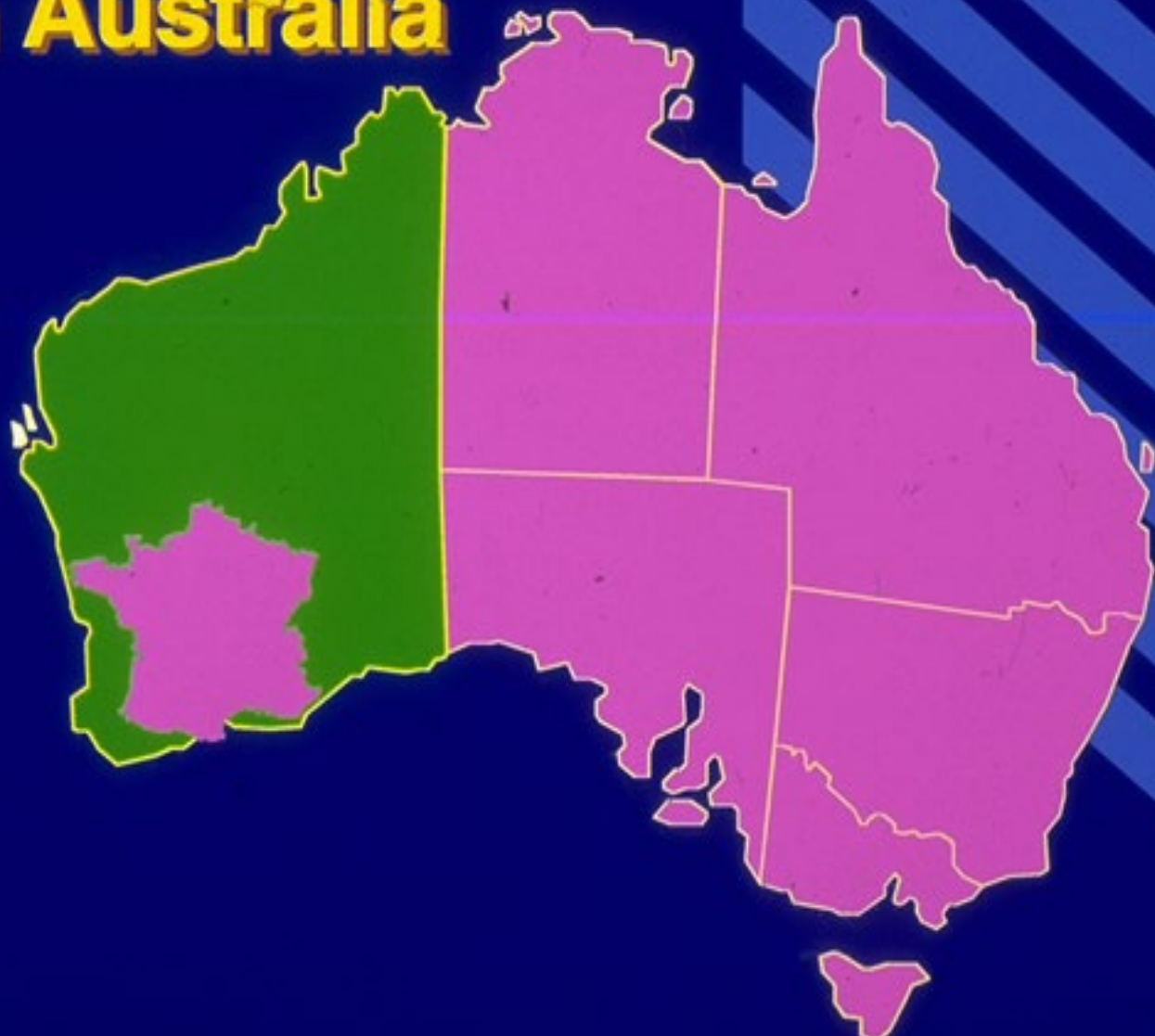


*The potential for using tree crops and
biodiversity plantings in Western
Australia for Carbon sequestration*





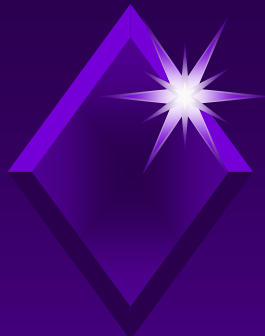
**France occupies a land area
about a quarter the size of
Western Australia**



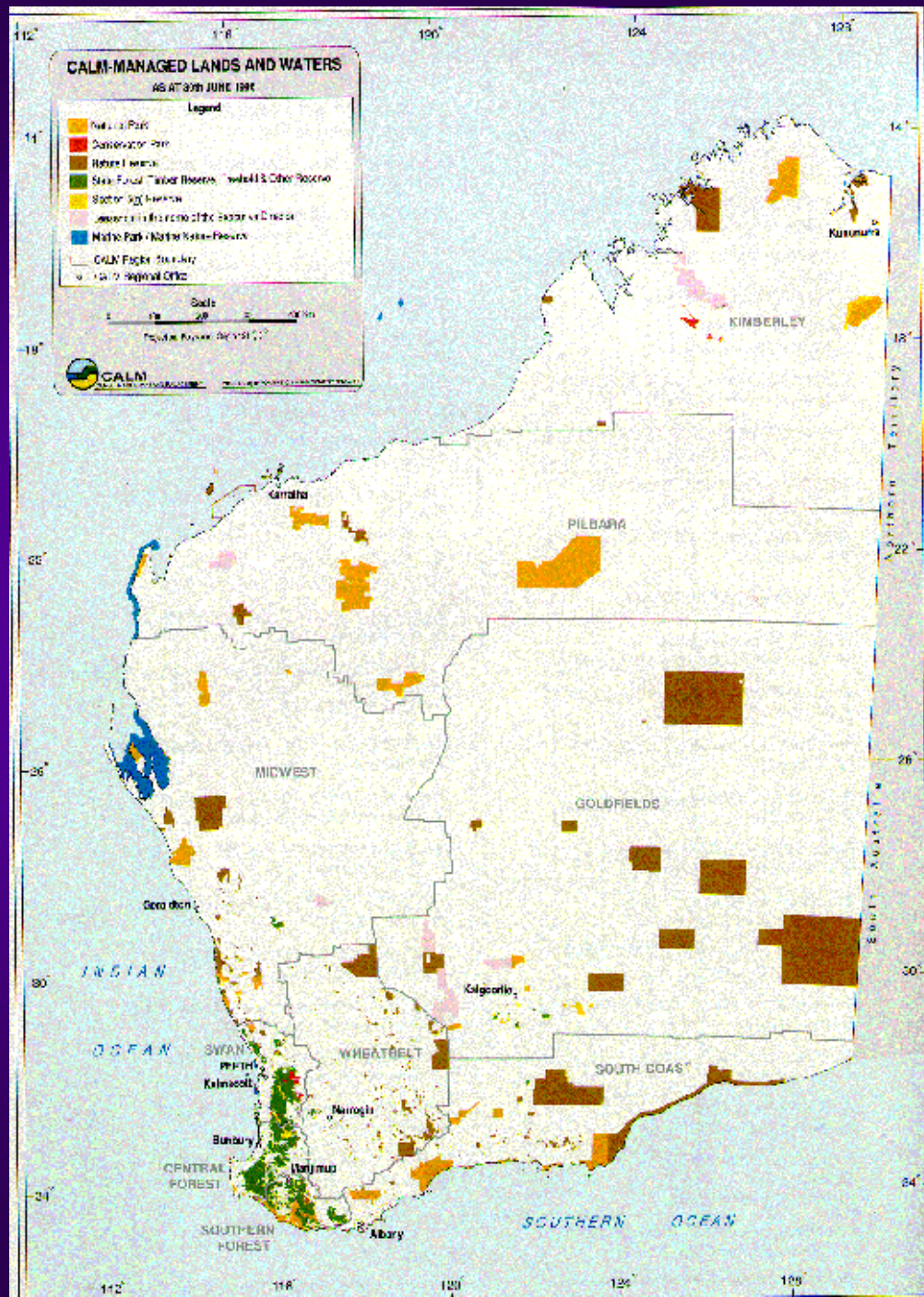
**CALM manages a land area
51% the size of Japan**

