BIONIC BEAVER

www.bionicbeaver.com





"It's just a bloody big forage crop"

Bionic Beaver Harvester Development and Testing

Acknowledgements

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Department of
Environment and Conservation
A Low Emissions Energy Development (LEED) Fund initiative

FUTURE FARM
INDUSTRIES CRC

Australian Government

Rural Industries Research and Development Corporation

Renabi

Sorting out the pack

"Various studies underline, that there could be a very high potential for short rotation wood in Europe and other export regions, if the industry is providing economical solutions for harvesting, drying and storage.

Claas acknowledges this potential and has developed a forage harvester based equipment to get woodchips from short rotation wood already in 1995. **Conceptually, the equipment has clear limitations in respect to size, diameter and wood hardness**."

(Ulrich Timcke – Vice President of Finance and Marketing - CLAAS, 2010)

Trial of AHWI RT400 mulching chipper with specially modified Bio-harvesting head on 6m tall Casuarina (80Mg.t/ha)

"Foreign matter was easily drawn into the system resulting in foreign bodies, like dirt, clogging the action of the cutting/chopping rotor, which then required cleaning. **It did not exceed 5g.t/hr in a month of operation.**

(Ross Sigley – Plantation Manager - Willmott Forests, 2010

Total Australian investment to date

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Investment phases for prototyping and commercialisation (P0/P1/BB1000)

Date	Cost AUD $	Participants
1998-2000	$200,000	P0 development - Oil Mallee Company and the Western Australian Government
2000-2004	$300,000	P0 development - Western Australian Government and Verve Energy
2003-2006	$300,000	Research of an efficient biomass chipper
2008-2011	$4,000,000	P1 development – Western Australian Government “Low Emissions Energy Development” fund, Future Farm Industries CRC, Biosystems
2012-2014	$2,000,000	Bionic Beaver Pty Ltd purchased IP from FFICRC to develop the BB1000 Biosystems to enhance the IP into the future
	$6,800,000	**Total Harvester Investment in Australia**




P1 – Isn’t she beautiful!

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Creating a 'Step-Change' in the supply chain

