The economics of the industry: future drivers and barriers to the bioenergy and mallee industries

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Presentation to Oil Mallee Industry Conference

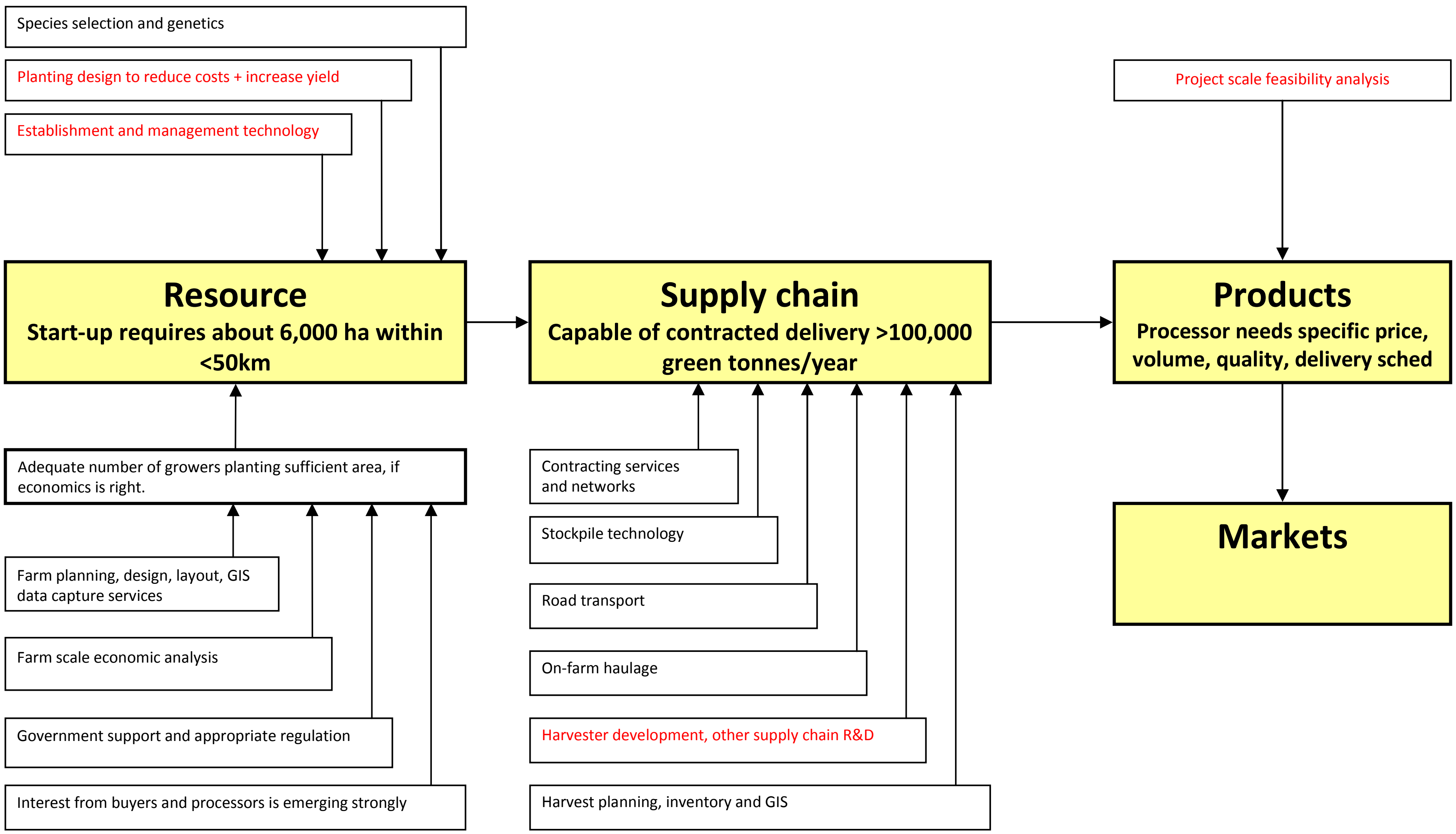
Friday 15 April 2011

South of Perth Yacht Club

Department of Environment and Conservation

FUTURE FARM INDUSTRIES CRC

Mallee industry development flow chart – drivers and barriers



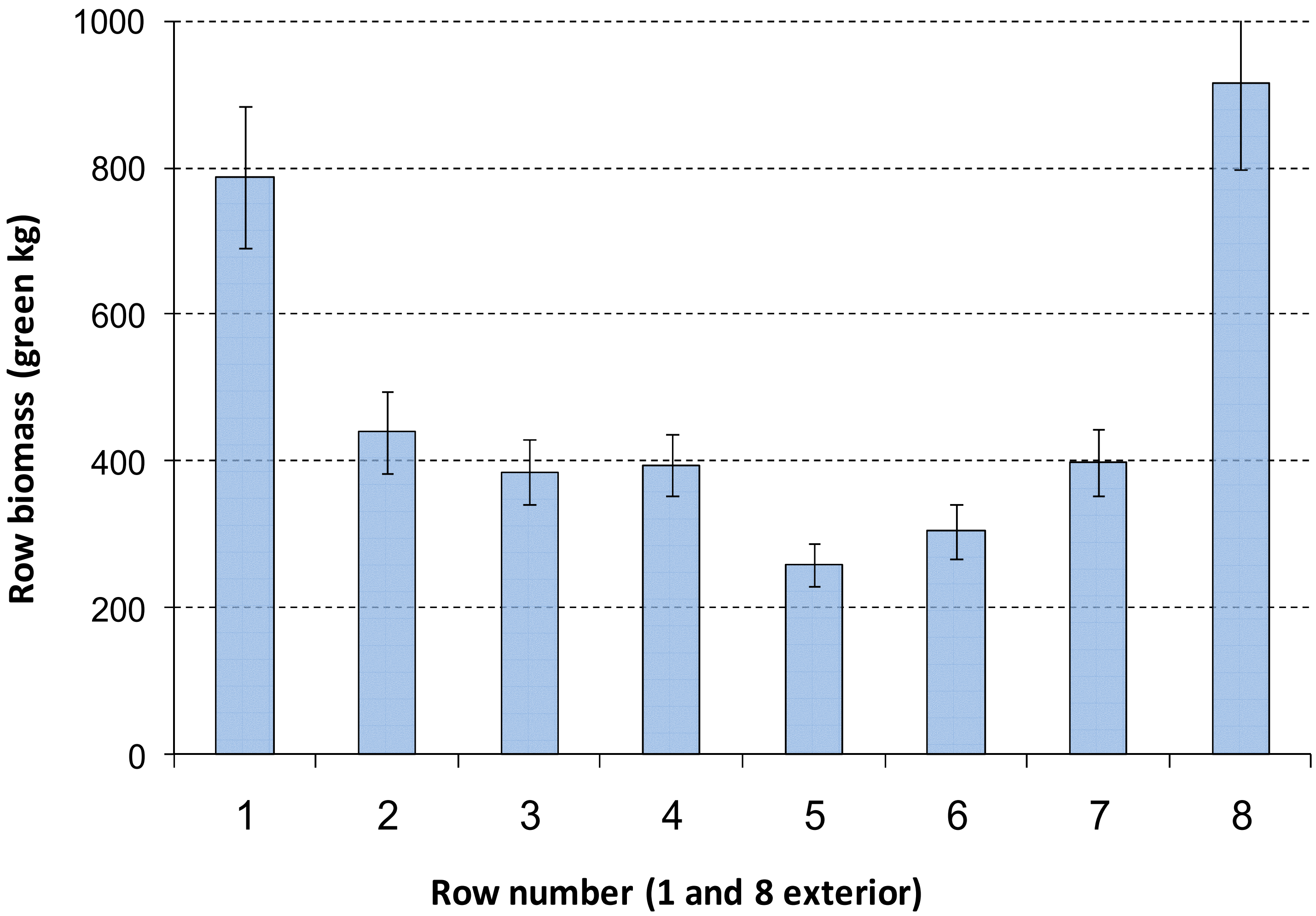
Major current biomass supply barriers/drivers