51%

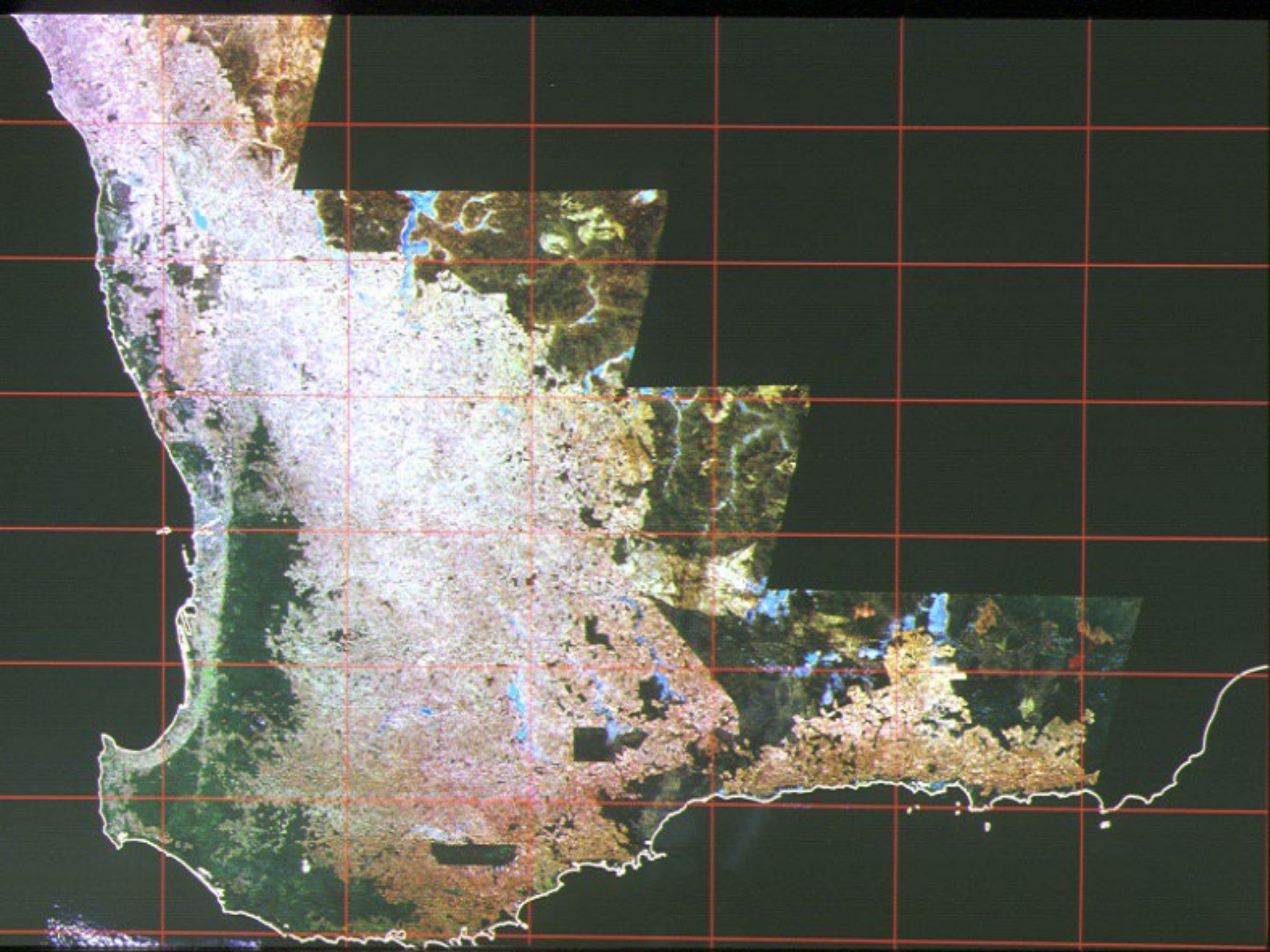




CALM managed lands and waters



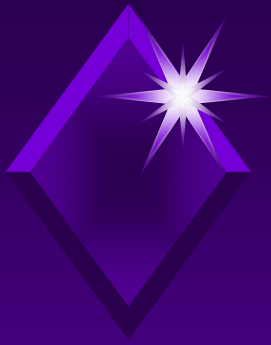




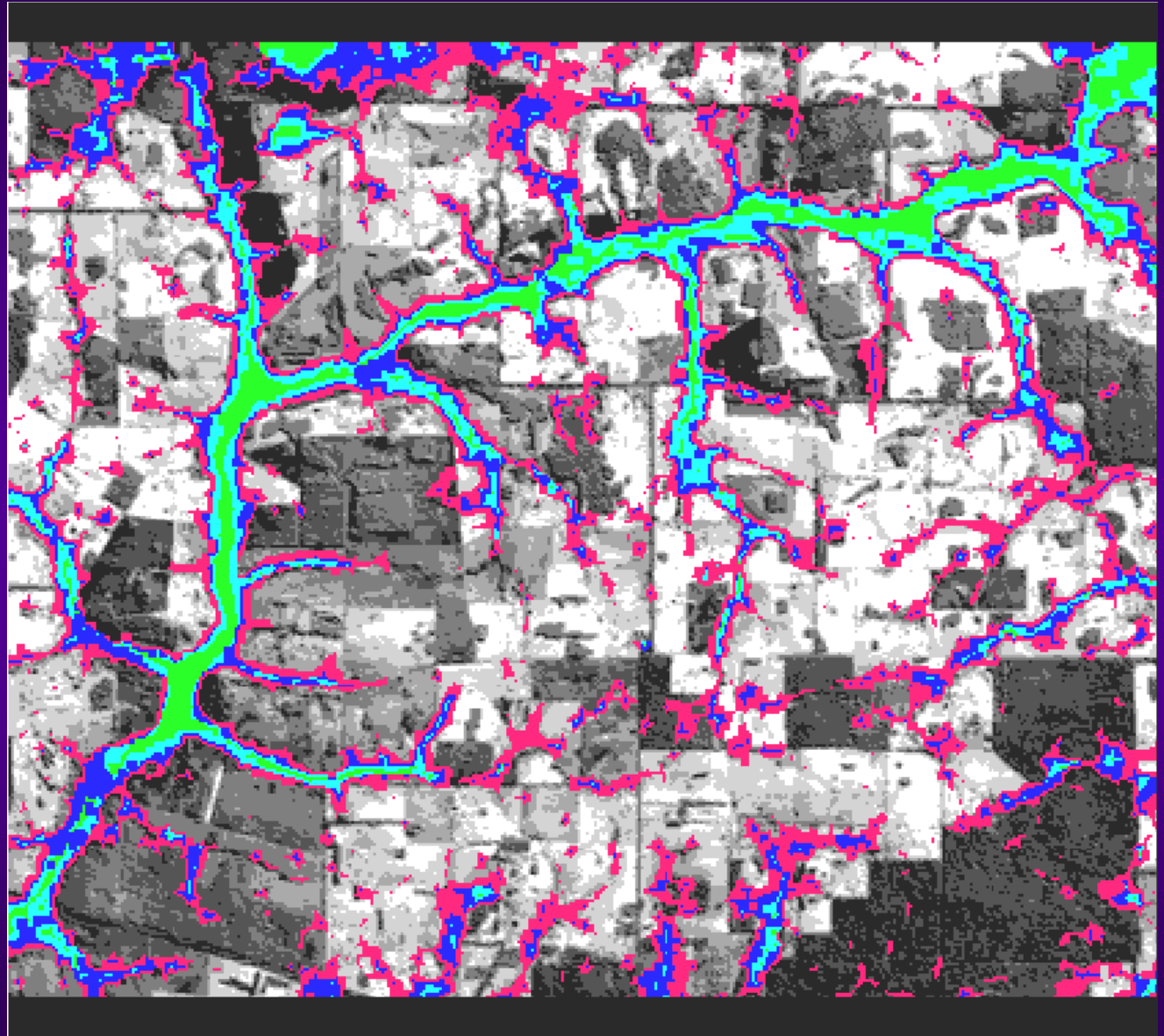






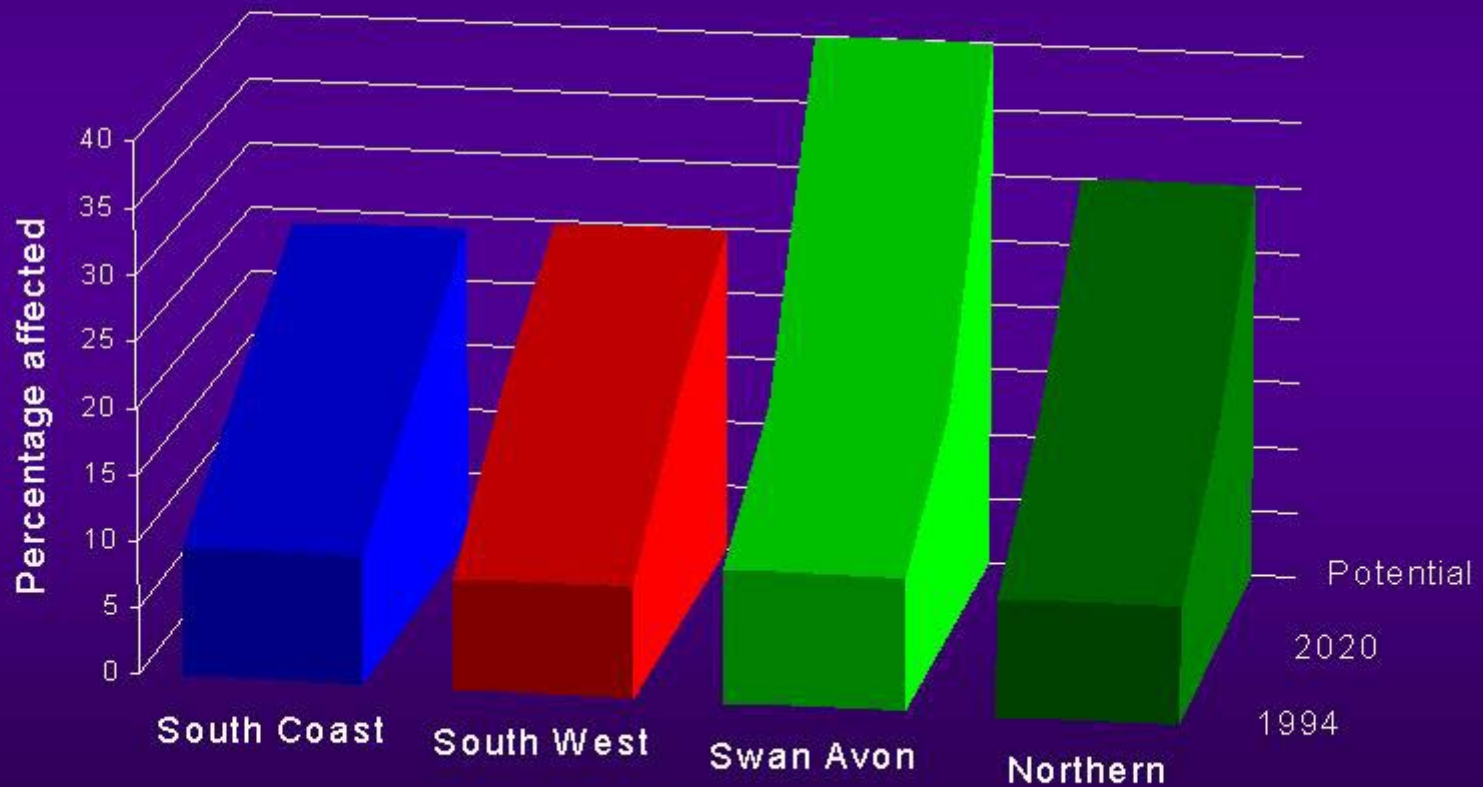


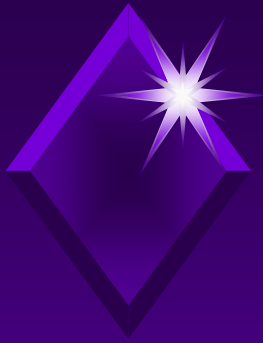
*Satellite
imagery
and
salinity*





Estimated areas affected by salinity by region





Estimated areas affected by salinity in 1994, 2020 and potential at full development

Region	Total Area 000ha	Salt affected 1994		Salt affected 2020		Potential area	
		000ha	%	000ha	%	000ha	%
South Coast	4 079	395	9.7	688	16.8	977	24.0
South West	3 310	274	8.3	596	18.0	820	24.8
Swan-Avon	7 591	759	10.0	1 290	17.0	3 035	40.0
Northern	4 252	376	8.8	723	17.0	1 276	30.0
Total	19 231	1 805	9.4	3 296	17.1	6 111	31.8

From Ferdowsian *et al.* 1996

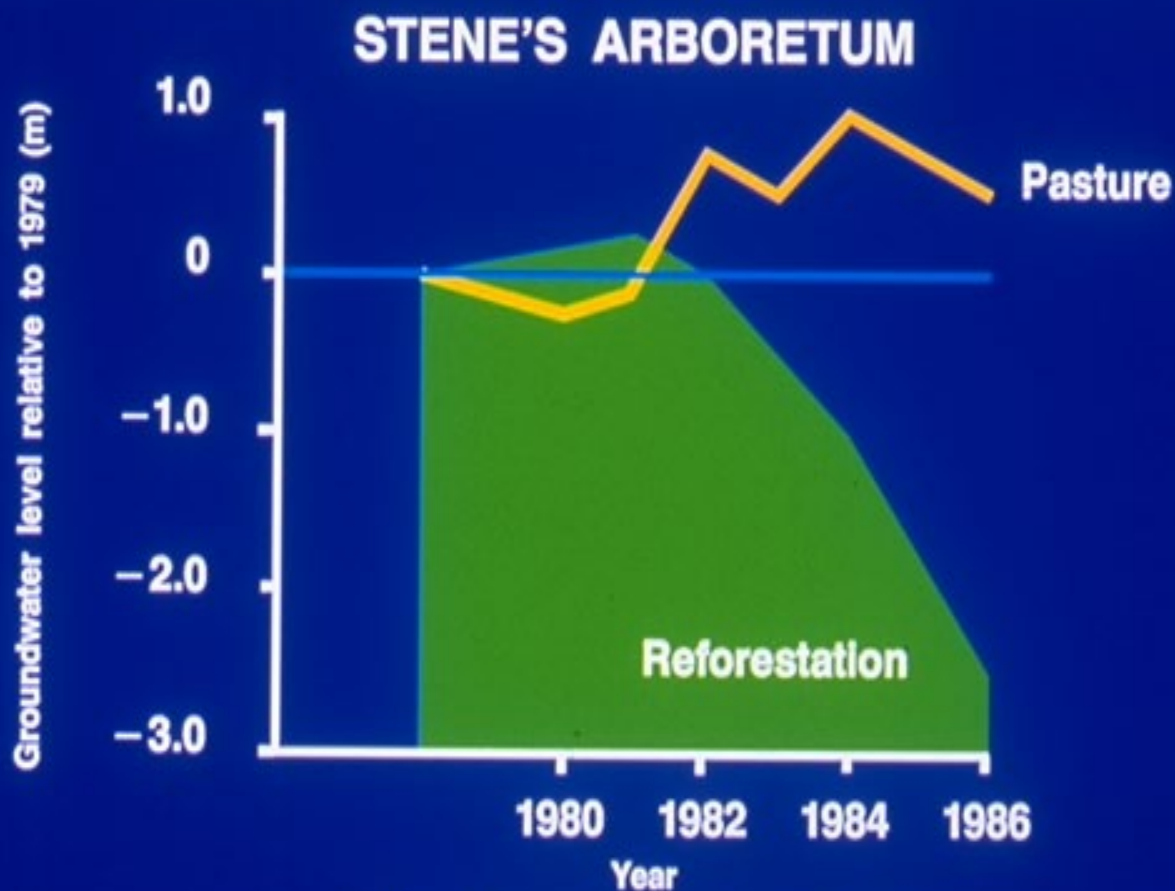




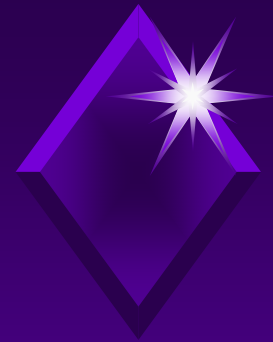




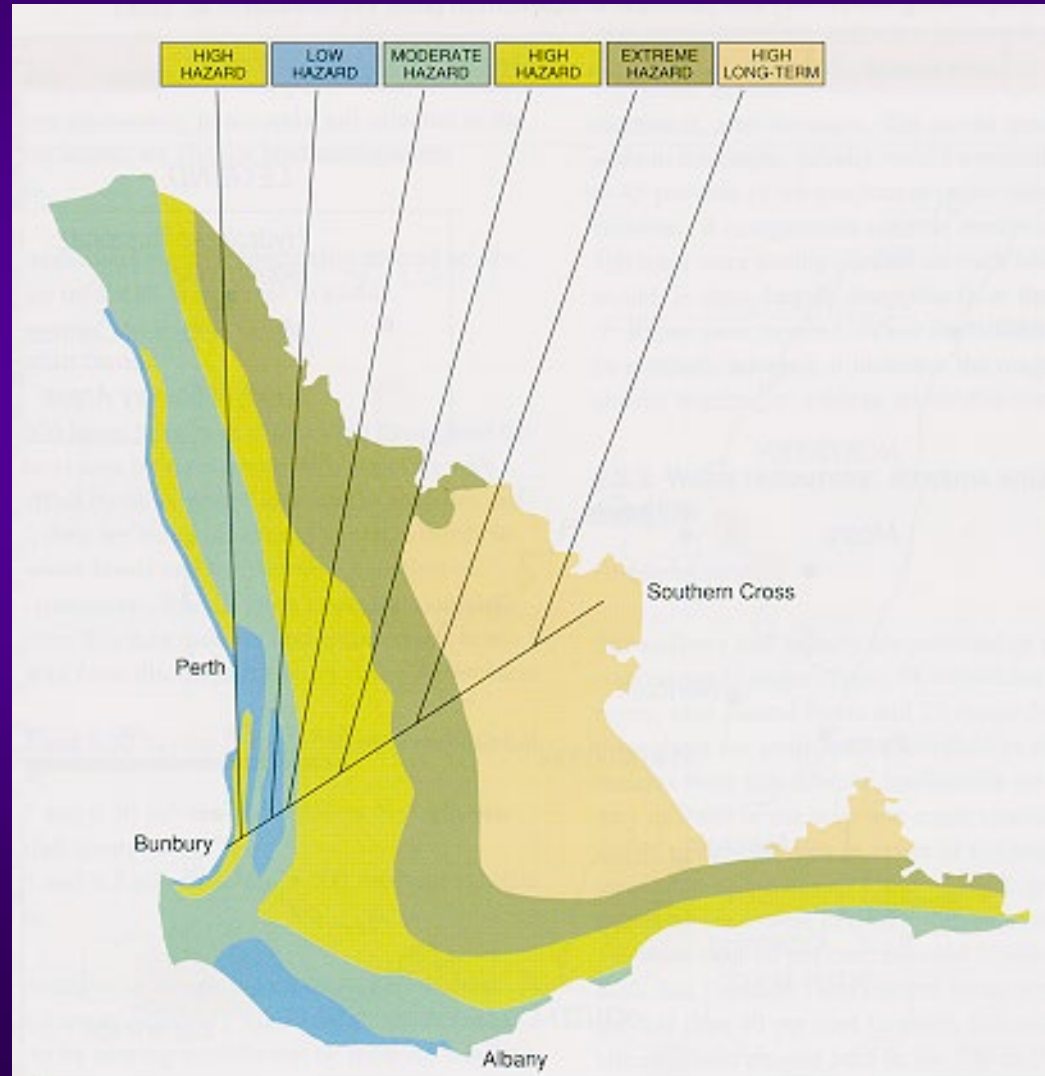
THE EFFECT OF TREE CROPS ON WATER TABLE LEVELS

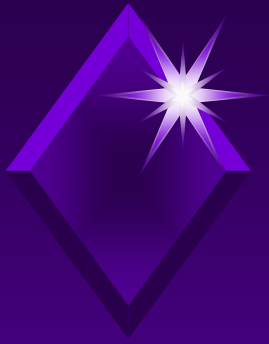


Water Authority of Western Australia
July 1989
Report No. WS 33



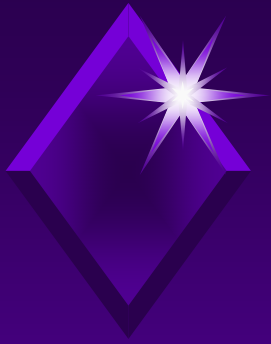
Salinity hazard zones in the South-west



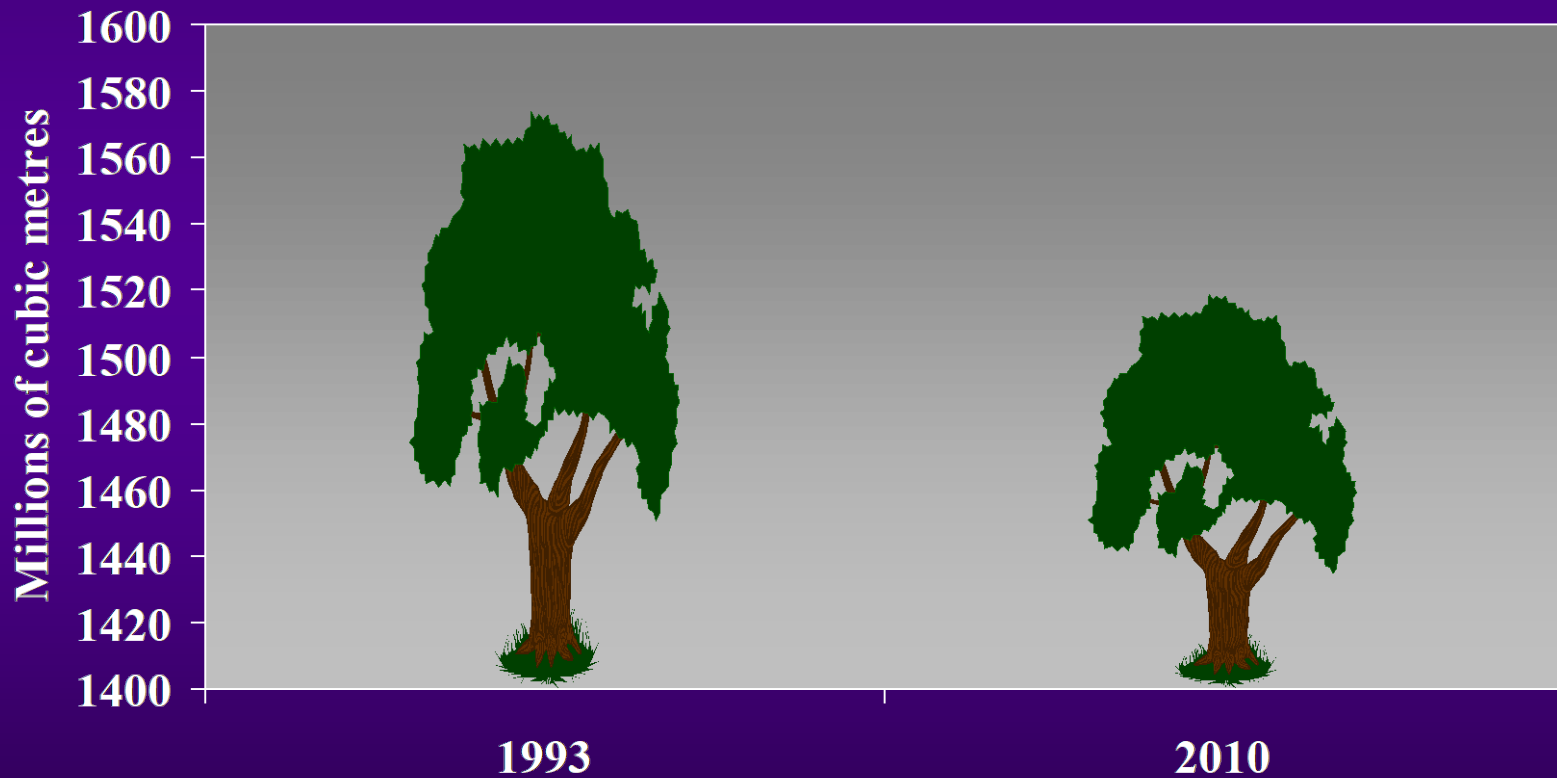


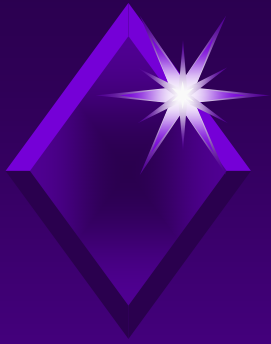
Farm forestry zones by area and rainfall