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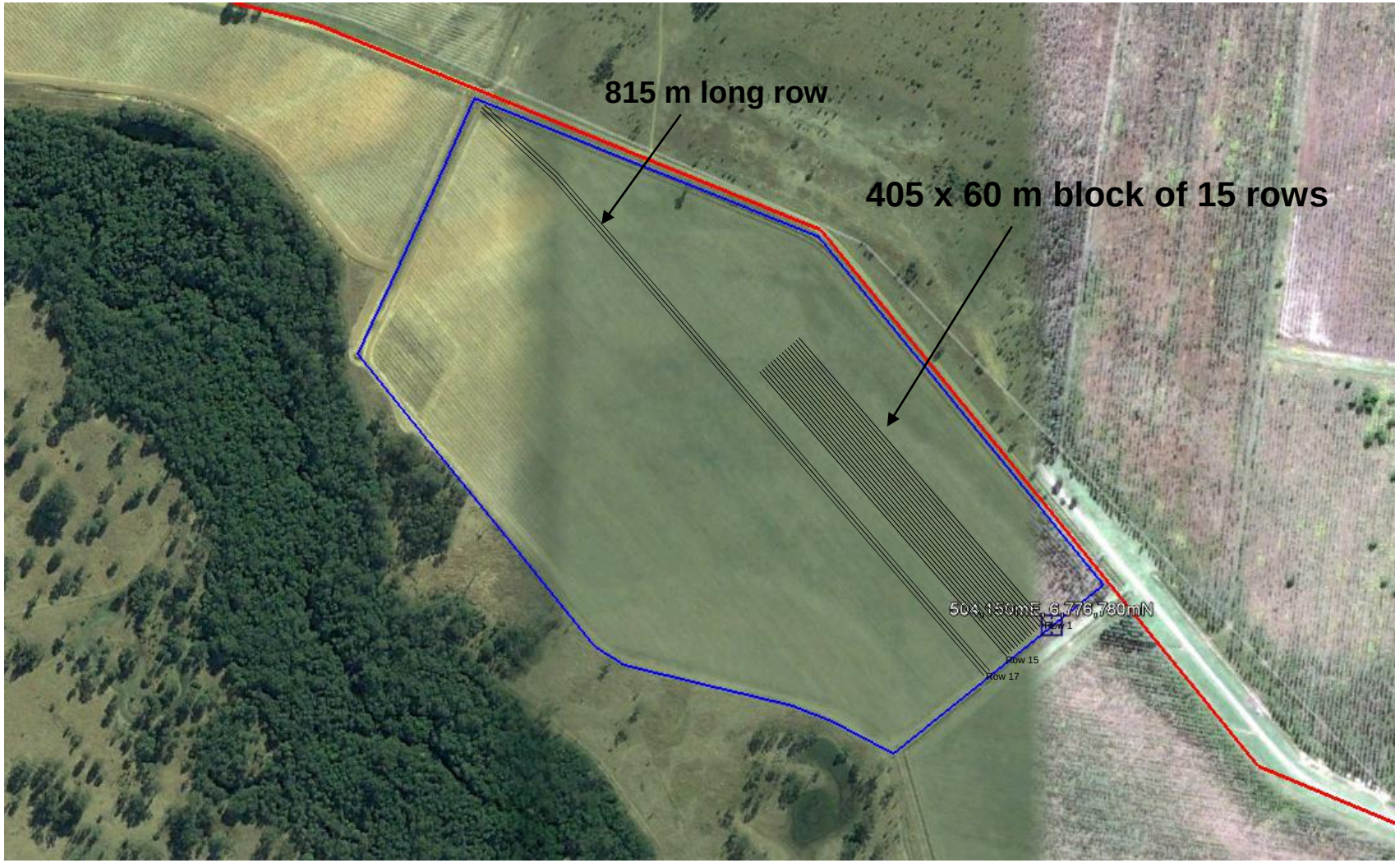
The Logic behind the Bionic Beaver development….

- Smooth continuous harvesting action **(operational efficiency = lower OPEX)**
- One pass harvester/chipper **(capital & operational efficiency = lower CAPEX/OPEX)**
- All components are rotating **(no reciprocating motion = lower OPEX)**
- Excellent cutting height control, w/wo mounds between 5-50cm **(increased coppice)**
- Vertical handling of the tree to the chipper **(operational efficiency = lower OPEX)**
- No soil contamination **(improved biomass quality)**
- Vertical chipping concept does not restrict size and height of tree **(crop flexibility)**
- Will work with existing sugar haul logistics **(CAPEX/OPEX efficient)**
- Continuous harvesting enables GPS auto steer & yield mapping **(agronomic benefits)**