- **Understanding yield potential and related costs (especially the competition zone) and management options**
- Harvester and hard supply chain links
- **Biomass supply costs for input to project scale commercial feasibility assessment**

Major factors affecting mallee yield and competition impact

- Available water is the primary limit on yield. Requires narrow belts (or small blocks) on ~10% of the farm designed to capture surplus water.
- Long narrow belts also require careful planning and design for integration into the farm and to achieve low cost harvest
- Narrow belts impose a high level of competition on adjacent crops and pastures but regular short-cycle harvest will minimise this but at some cost to yield

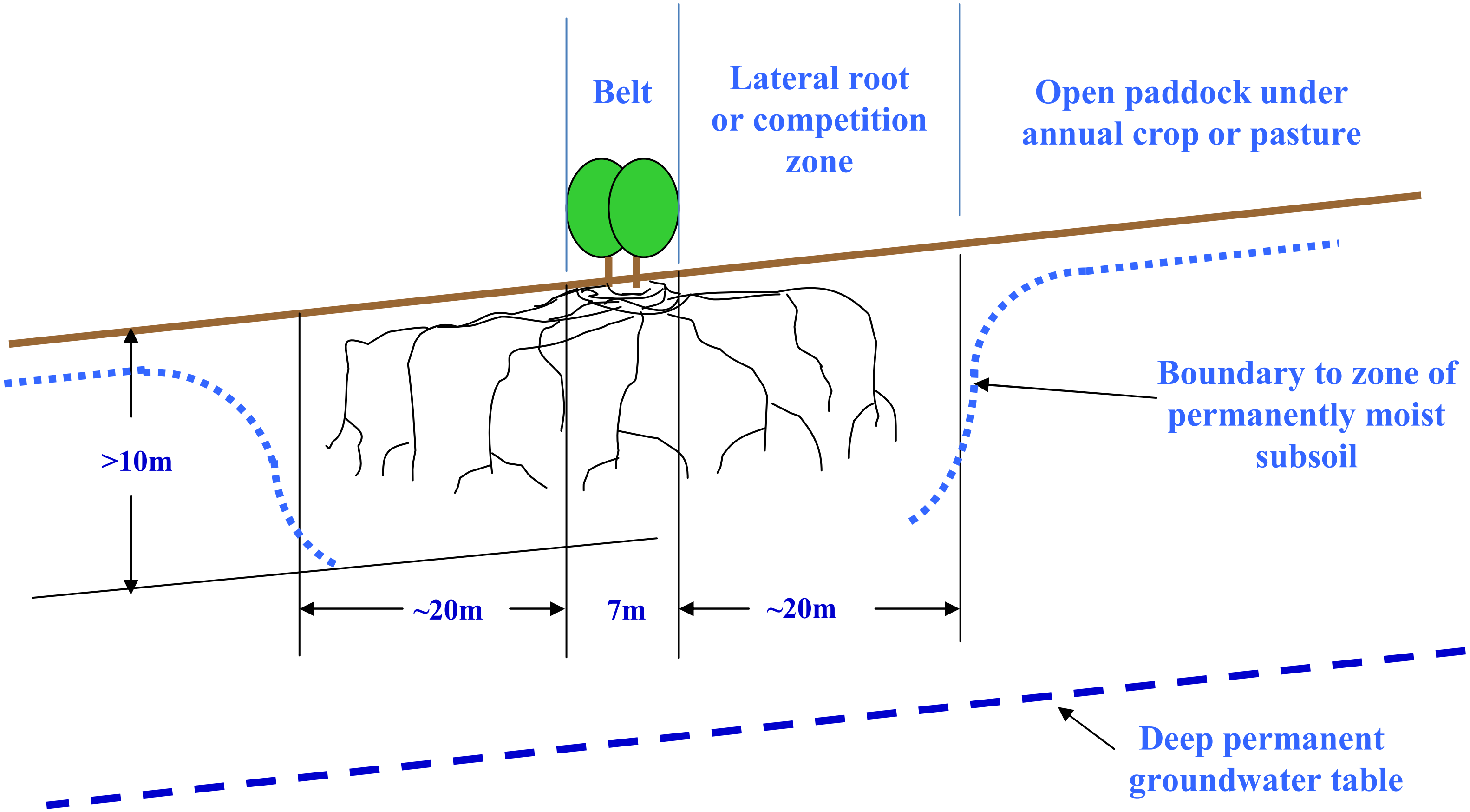
Yield variation across 8 row mallee belts near Esperance




Harvestable size mallees with about 40
tonnes/km in the outside rows, but only 20
t/km in the inside rows.