Farm forestry zone	Rainfall	Area (in million ha)
Traditional pine and new bluegum	>600 mm	2
New maritime pine	400 to 600 mm	6
Wheatbelt	<400 mm	10

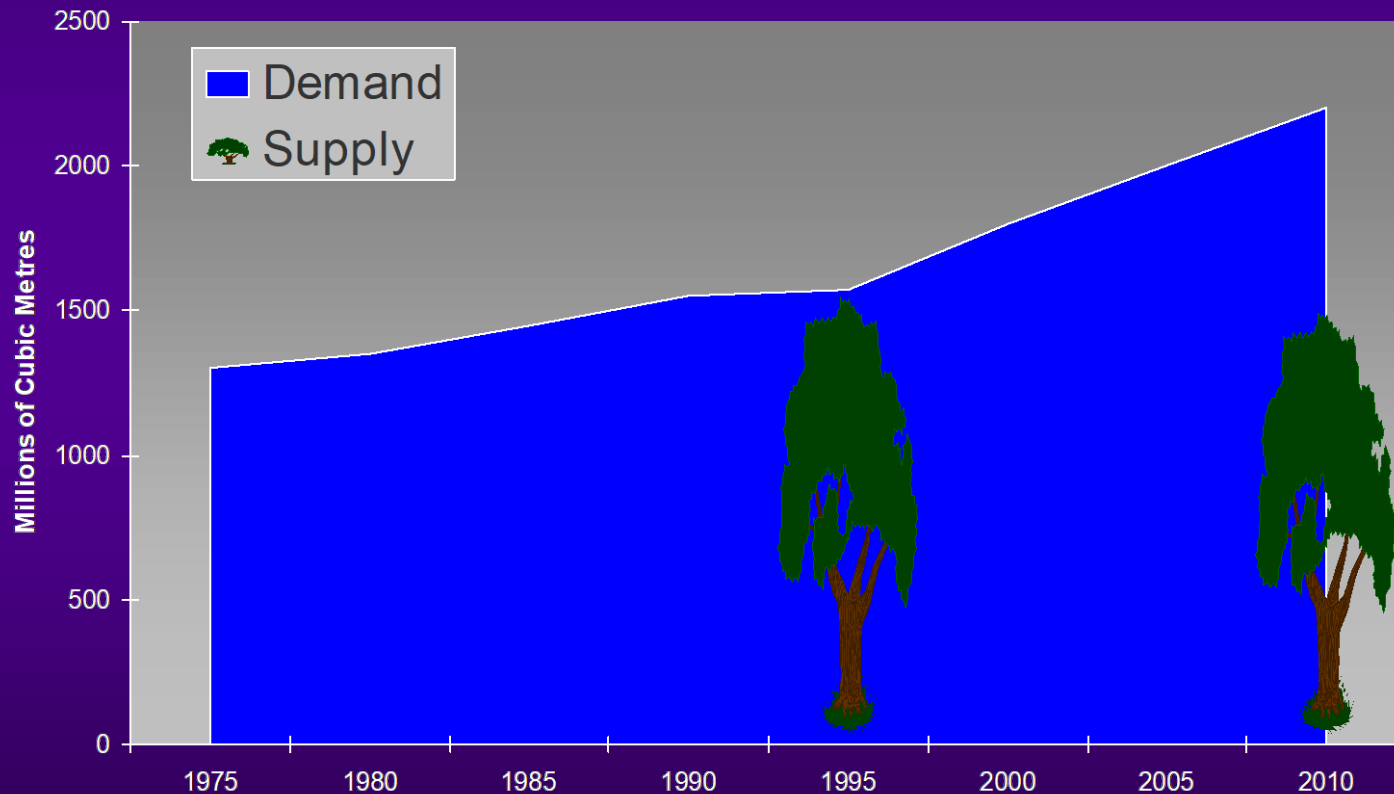


Declining global wood harvests



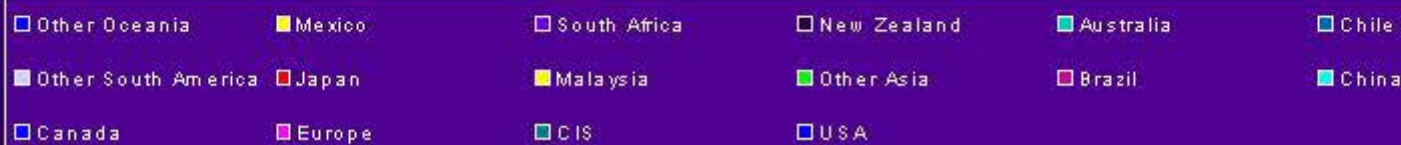
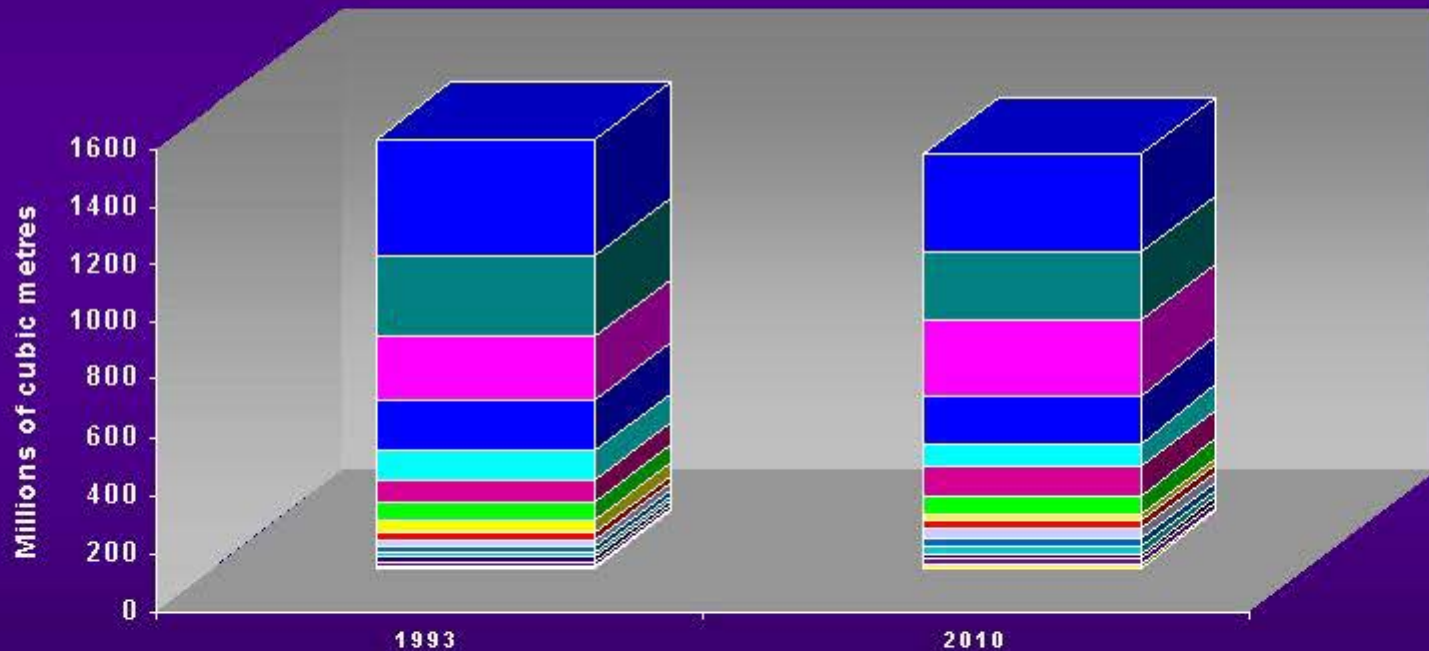


Global wood demand rises as supply falls





Declining Global Wood Harvests













Water Drawdown under Bluegum Plantations compared to Pasture

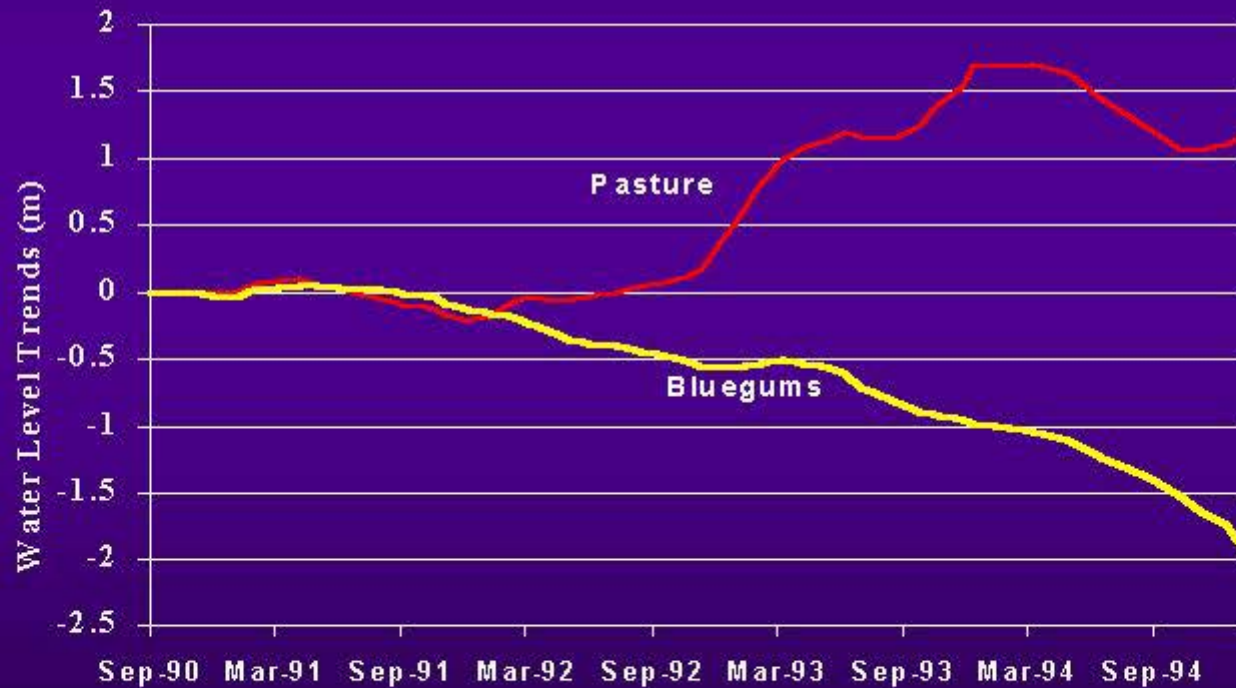
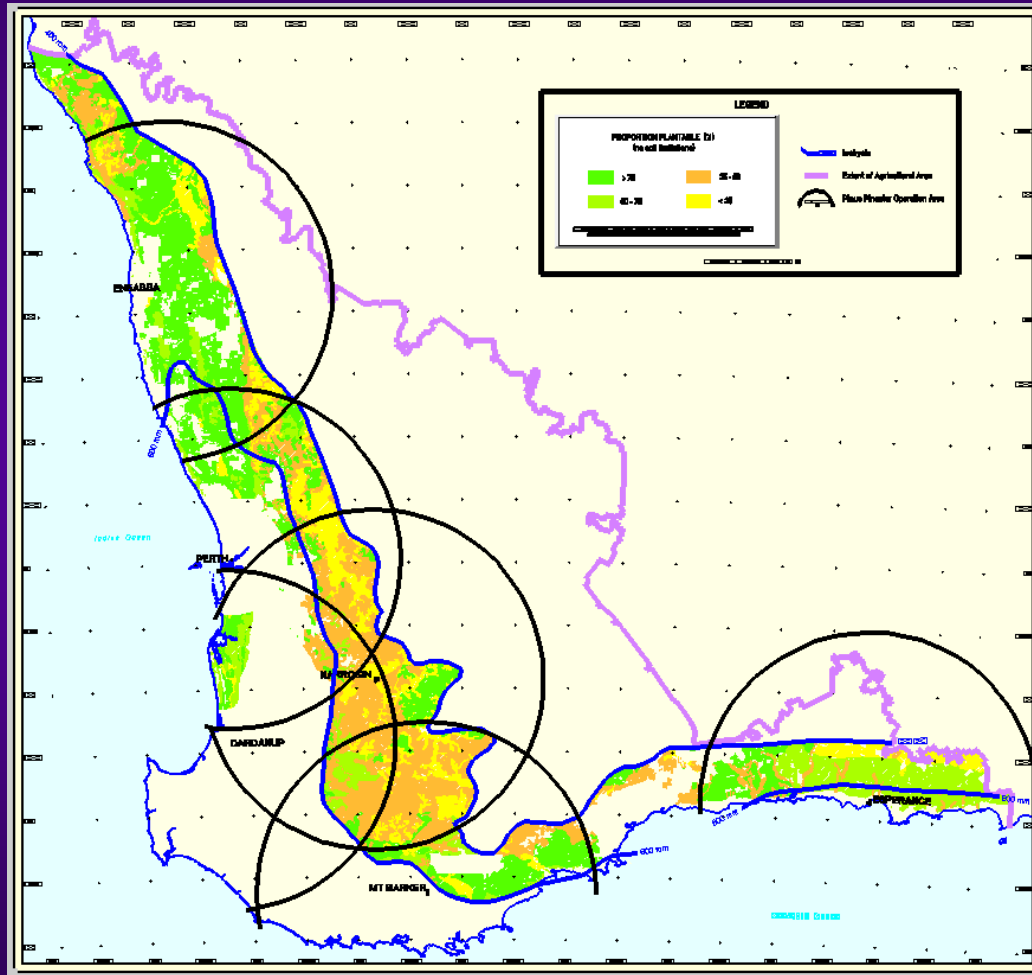