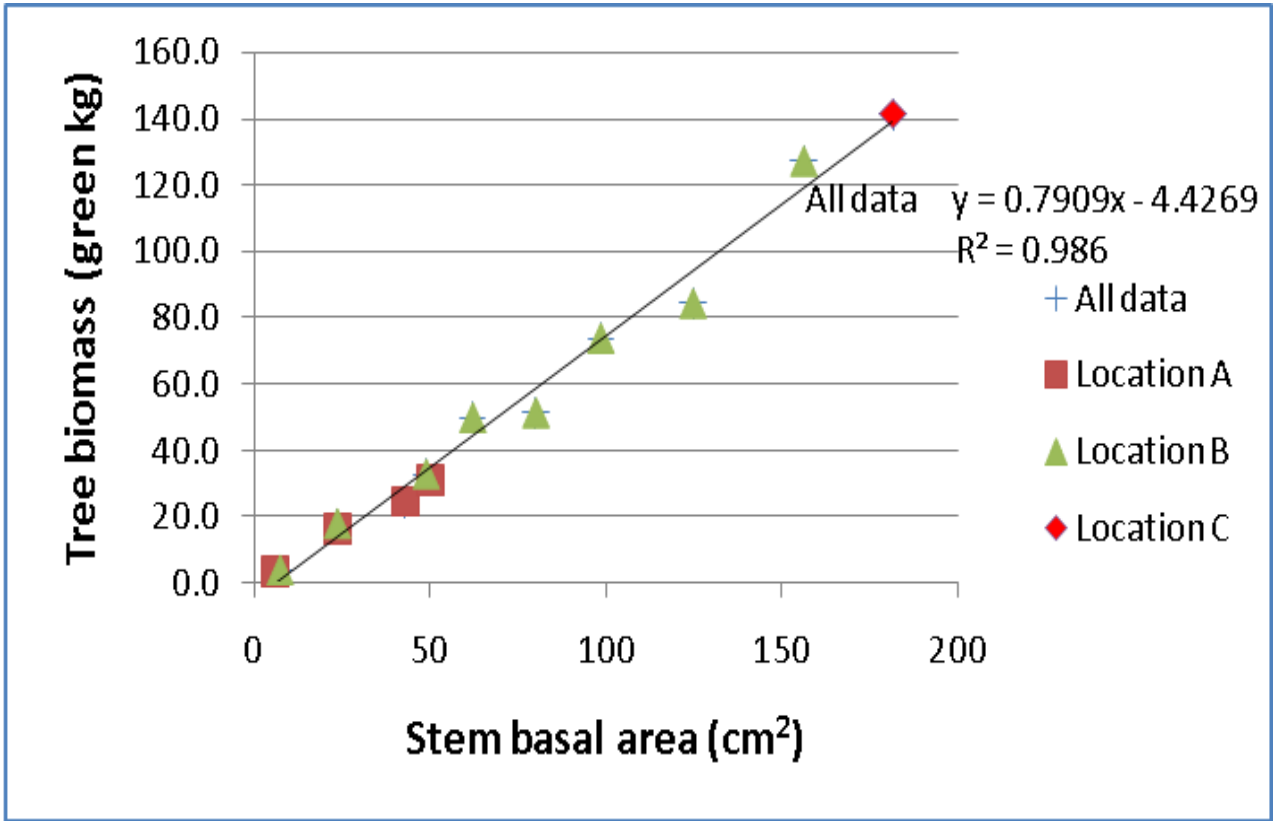
Critical key performance indicators

- **Minimum harvesting rate of 20g.t/hr for a continuous hour**
- **Harvest trees with a minimum height of 10m**
- **Harvest coppice (up to 10 stems)**
- **Cut and chip trees with a minimum large end diameter of Ø15cm**
- **Minimal cutting disturbance to the stump**
- **No residue left after harvest**

KPI - 20g.t/hr for an hour



KPI - 20g.t/hr for an hour



Regression of tree mass on stem basal area measured 1.3m above ground. Data collected from three locations across the harvested area by destructive measurement

KPI - 20g.t/hr for an hour

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Yield class	Average yield for each class	Standard error	n	Speed (km/hr)	Biomass harvested (green tonnes)
1	6.0 kg/m	0.721	27	6.4	5.0 ± 1.2
2	14.3 kg/m	1.026	74	2.7	25.6 ± 3.6
3	25.7 kg/m	2.795	14	1.5	19.7 ± 4.2
Total harvested during trial					50.3 ± 9.0
Total continuous time (mins)					78.0
Harvesting mass flow rate (g.t/hr)*					**38.5 ± 6.9**

*This result was achieved with a 288kW (380hp) C9 Caterpillar engine

KPI – Minimum tree height of 10m

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KPI – >Ø150mm basal and coppice