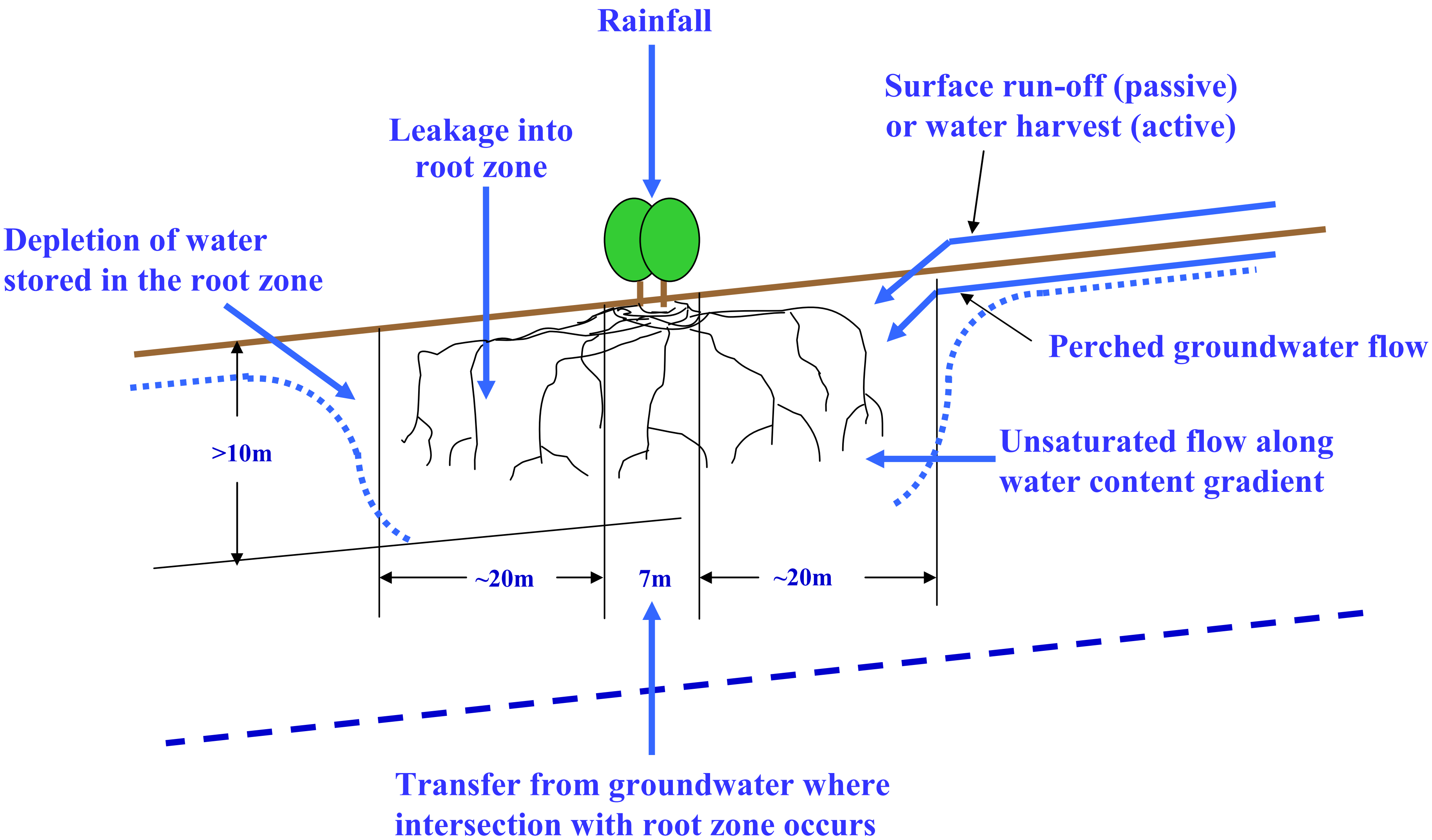

Harvest impact on
competition zone

Soil water depletion by mallee belts



Water storage depletion within root zone ~1,000mm
(Robinson et al 2006, Sudmeyer and Goodreid 2007)

Seven potential sources of water for mallee belts



Harvest regime experiments -sites

Site Number	Species	Planting Year	Belt Configuration	Nearest Major Town	Annual Rainfall	Evaporation	Lat	Long
1	E. polybractea	1996	2 row	Narrogin	466	1653	-32.9	117.3
2	E. loxophleba lissophloia	1997	2 row	Narrogin	385	1630	-33.0	117.5
3	E. loxophleba lissophloia	2000	3 row	Wickepin	376	~1630	-32.9	117.6
4	E. polybractea	1995	4 row	Narrogin	337	1833	-32.7	117.3
5	E. loxophleba lissophloia	1998	4 row	Wubin	294	2342	-30.0	116.5
6	E. loxophleba lissophloia	1999	3 row	Kalannie	294	2342	-30.3	117.4
7	E. loxophleba lissophloia	?	2 row	Kalannie	321	2279	-30.5	117.1
8	E. polybractea	1998	4 row, on bank	Wickepin	386	1616	-33.0	117.7
9	E. loxophleba lissophloia	1999	2 row	Wagin	447	1514	-33.5	117.0
10	E. loxophleba lissophloia	1997	2 row	Wickepin	347	1666	-32.8	117.8
11	E. plennissima	1999	2 row	Koorda	313	2261	-30.8	117.6
12	E. loxophleba lissophloia	2000	6 row	Katanning	377	1579	-33.5	117.8
13	E. loxophleba lissophloia	1997	2 row	Kulin	337	1832	-32.7	118.2
14	E. loxophleba lissophloia	?	4 row	Wongan Hills	315	2239	-31.0	116.9
15	E. plennissima	1998	2 row	Kalannie	294	2342	-30.2	117.4
16	E. plennissima	1994	2 row	Kalannie	294	2342	-30.2	117.4
17	E. loxophleba lissophloia	1999	2 row	Koorda	299	2093	-30.6	117.4
18	E. polybractea	2001	6 row	Esperance	508	1732	-33.6	121.8
19	E. polybractea	2001	6 row	Esperance	508	1732	-33.6	121.8

Harvest regime experiments - design

Six treatments are being tested:

- Unharvested control
- Short autumn harvest cycle
- Short spring harvest cycle
- Short spring harvest cycle with root ripping
- Long autumn harvest cycle
- Long spring harvest cycle

Three replications in 20 m plots established in 2006.