Figure 9

Land availability in the intermediate rainfall zone for maritime pine











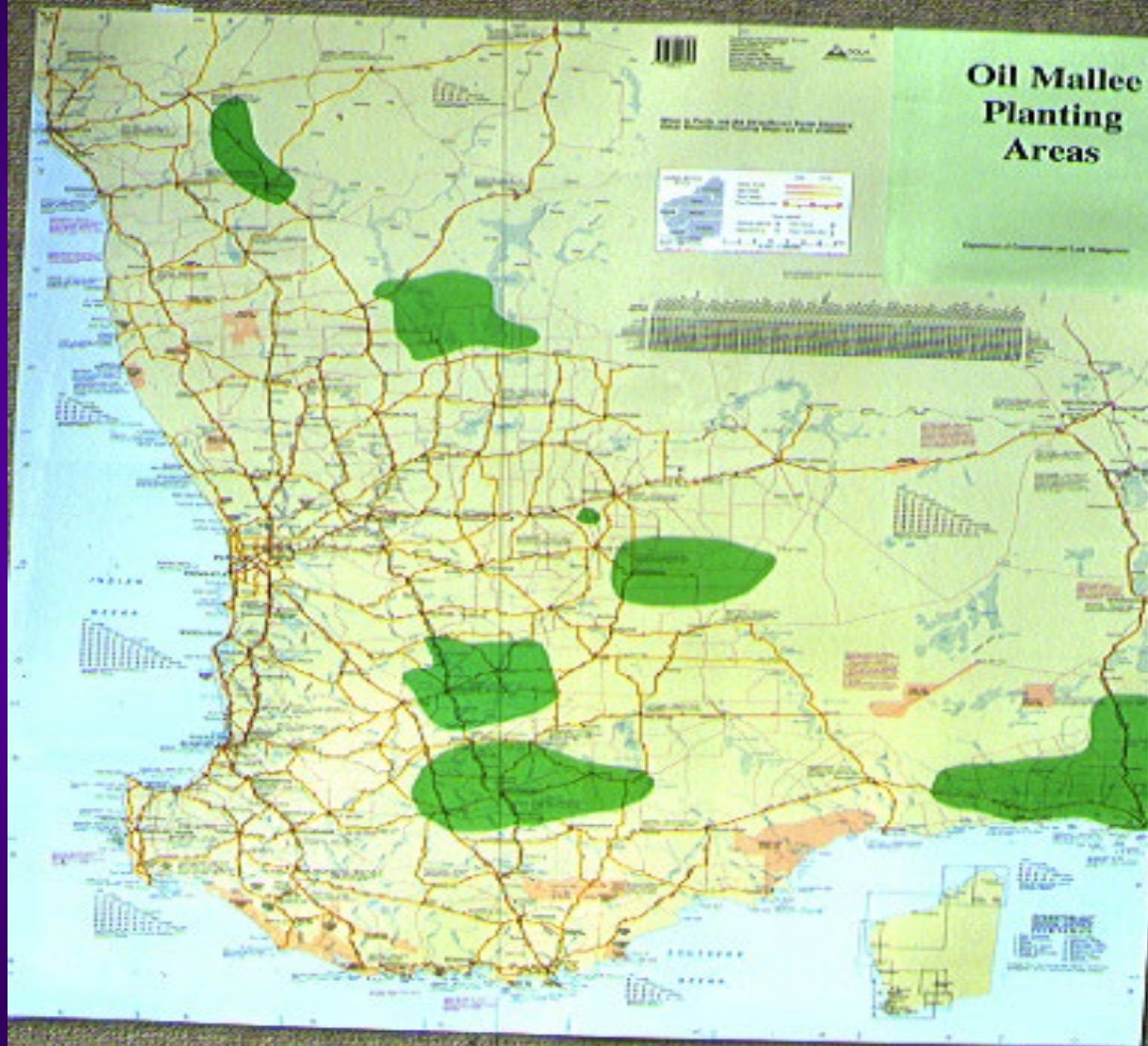
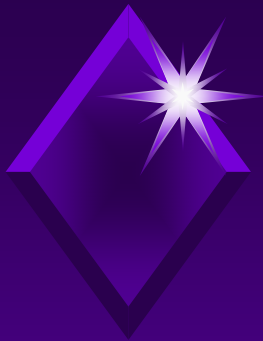






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ANGLUSTISSIMA
P.93

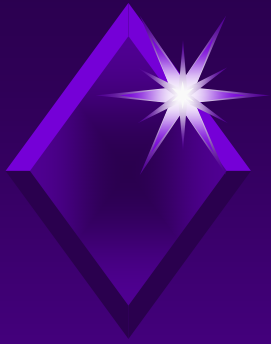




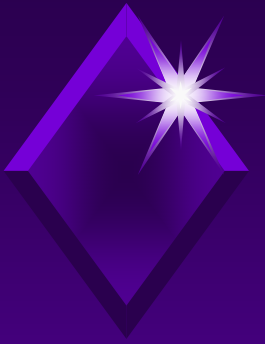
















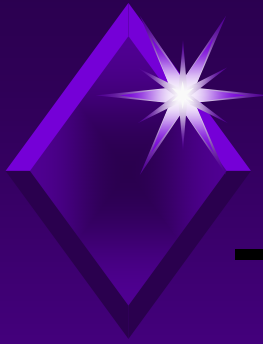




CALM SHAREFARMS

MARITIME PINE

DORMAN PLANTATION PLANTED 1996



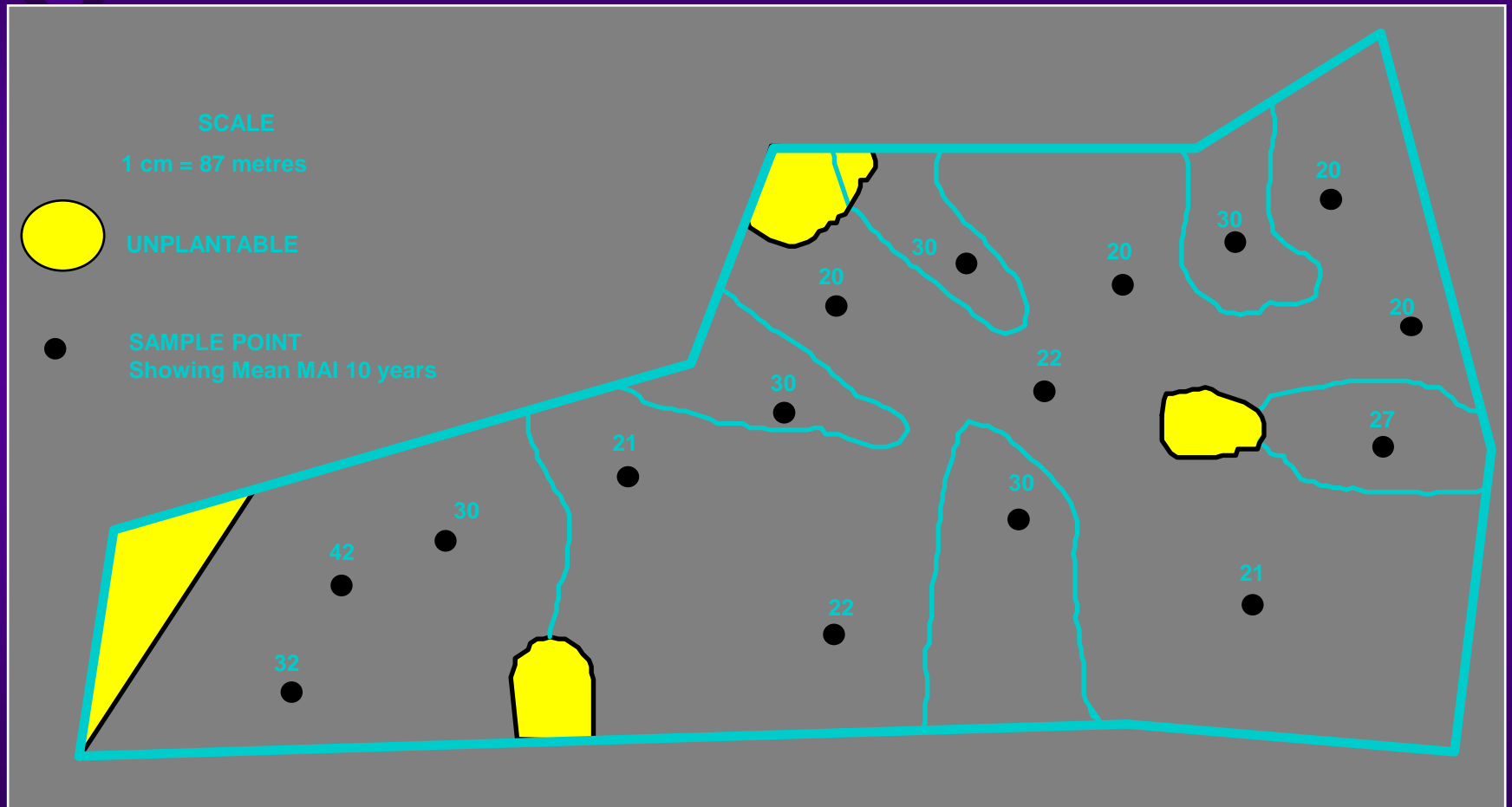
CALM has joint ventures with 1303 farmers



CALM has contracts with 84 land management contractors

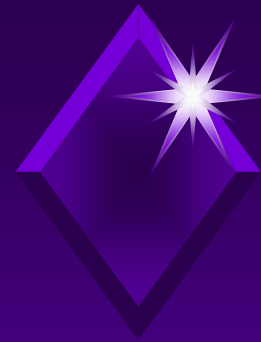


E. globulus site productivity assessment for a typical farm









Effect of site preparation on tree volume and survival of E. globulus after 9 months growth on a grey sand soil

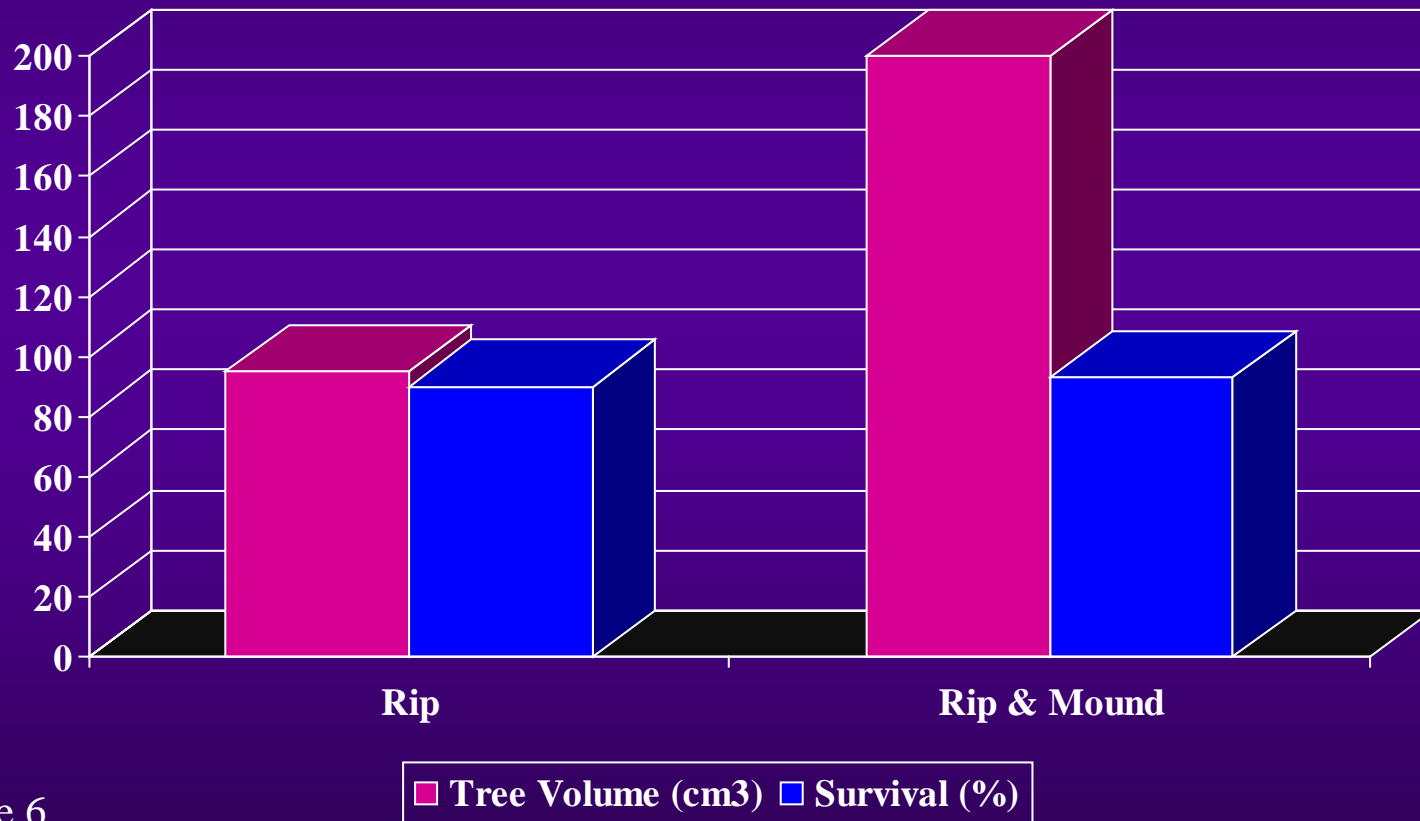
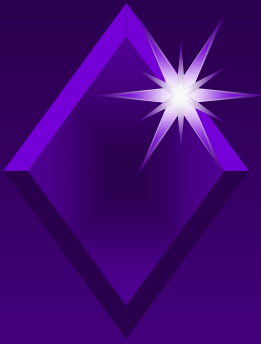


Figure 6



Basal area response to Nitrogen and Phosphorus over four years after fertilization

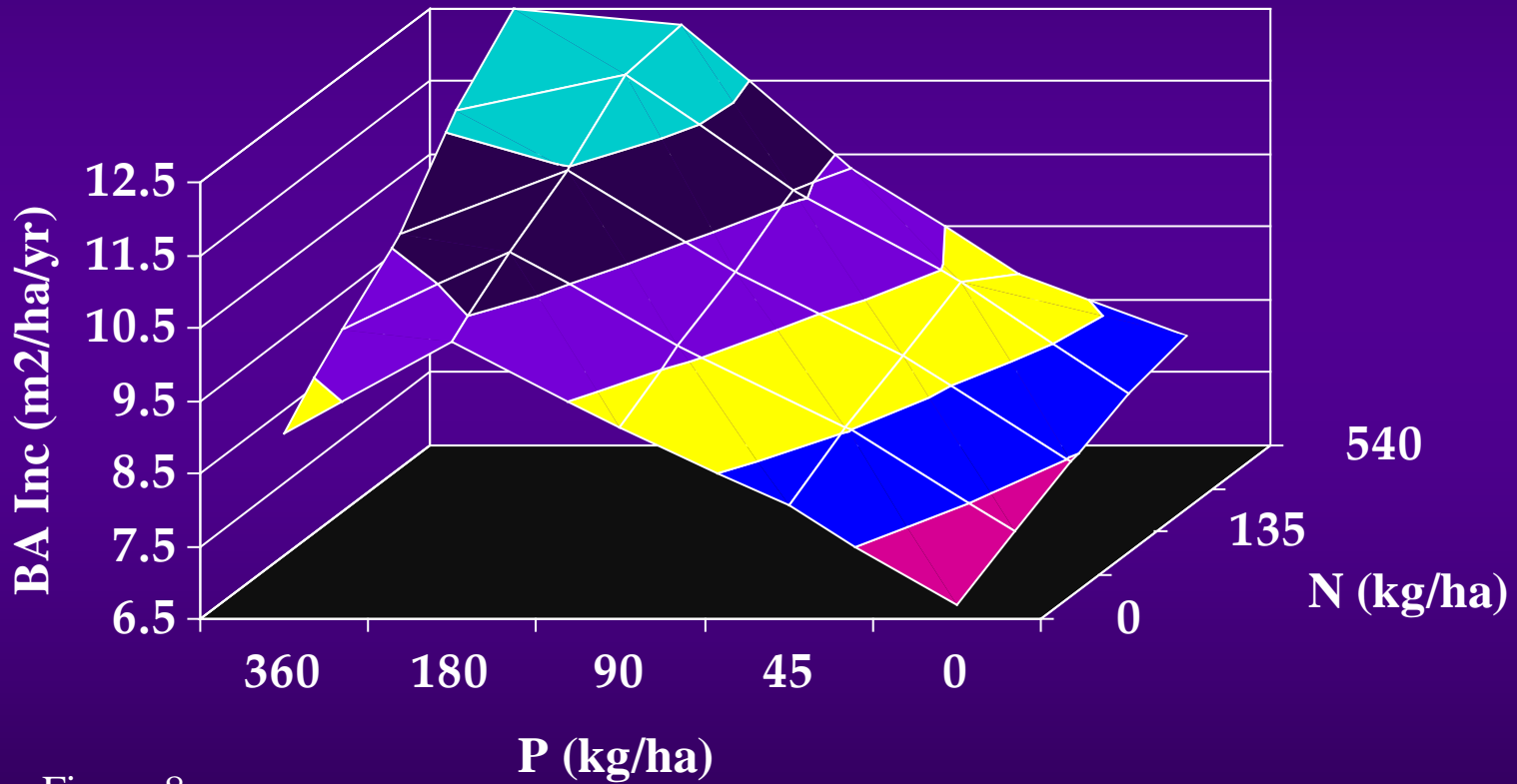
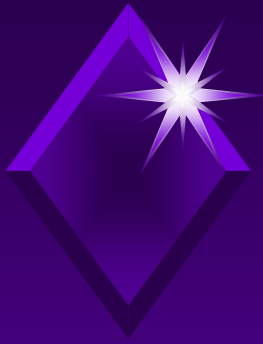