Yield of the adjacent annual crop or pasture is recorded annually


View of a harvest regime experiment site

Harvest regime experiment results: mean annual increment in green tonnes/ha

Treatment	Description	Rainfall zone in mm/year		
		300-400	400-500	500-600
Controls	Yield since planting	9	13	13
	Yield in period 2006-2009	14	22	23
Harvest frequency	Yield 3 year cycle 2006-2009	9	16	15
	Yield 4 yr cycle 2006-2010	11	19	14
Harvest season	Autumn harvest yield 2006-2009	10	18	13
	Spring harvest yield 2006-2009	8	13	16

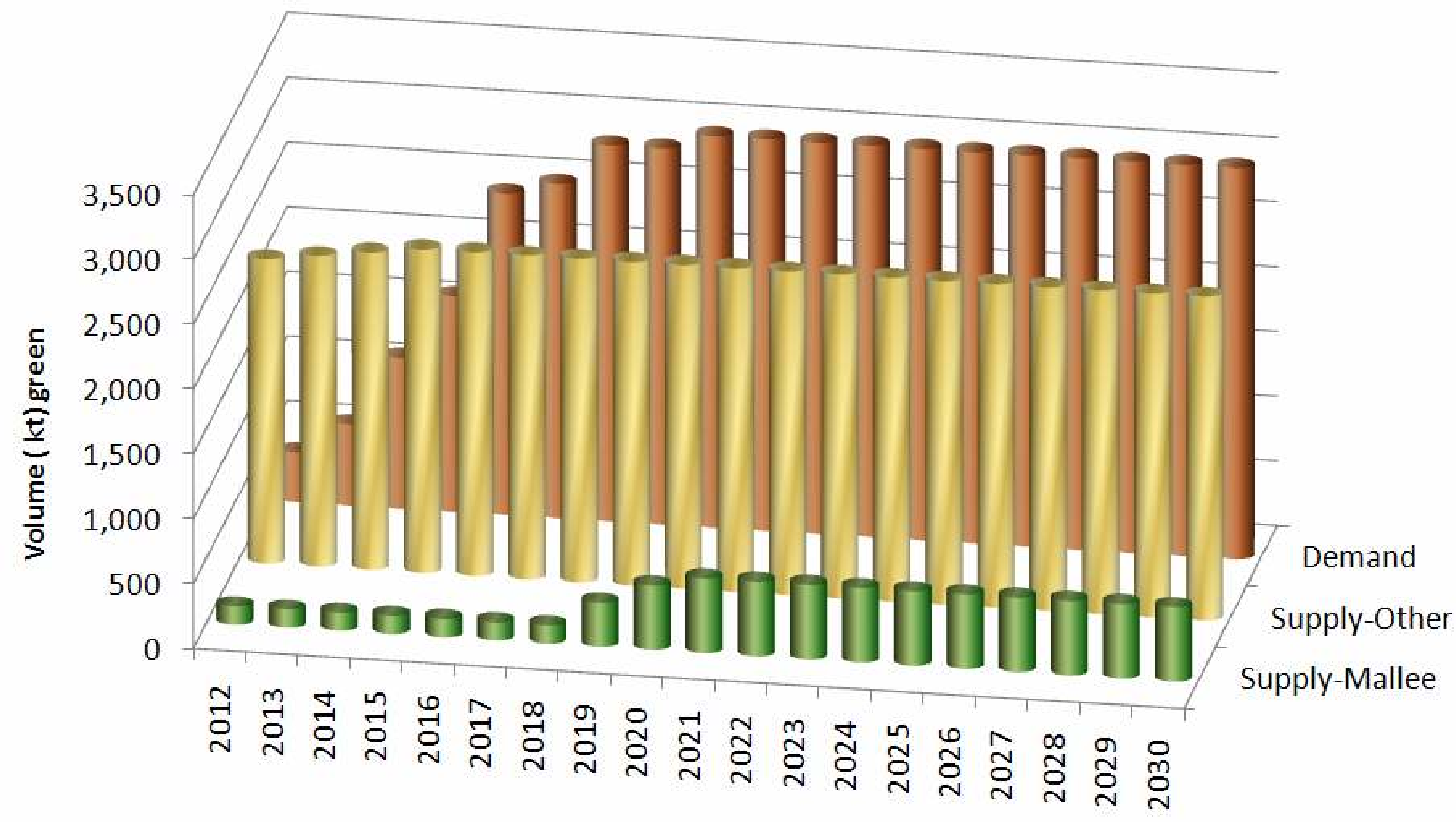
A scenario for projected demand for woody biomass in WA

Demand Biomass Processors	2012 gt	2016 gt	2020 gt	2025 gt	2030 gt
Neerabup-N Metro, Pyrolysis	-	400,000	400,000	400,000	400,000
Collie-Muja-BW I&II, Cofiring	-	200,000	200,000	200,000	200,000
Collie-Mujia, BW III&IV, Cofiring	-	200,000	200,000	200,000	200,000
Manjimup Power, Pyrolysis	-	200,000	400,000	400,000	400,000
Kemerton Heat and Charcoal	20,000	50,000	50,000	50,000	50,000
Albany Industrial Heat	5,000	10,000	10,000	10,000	10,000
Power Co Albany, Pyrolysis	-	400,000	400,000	400,000	400,000
Bunbury Biofuel, Pyrolysis	-	5,000	5,000	5,000	5,000
Biofuel GS South, Pyrolysis	-	120,000	120,000	120,000	120,000
Biofuel GS Centre, Pyrolysis	-	-	120,000	120,000	120,000
Biofuel GS North, Pyrolysis	-	-	120,000	120,000	120,000
Power Co Worsley Cofiring	60,000	400,000	500,000	500,000	500,000
Pelleting Co	300,000	300,000	300,000	300,000	300,000
Power Co Esperance Pyrolysis	-	200,000	200,000	200,000	200,000
Total (Million tonnes)	**0.39**	**2.49**	**3.03**	**3.03**	**3.03**

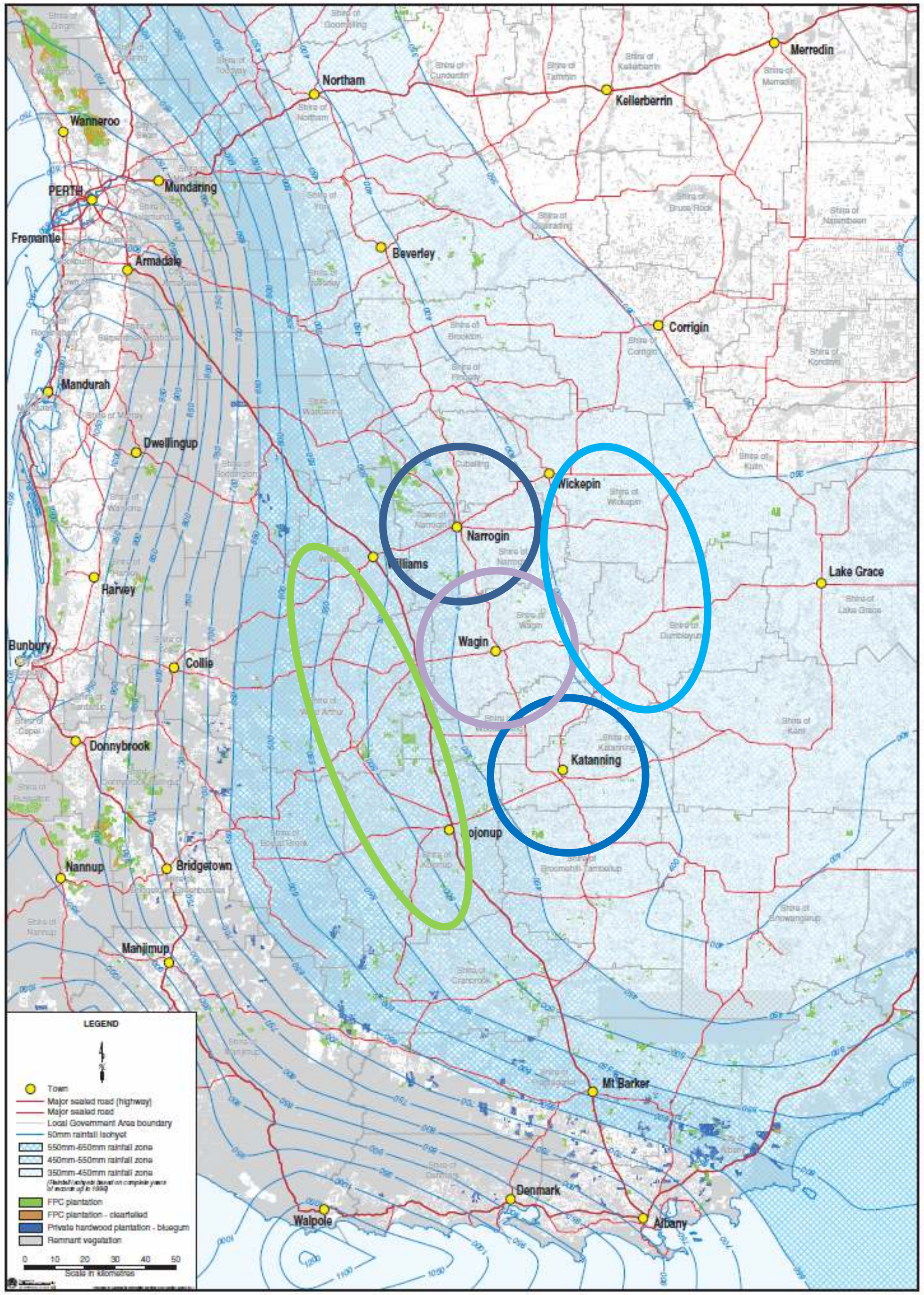
A scenario for projected supply for woody biomass in WA

Supply Biomass Sources	2012 gt	2016 gt	2020 gt	2025/2030 gt
Forest residues (SW)	1,200,000	1,200,000	1,200,000	1,200,000
Forest residues (SC)	800,000	800,000	800,000	800,000
Municipal waste	50,000	200,000	200,000	200,000
Mine site clearning	300,000	300,000	300,000	300,000
Mallees existing - SW & GS (Planted 1996)	**141,000**	**141,000**	**141,000**	**141,000**
Mallees in the South West (Planted 2014)	**-**	**-**	**200,000**	**200,000**
Mallees in the GS South (Planted 2015)	**-**	**-**	**78,333**	**78,333**
Mallees in the GS Centre (Planted 2015)	**-**	**-**	**78,333**	**78,333**
Mallees in the GS North (Planted 2016)	**-**	**-**	**-**	**78,333**
Total (Million tonnes)	**2.49**	**2.64**	**3.00**	**3.08**

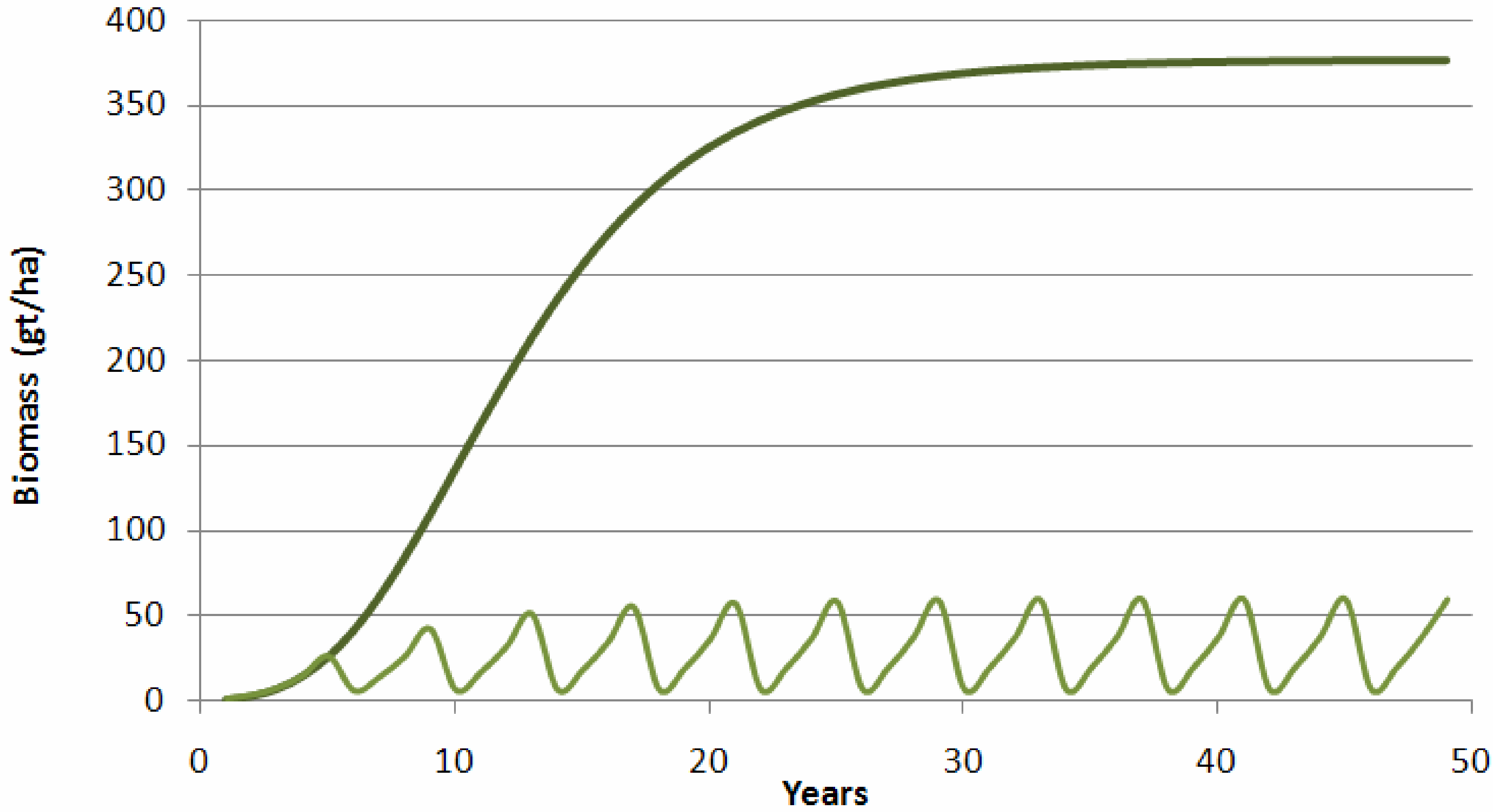
A scenario for projected demand for and supply of woody biomass in WA