Figure 8





*Response to second year weed control of *E. globulus* on different soils*

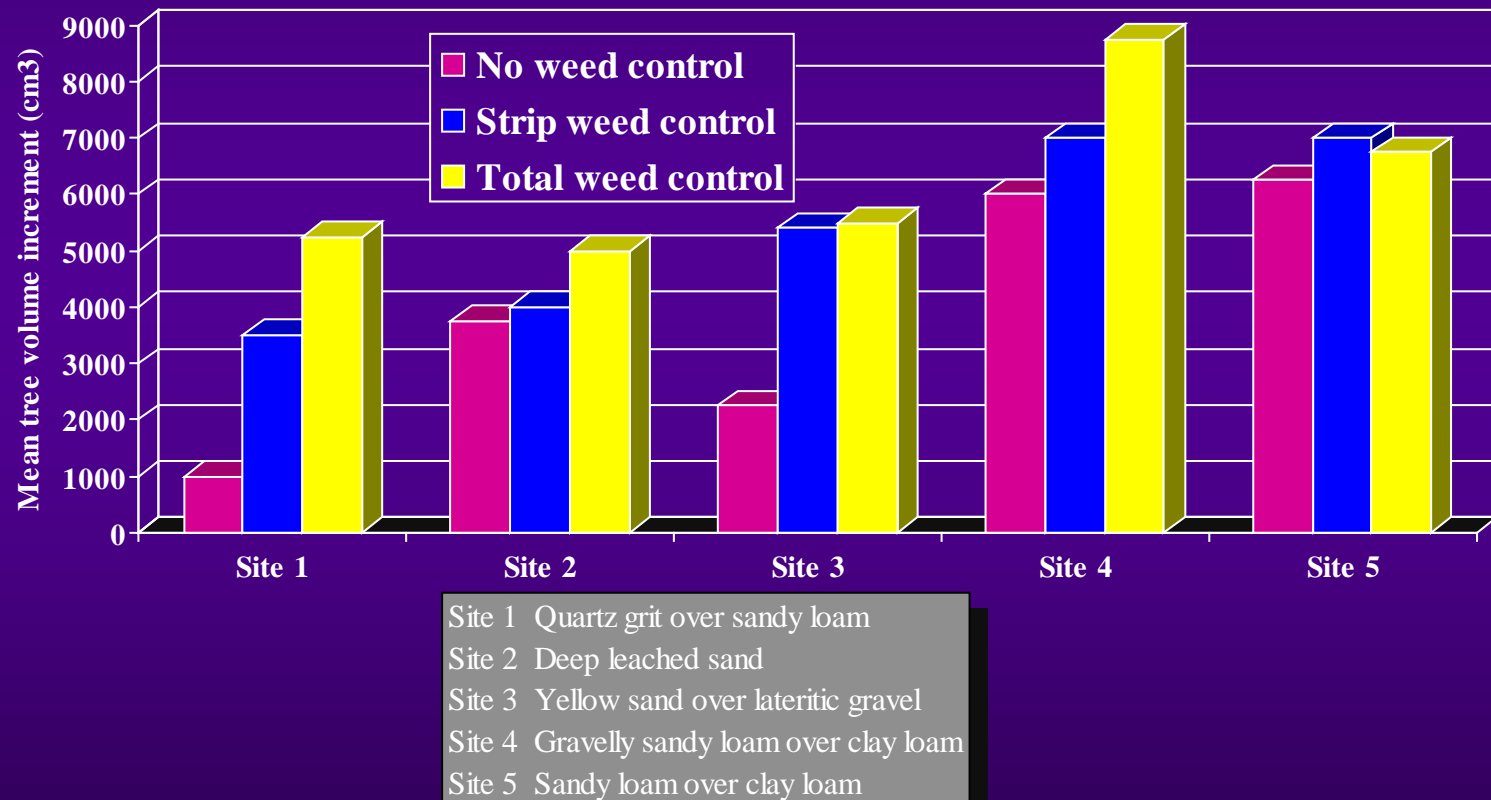


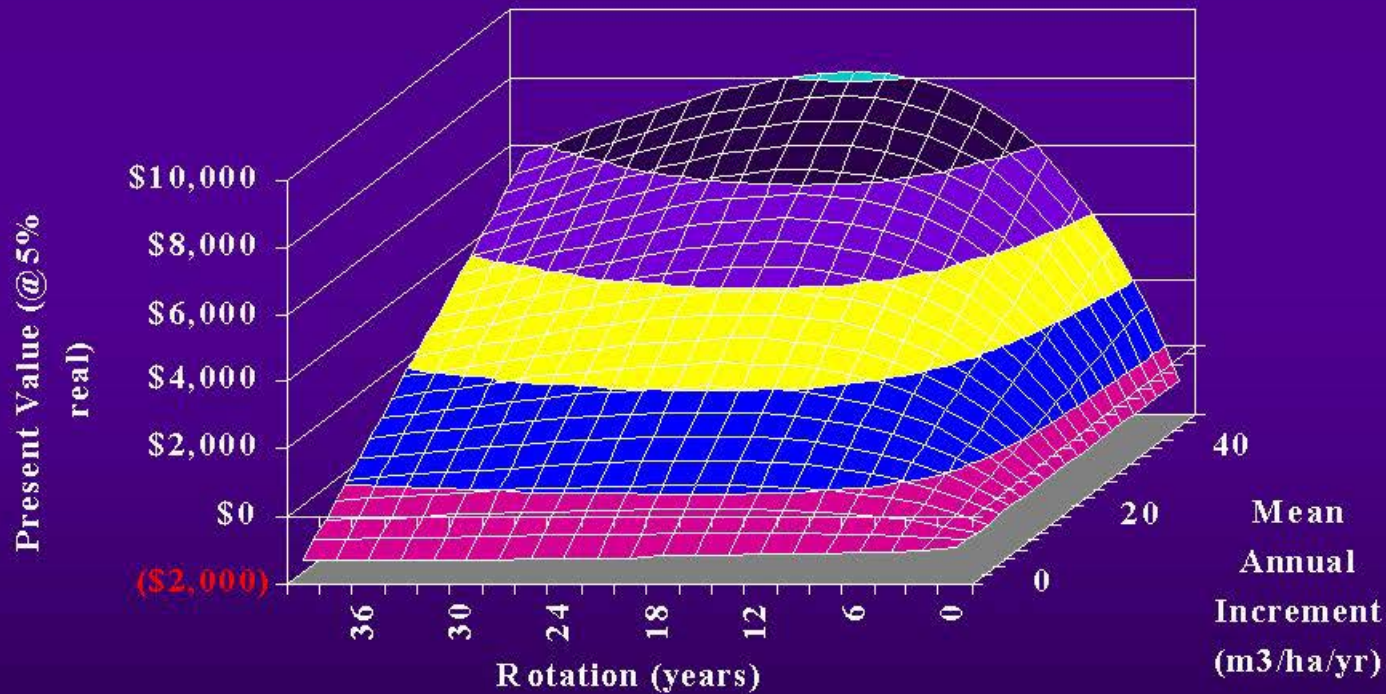
Figure 7



Plantation forest

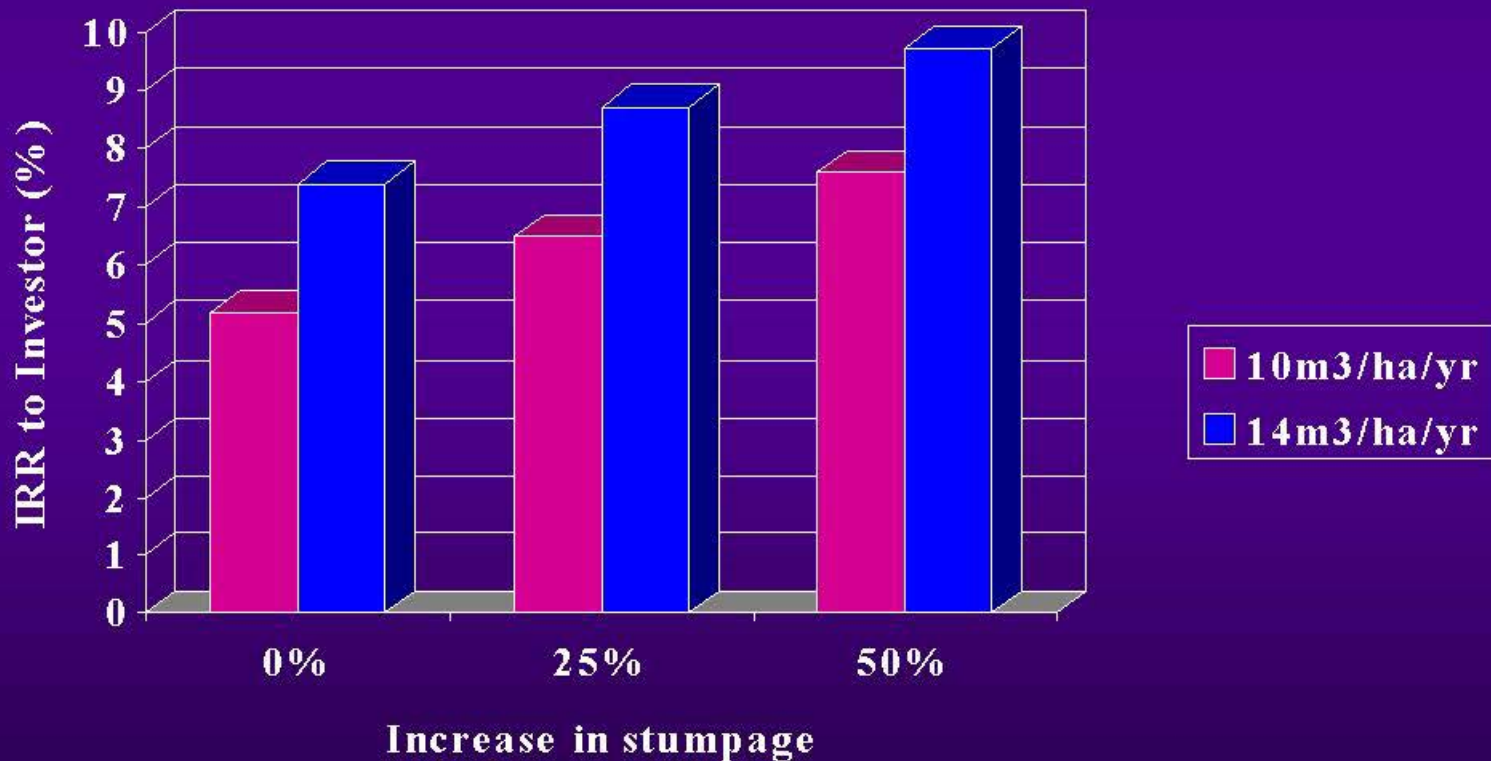
Timber production profitability

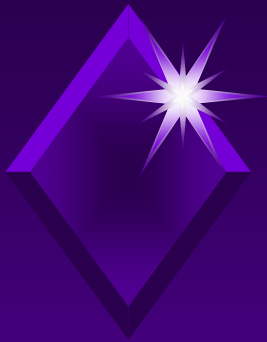
Rotation age vs productivity (MAI)



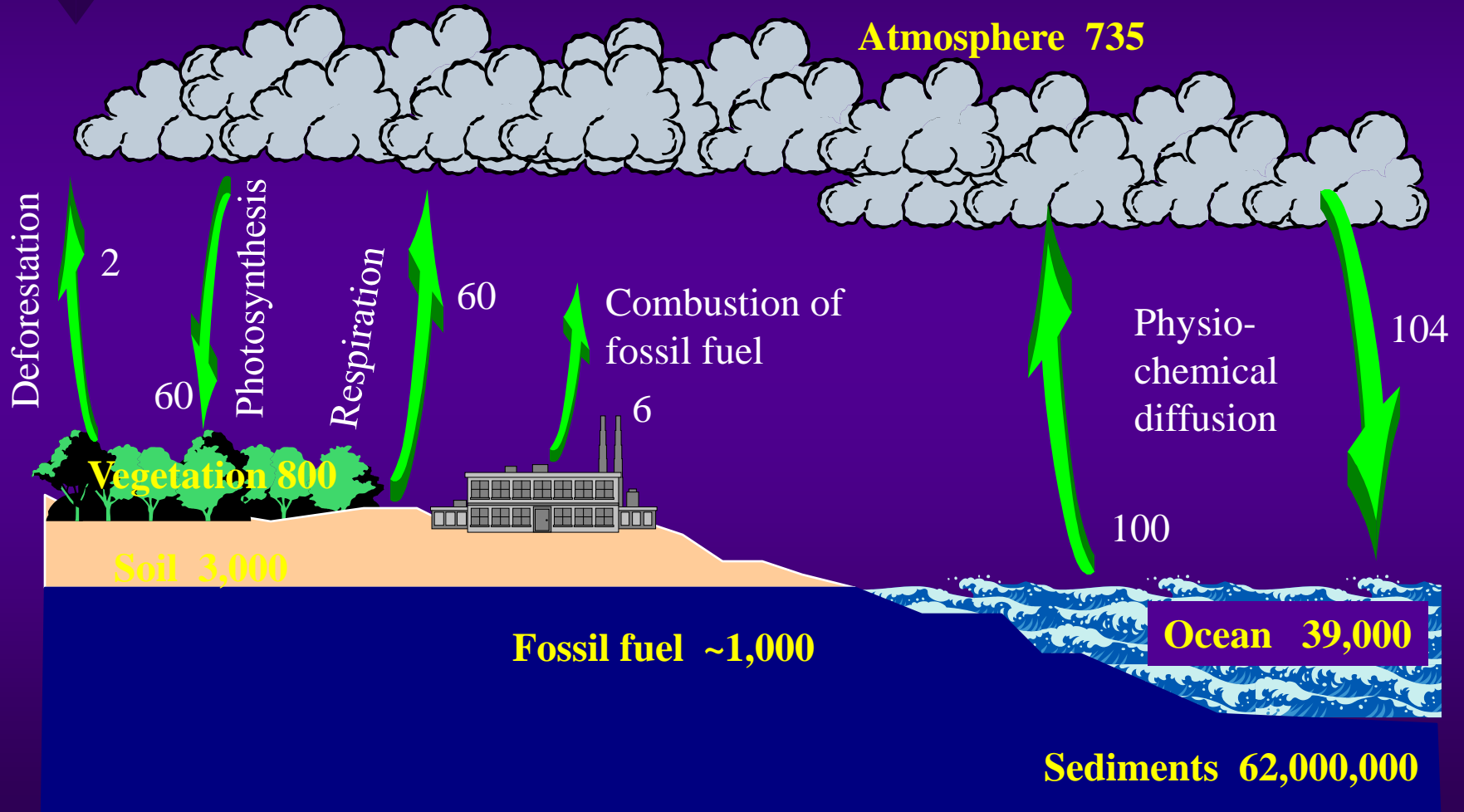


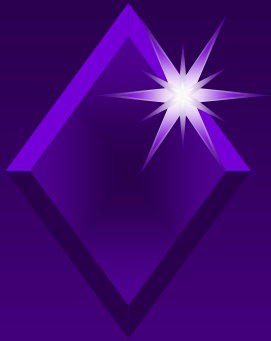
IRR to an investor for various growth rates and increases in stumpage under a 25 year rotation with one thinning





The carbon cycle





Extract from Kyoto Protocol - Article 2

Each Party included in Annex 1 in achieving its quantified emission limitation and reduction commitments under Article 3, in order to promote sustainable development, shall:

(a) Implement and/or further elaborate policies and measures in accordance with its national circumstances, such as:

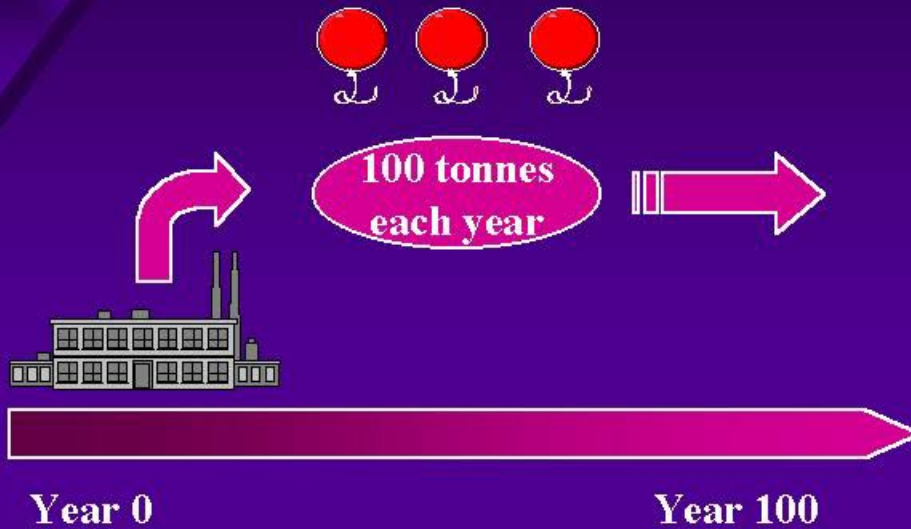
.....

(ii) Protection and enhancement of sinks and reservoirs of greenhouse gasestaking into accountpromotion of sustainable forest management practices, afforestation and reforestation.



"Tonne-year" currency

Balance sheet of 1 year of emissions and storage



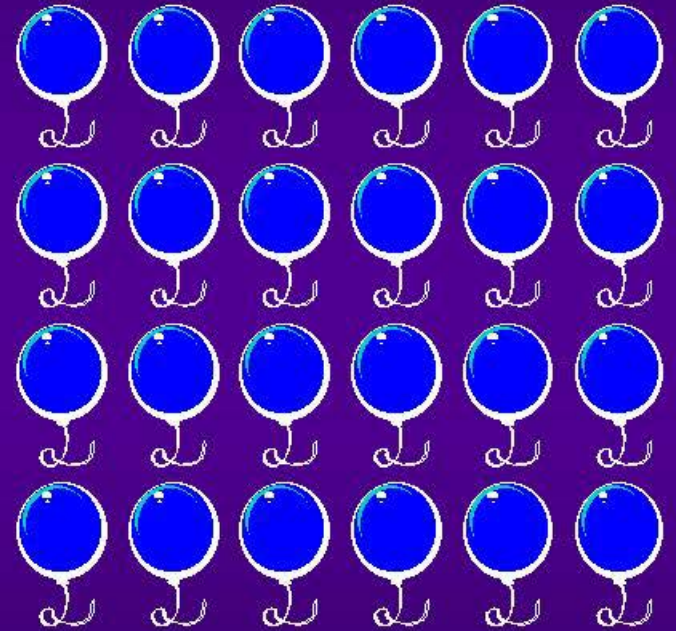
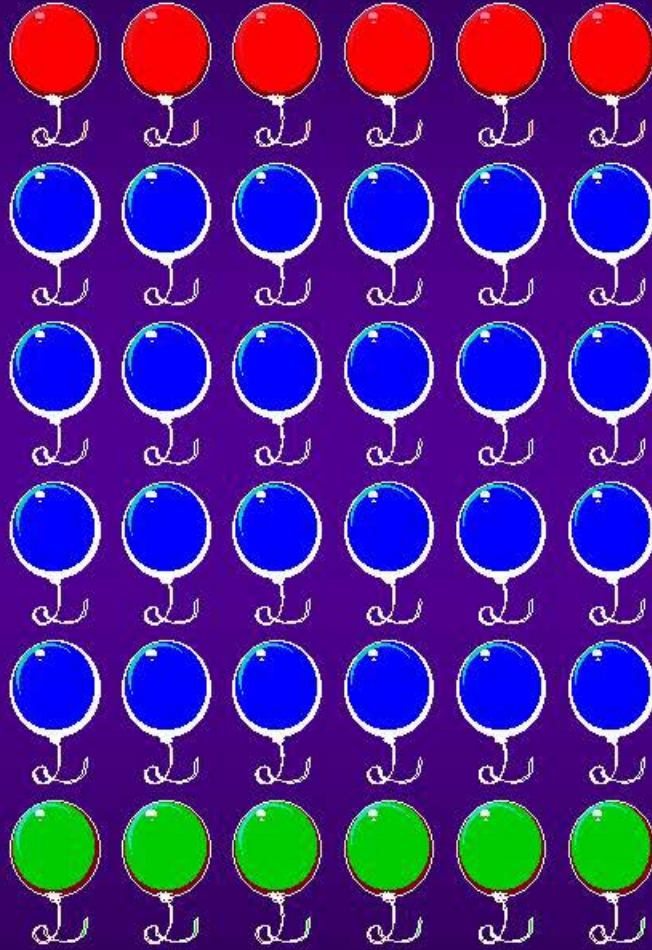
$$\Rightarrow 100 \times 100$$

$$= 10\,000 \text{ tonne years}$$



$$\Rightarrow 290 \times 35$$

$$= 10\,000 \text{ tonne years}$$



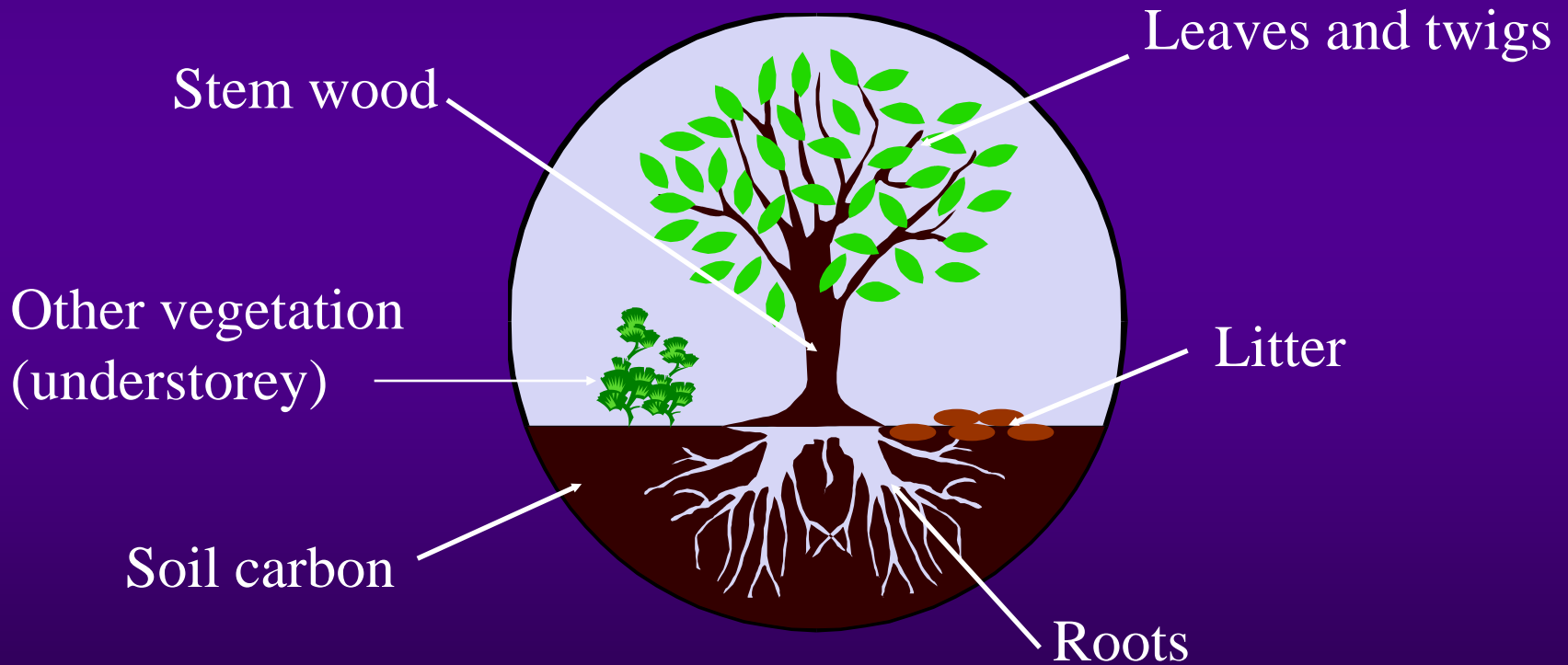
1997



2097

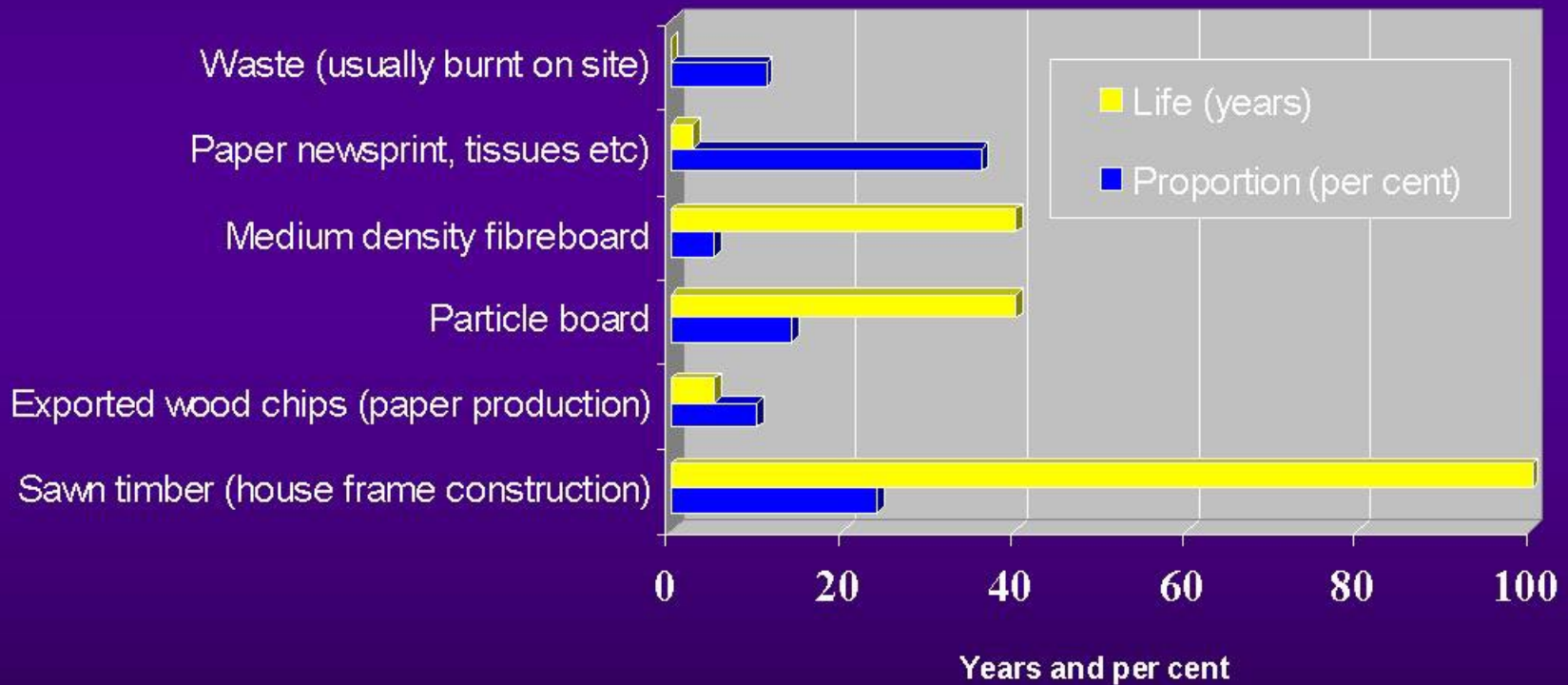


Major pools of forest carbon





Estimate of typical proportions and lifetimes of merchantable pine wood used for different products

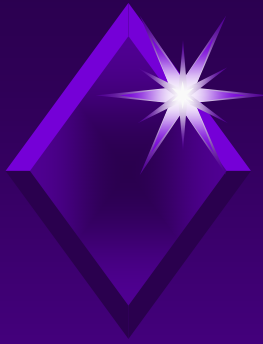






Energy required to produce one tonne of each product and tonnes of CO₂ emitted during production

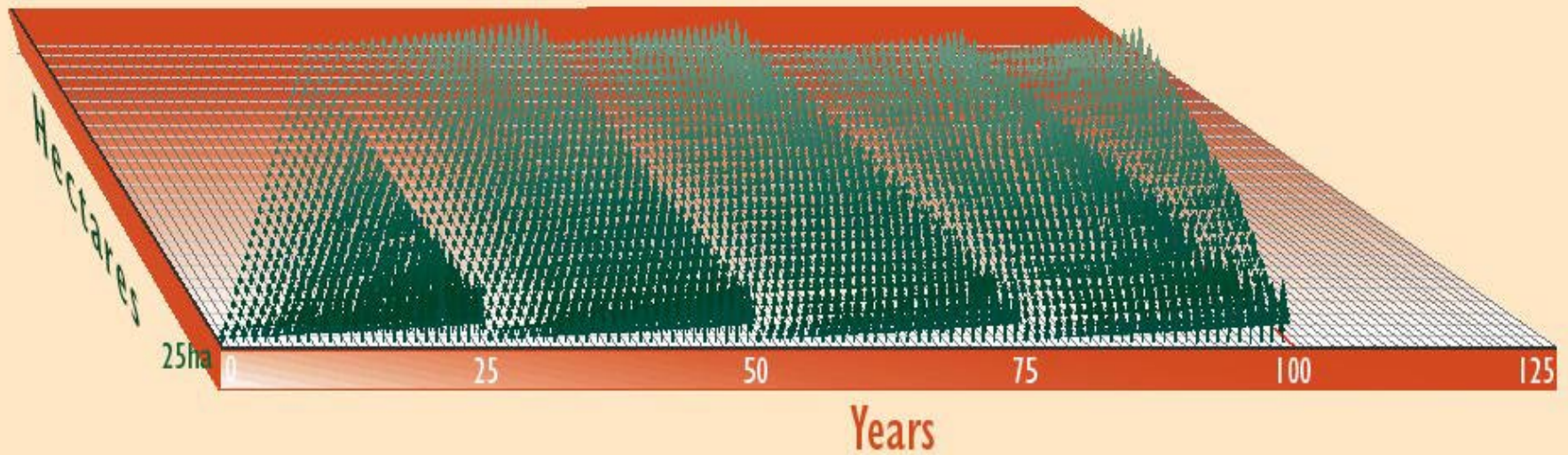
	Energy (KWH equivalent)	CO ₂ produced (tonnes)
Aluminium	15 000	25.0
Iron	3 000	2.5
Cement	2 000	0.3
Bricks	700	0.1
Timber	300	-0.2