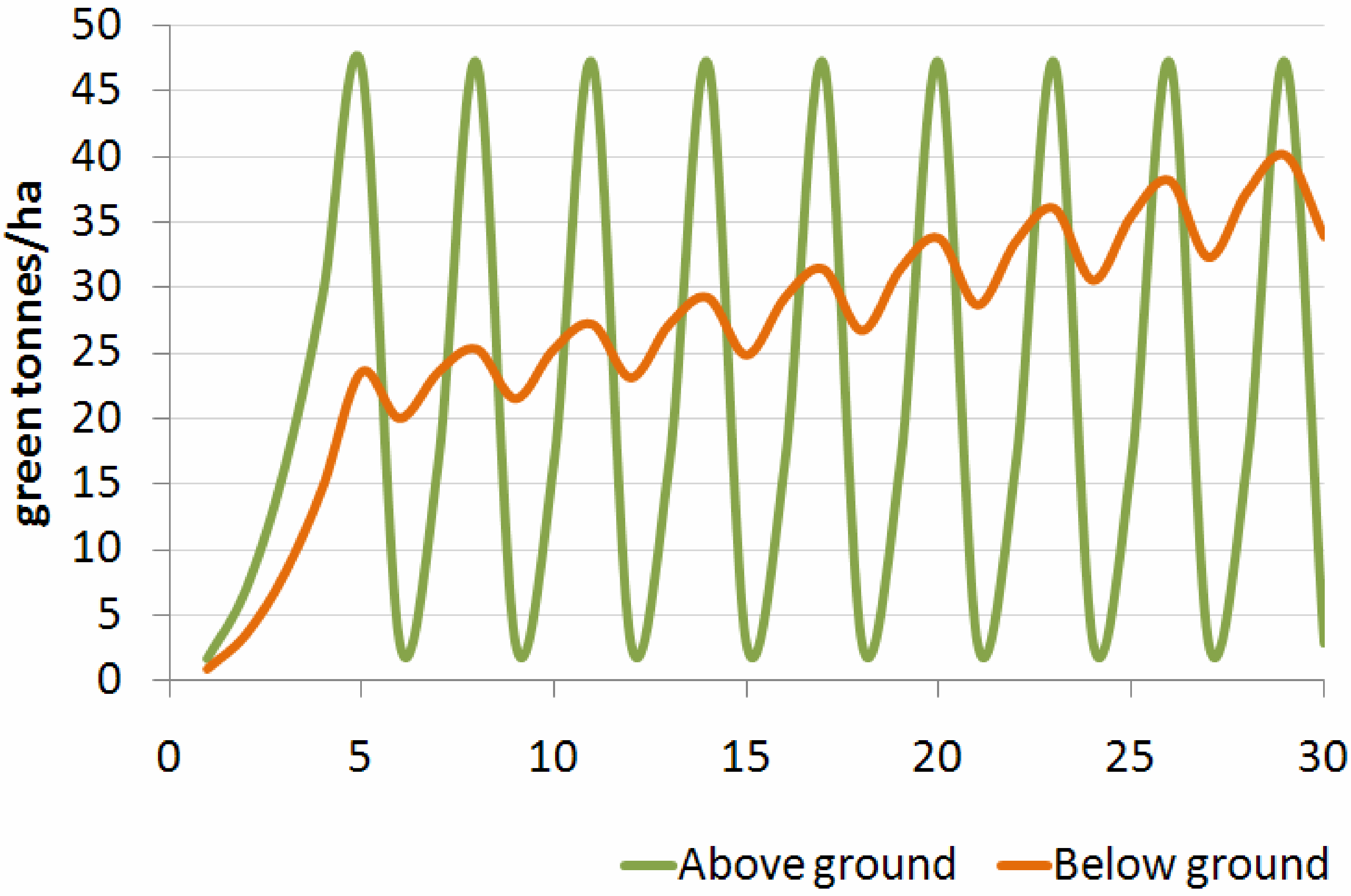
Some possible mallee production zones in the 450-600 mm rainfall between 2012-2030



Mallee Growth in Belts
Harvested vs Unharvested



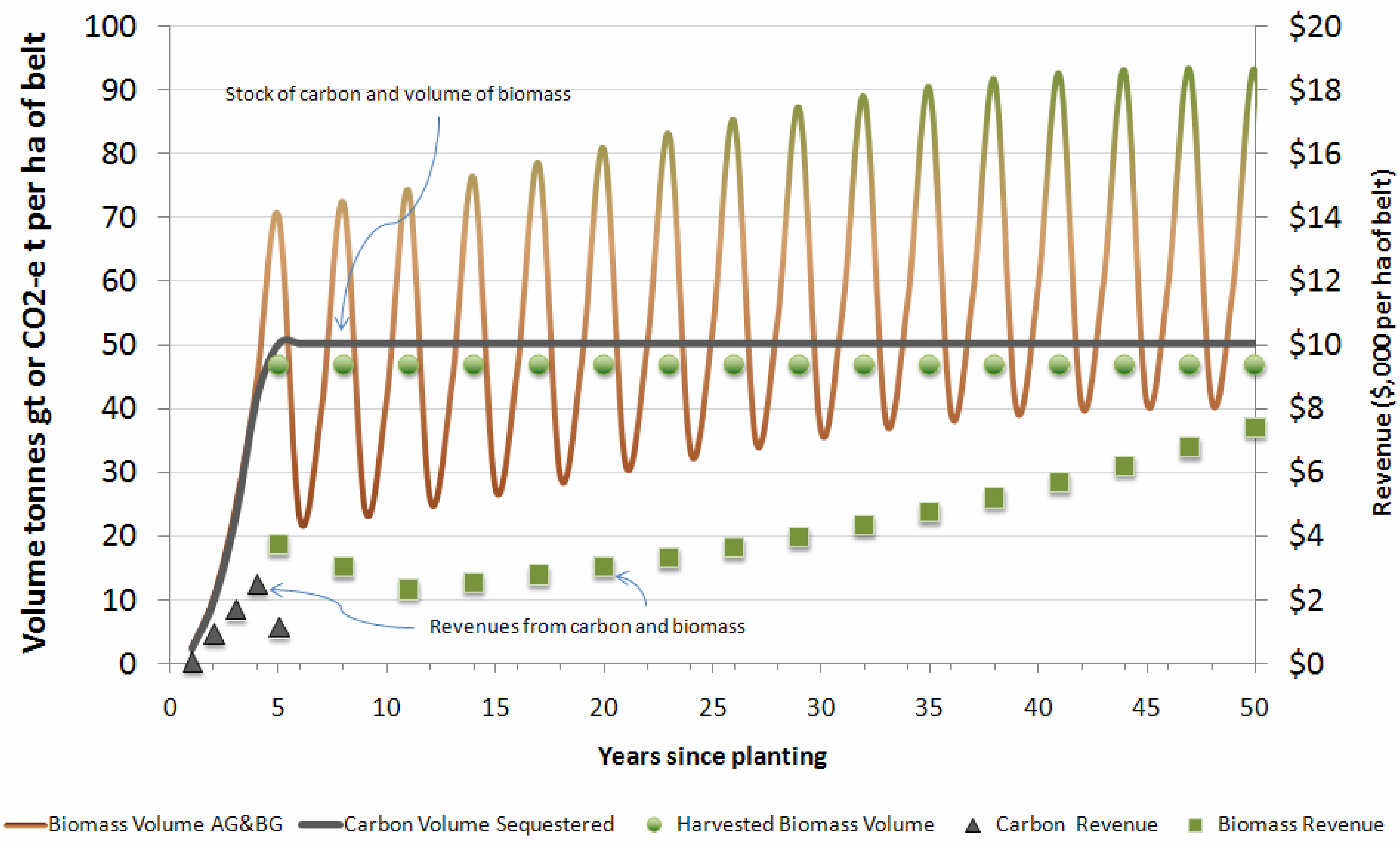
Biomass growth in harvested mallee belts



Assumptions for carbon accounting, revenue from biomass and opportunity cost of land in harvested mallee belts

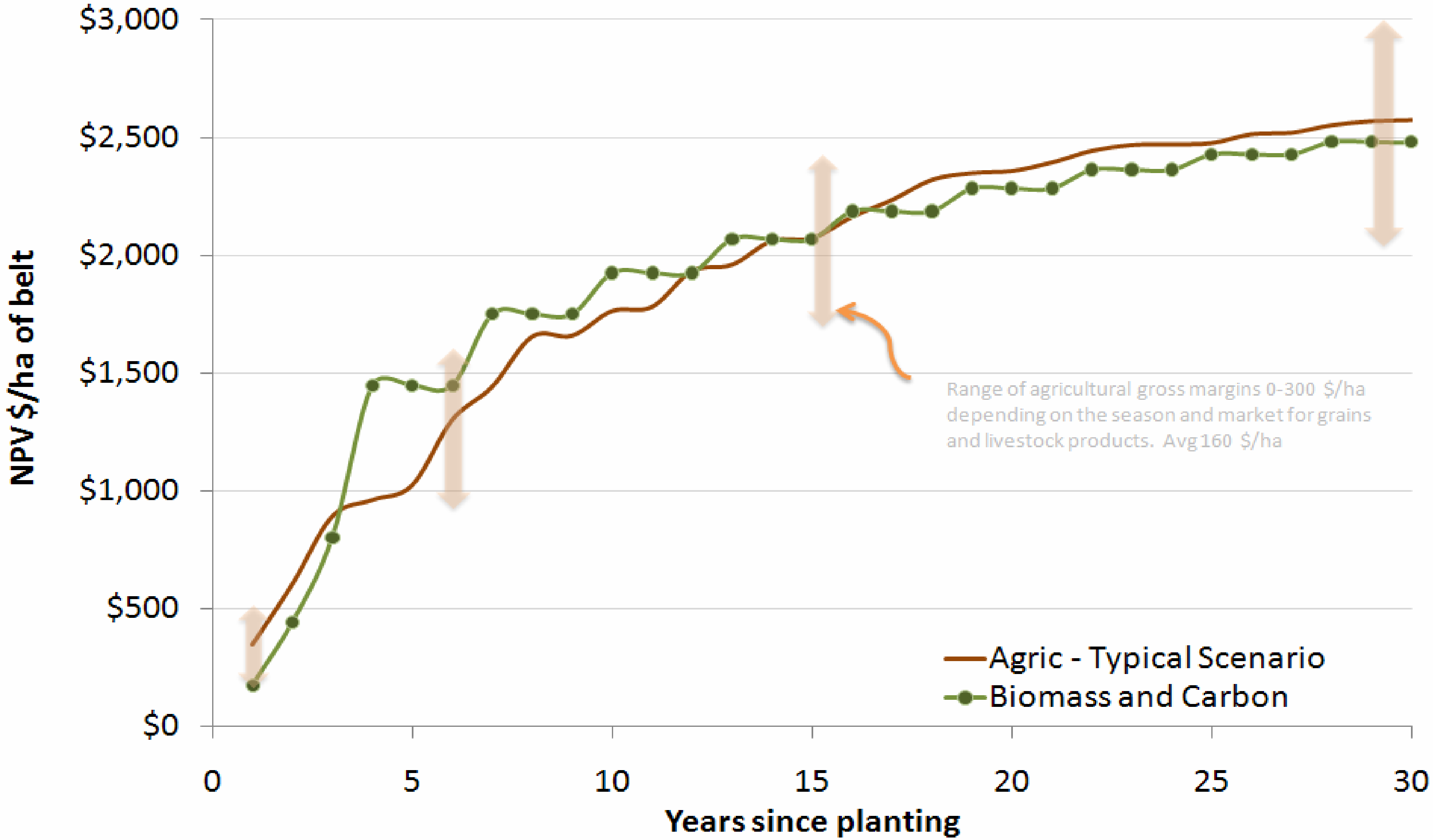
Assumption	value	unit
Fixed coppice harvest cycle	5,3,3	Years
Biomass yield at first and subseq harvests	50	t/ha
Agric GM upper range	300	$/ha
Agric GM lower range	0	$/ha
Agric Expected Long Run Avg GM	161	$/ha
Risk of reversal buffer for carbon stock (as per CFI)	5%	one off
Carbon price escalator (% per annum)	3%	per annum
Biomass price escalator (% per annum)	3%	per annum
Carbon price start	25	$/t
Delivered cost of biomass (at start)	100	$/gt
Delivered cost of biomass (start +10 years)	50	$/gt
Farmer's share of deliverd cost of biomass (for belt and competition)	20%	of $/gt
Discount rate	10%	per annum
Final cumulative avearge green biomass/CO2-e stock	53.4	t/ha