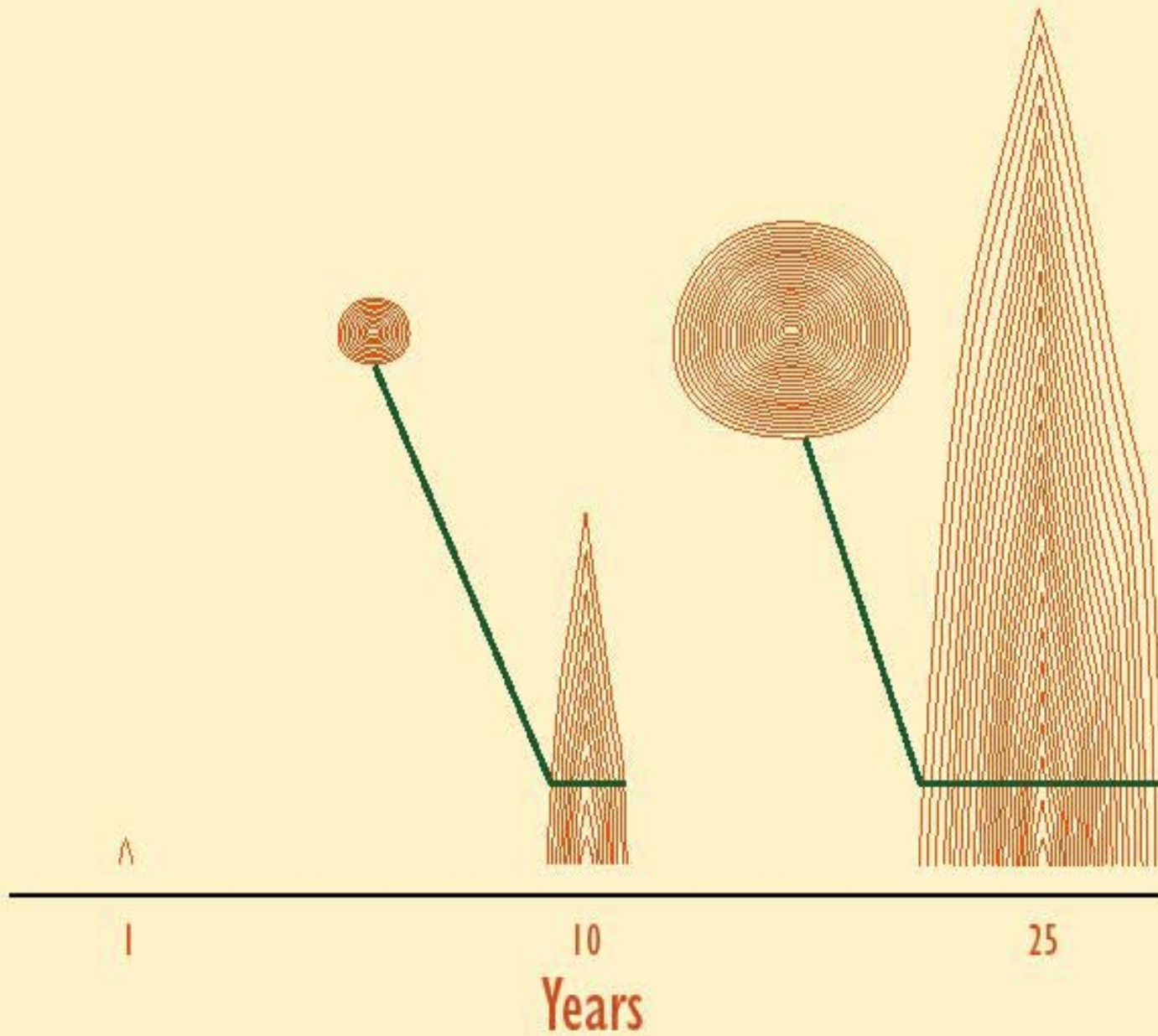


Estimated tonnes and Carbon tonne years produced per hectare per year

	Carbon Tonnes per year	Average Carbon storage time (years)	Tonne years
Maritime pine	10	40	400
Bluegum	20	7.5	150
Mallee Stems	1	5	5
Roots	1	100	100
Biodiversity planting	2	50	100

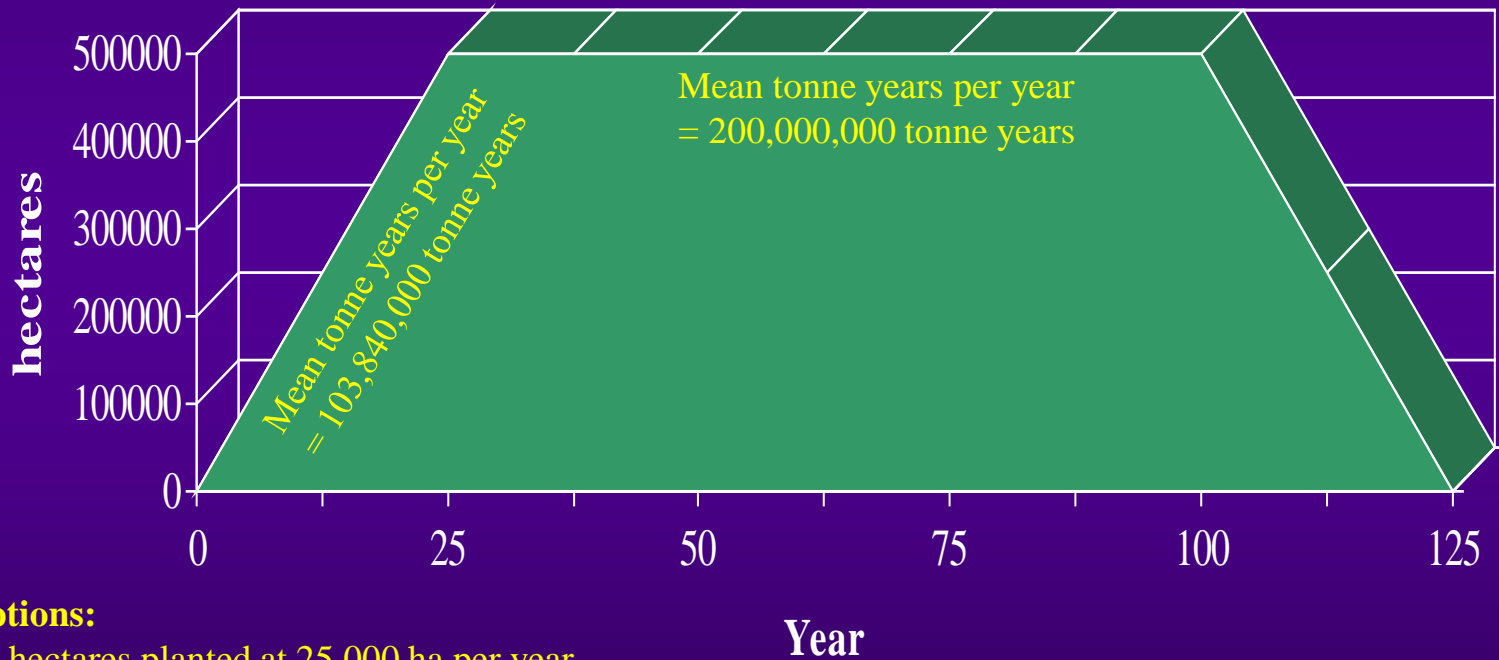
Model Forest — 4 Rotations of 25 years







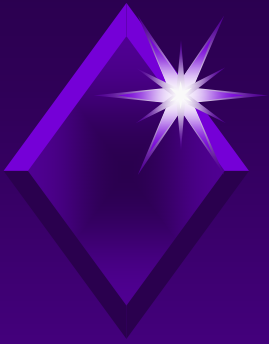
Maritime pine



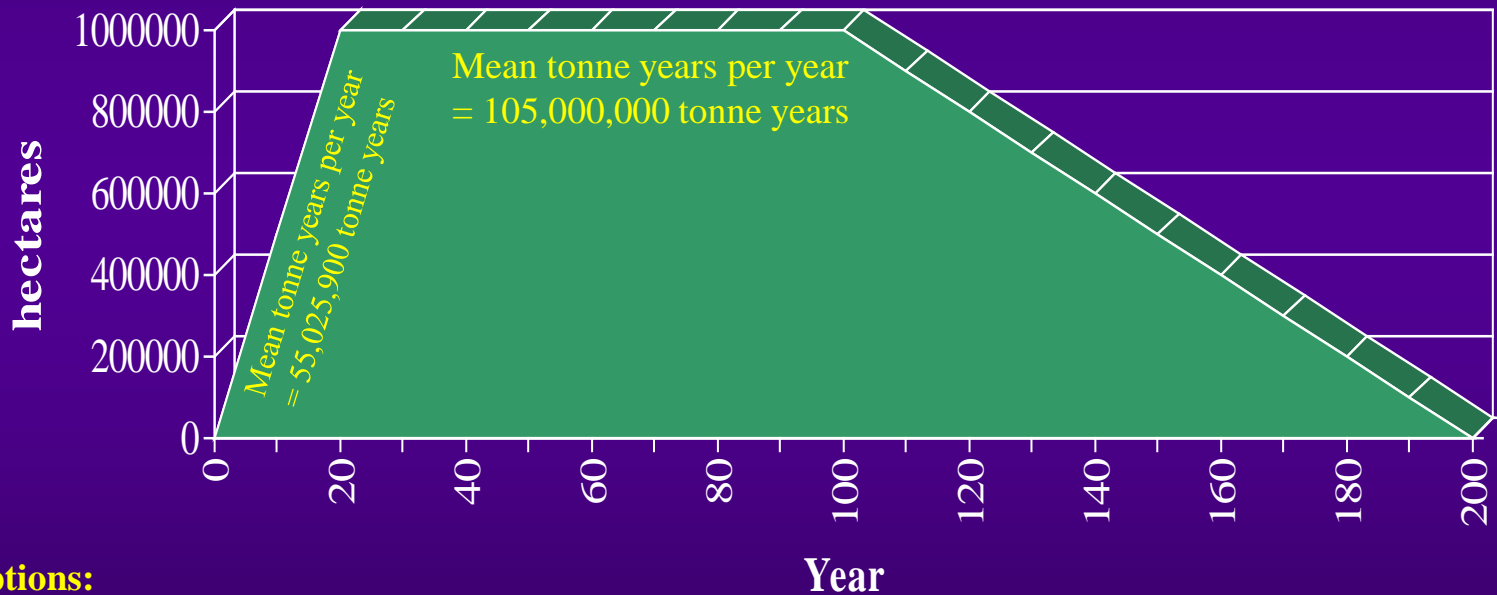
Assumptions:

- 500,000 hectares planted at 25,000 ha per year
- Carbon production 10 tonnes per year per hectare
- Rotation 25 years
- Assume 4 rotations
- Average Carbon storage time 40 years

Mean
~ 150 million tonne years per year



Mallee Eucalypts



Assumptions:

1,000,000 hectares planted at 50,000 ha per year

Carbon production 2 tonnes

Rotation 100 years

Carbon storage times

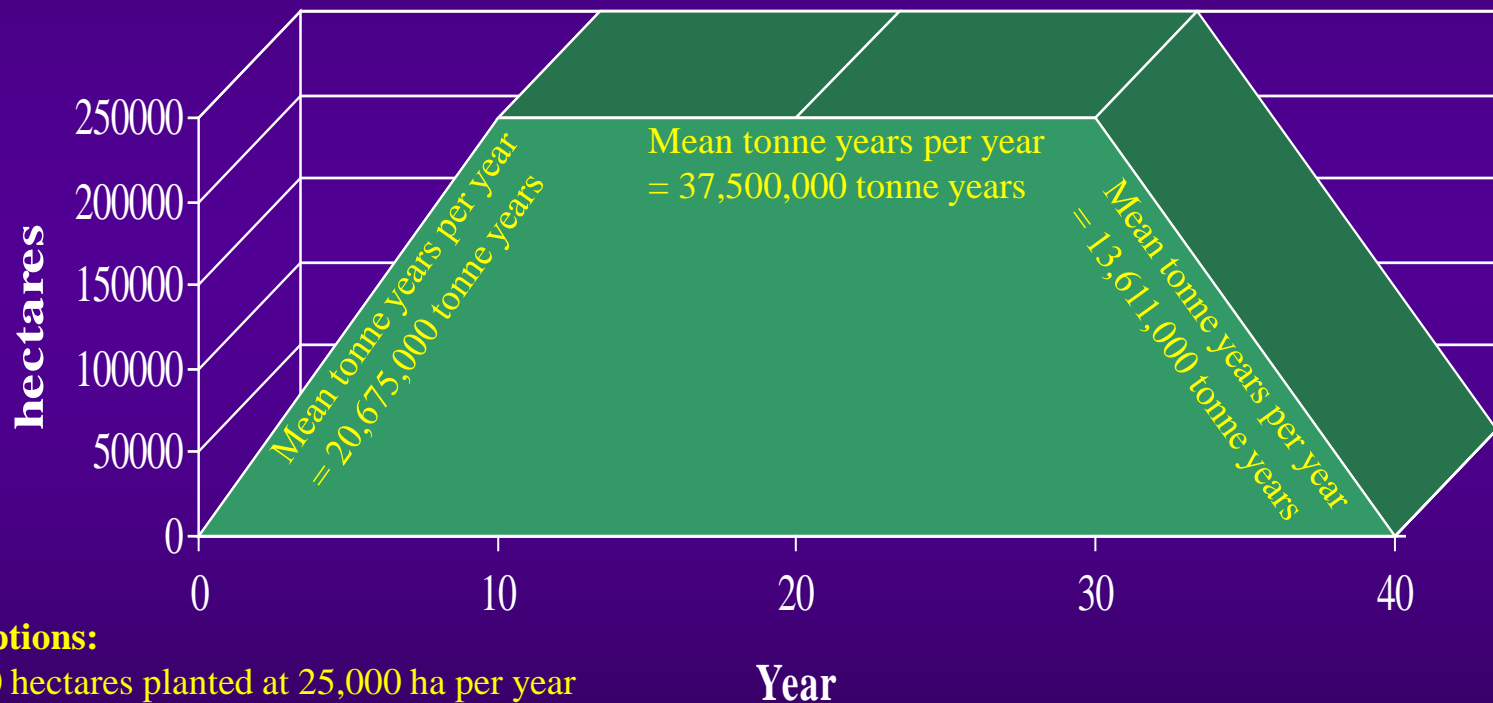
- 100 years for roots

- 5 years for tops

Mean over 100 years
~ 95 million tonne years per year



Tasmanian bluegums



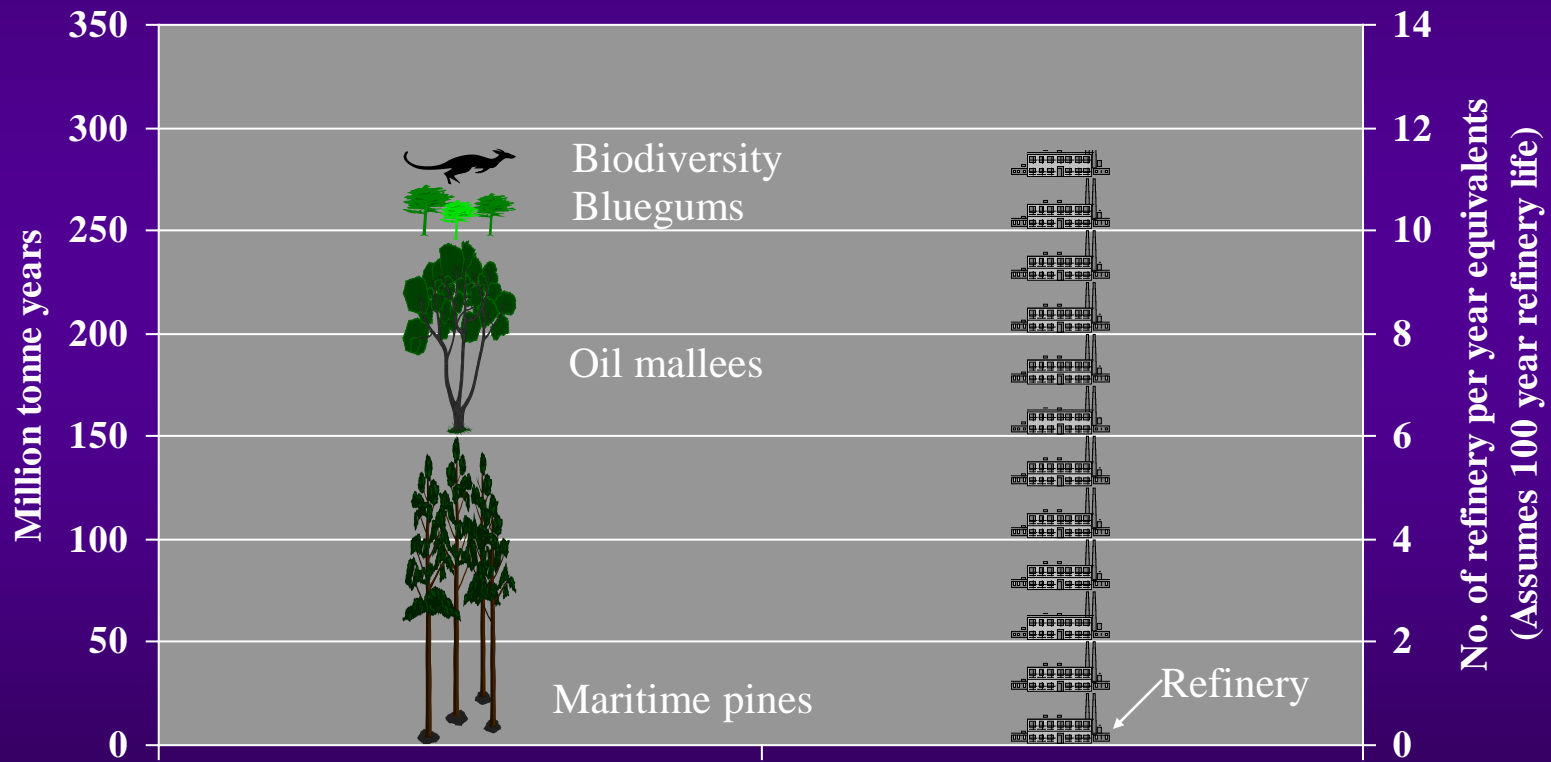
Assumptions:

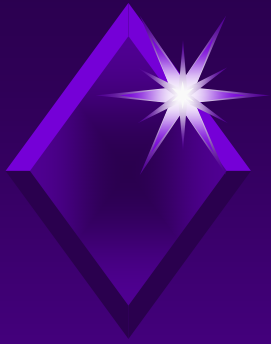
- 250,000 hectares planted at 25,000 ha per year
- Carbon production 20 tonnes per year per hectare
- Rotation 10 years
- Assume 3 rotations
- Average Carbon storage time 7.5 years

Mean
~ 27 million tonne years per year

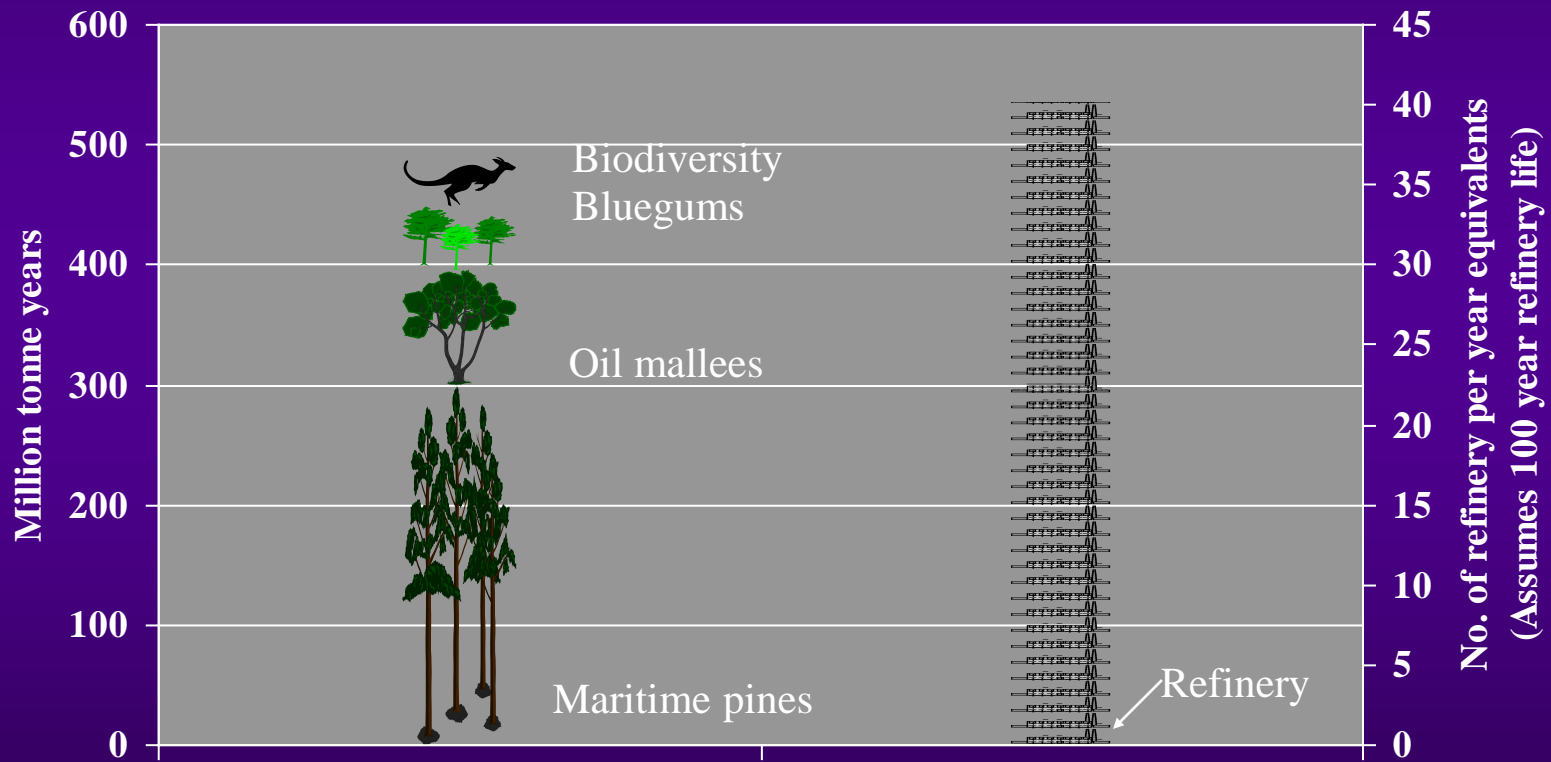


Conservative scenario





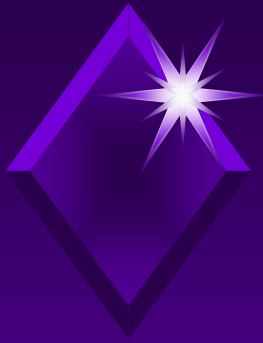
Optimistic scenario



Assumptions

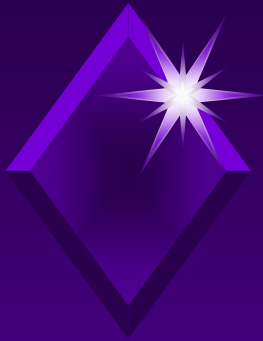
Half life of refinery,

double carbon storage times for pine, bluegum and biodiversity plantings



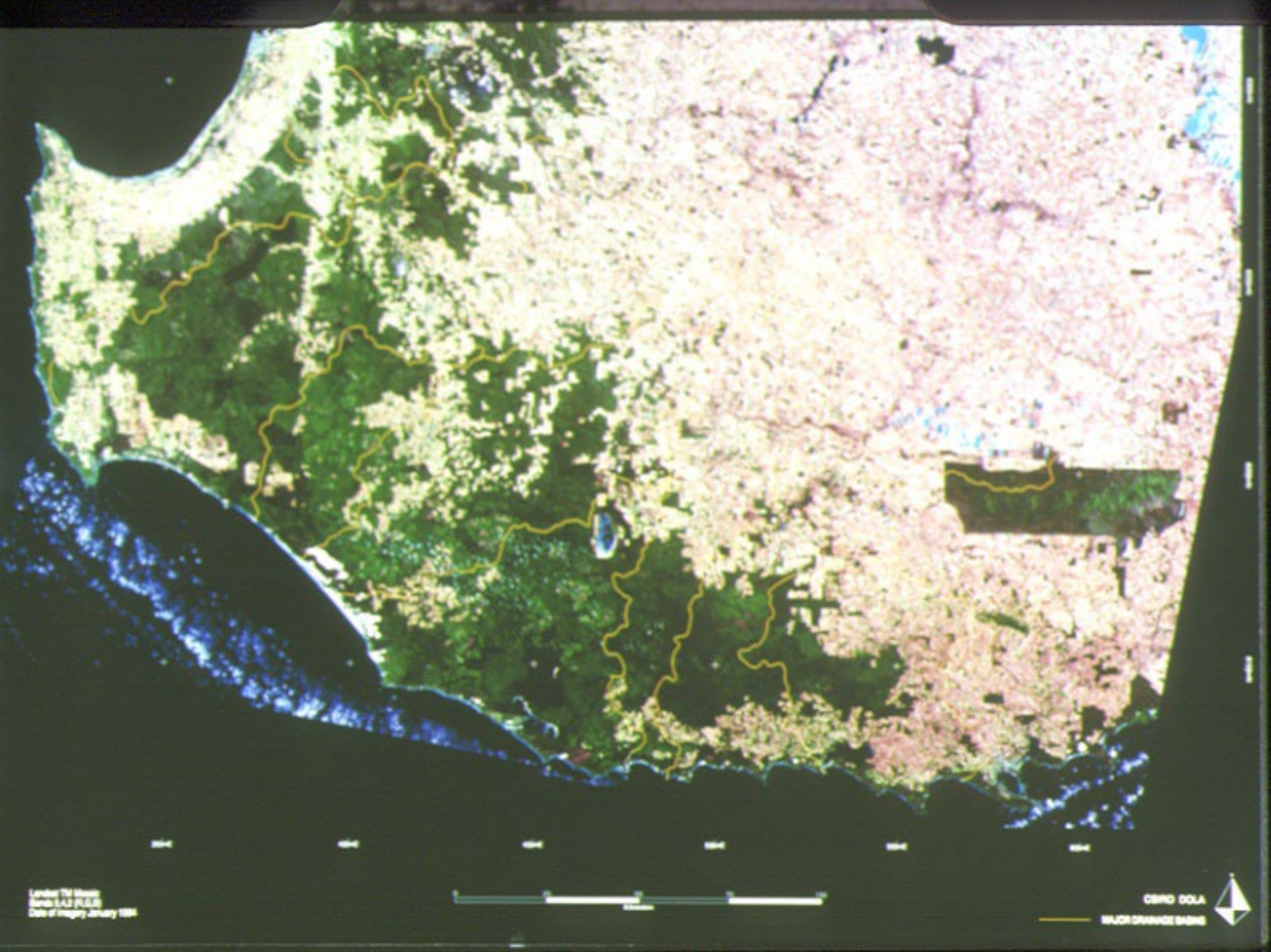
Factors determining the effectiveness of tree establishment as a method of compensating for CO₂ emissions

- Cost
- Land availability, on the scale required, which has climate, soils suitable for maximum production of carbon tonne years
- Efficiency of planting and maintenance
- Productivity of tree crops
- Survival of seedlings and trees - eg. fire risk, pests, etc.
- Credibility of carbon accounting process, eg. inventory system
- The potential to integrate tree planting for carbon sequestration with other benefits, eg. reducing land degradation, increasing biodiversity
- The potential to offset the cost of tree planting by the commercial returns from wood products while at the same time maximising carbon tonne year accumulation
- Politics
 - a political environment which is secure for long time periods
 - farmer and local government support
 - integration with the community and other industries based on the land
- Speed



Assume that refinery each year emits 270,000 tonnes of Carbon

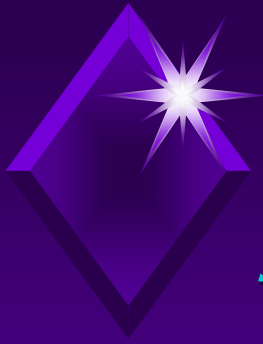
- Each year, must absorb 270,000 tonnes for 100 years - ie.
27,000,000 tonne years
- 50,000 hectares of Maritime Pine absorbs (assume productivity
12.5 t Carbon, Carbon life 44 years) 27,500,000 tonne years
- Over 50 years BP emits
 $270,000 \times 100 \times 50 = 1,375,000,000$ tonne years
- Over 50 years (2 x 25 year rotations) 50,000 hectares of Maritime
pine absorbs
 $50,000 \times 12.5 \times 44 \times 50 = 1,375,000$ tonne years



Los Angeles Basin
Scale 1:12,500,000
Date of Imagery January 1994



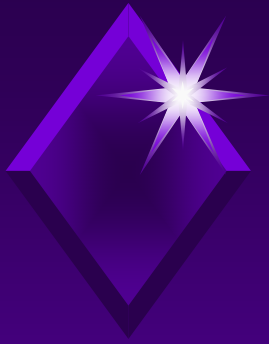
CSIRO DOLA
MAJOR DRAINAGE BASINS



Estimated carbon content for major farm forestry zones/types at full rotation age

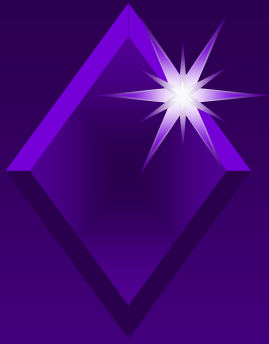
Rainfall zone	Type	Rotation length	Biomass (dry tonnes/ha)				Total carbon	Average long term carbon
			Wood	Leaf	Roots	Total		
> 600 mm	Pine	25 years	150	90	60	300	150	75
	Bluegum	10 years	100	60		160	80	40
	- roots	30 years			72	72	36	18
	General revegetan	Perpetual	180	108	72	360	180	180
400-600 mm	Maritime pine	35 years	140	84	56	280	140	70
	General revegetatn	Perpetual	150	90	60	300	150	150
< 400	Oil mallee	2 years	2.5	2.5		5	2.5	1.3
	- roots	50 years			50	50	25	25
	General revegetatn	Perpetual	120	80	40	240	120	120

Notes: Total carbon is 50% total biomass
 Bluegum and oil mallee roots have different life length to above ground parts due to coppicing
 Average long term carbon = 50% of full rotation carbon for harvested crops



Land use by area in the South West of Western Australia

Land use	Area (million ha)	% area within the Agricultural region
Agricultural region	25.25	100.0
Area of private land	20.71	82.0
Area of cleared land	17.98	71.2
Private remnant vegetation	2.75	11.1
Public land	4.52	17.9



Farm forestry zones by area and rainfall

Farm forestry zone	Rainfall	Area (in million ha)
Traditional pine and new bluegum	>600 mm	2
New maritime pine	400 to 600 mm	6
Wheatbelt	<400 mm	10

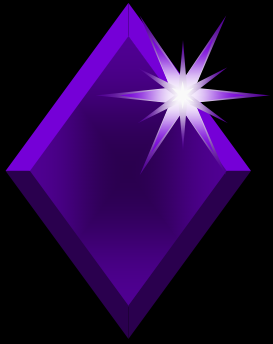


























SITE 4

WARRENS



1 2 3 4 5 6