Mallee biomass production, sequestered carbon stock and the associated revenues

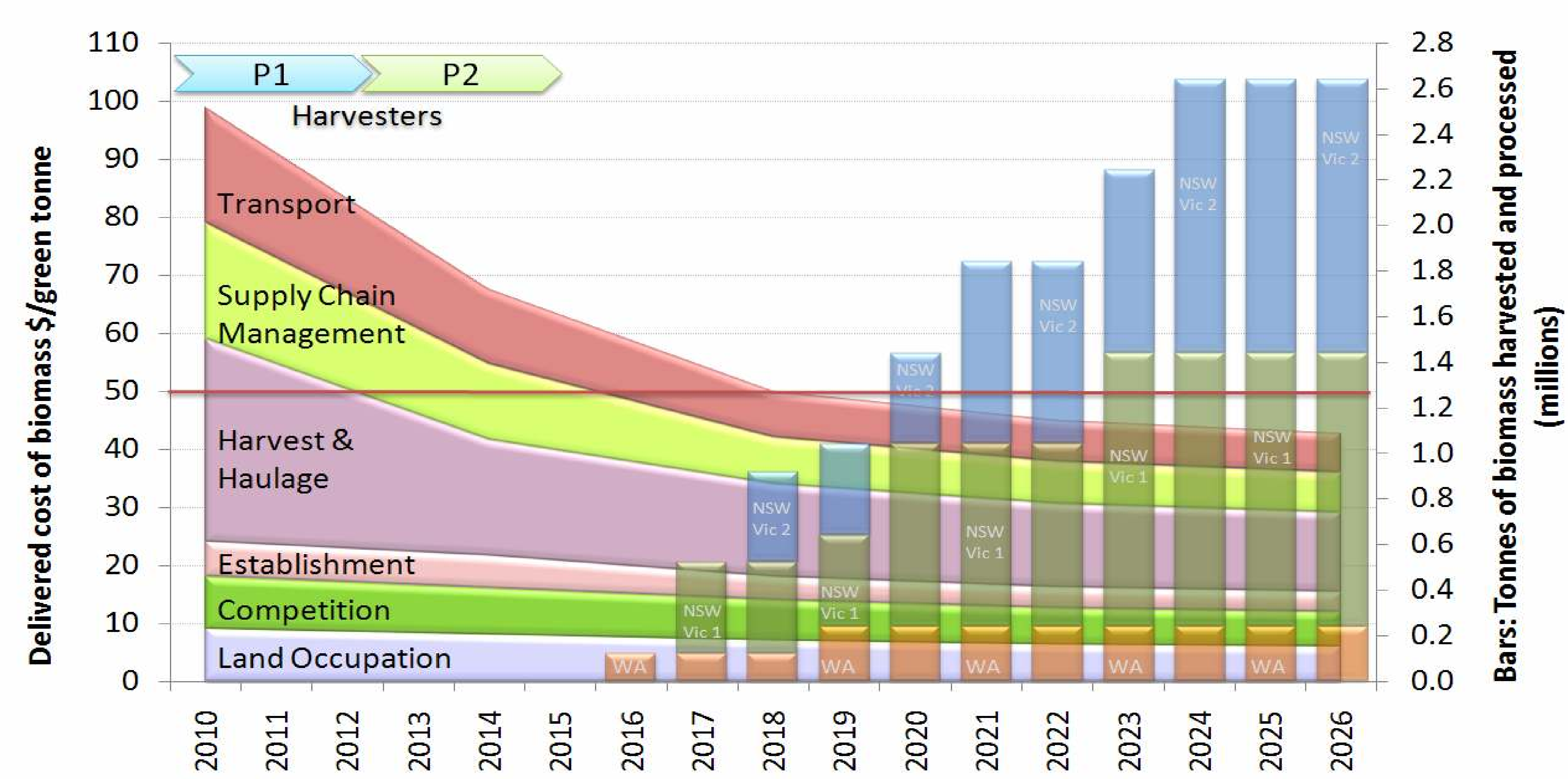


Cashflow of mallee belts from biomass and carbon and the opportunity cost of land in agriculture

Landholder's share is 20% of the delivered cost of biomass and carbon



A scenario for mallee biomass for bioenergy.
A projection of national industry development path



Tree Area (,000 ha): 2.4 13 31 50 68 86 105 123 139 155 163 163 163
Avoided emissions (Mt CO2-e) 0.1 0.3 0.8 1.3 2.1 3.0 4.0 5.1 6.4 7.8 9.1
Carbon sequestered (Mt CO2-e) 0.2 0.6 1.3 2.2 3.2 4.1 5.1 6.1 7.0 7.8 8.3 8.6

The FFI CRC Vision: Energy Tree Cropping