KPI – >Ø150mm basal and coppice

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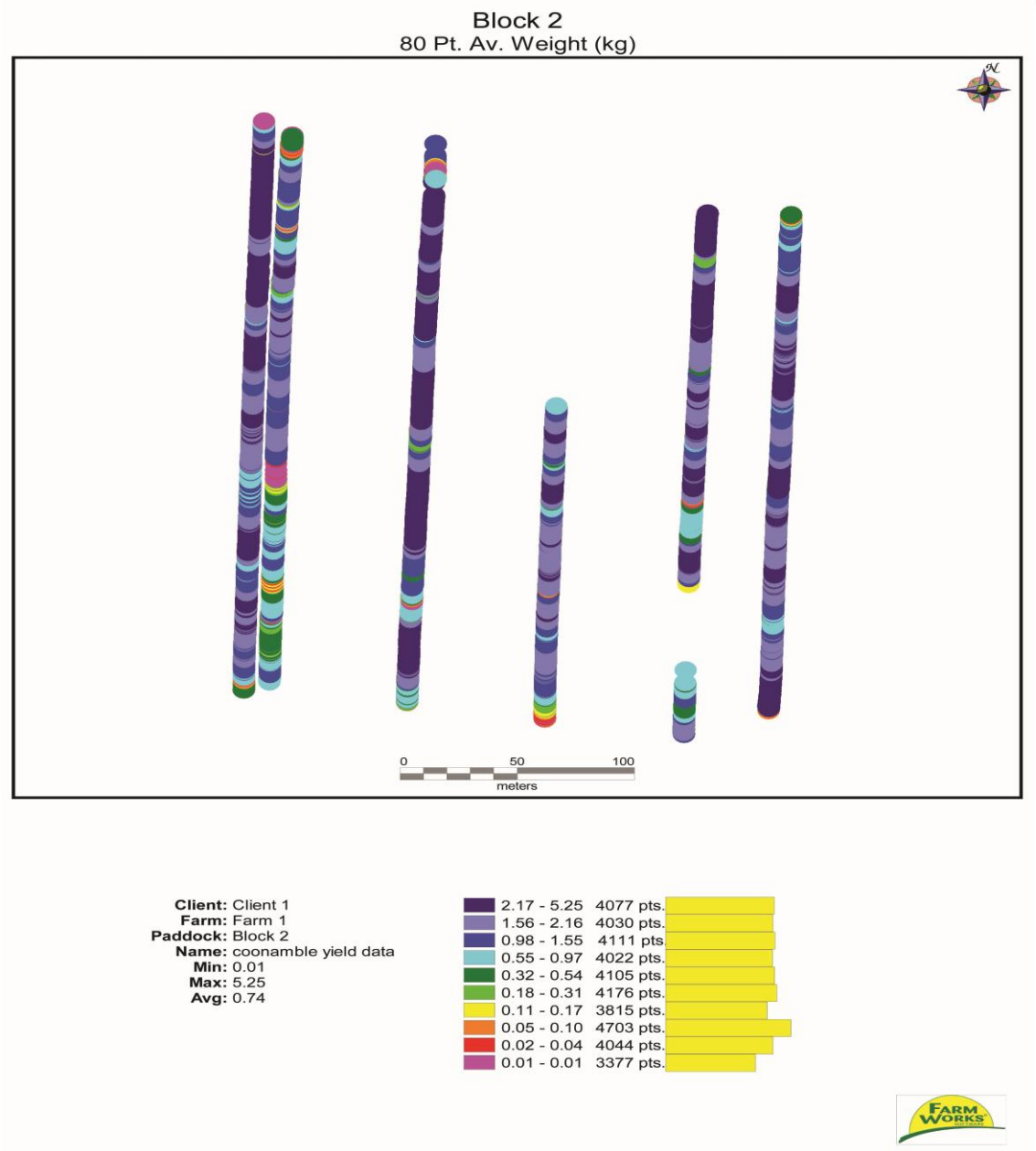
KPI – Clean cut & Clean field

Post harvest – More $$ for site prep

Other benefits – Yield mapping



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SIDE-BY-SIDE Comparison

Initial commercial indicators

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1 x Feller Buncher

1 x Bionic Beaver (P1)

2 x Skidders

Sugar transport

2 x Haul Out

1 x Chipper/Grapple

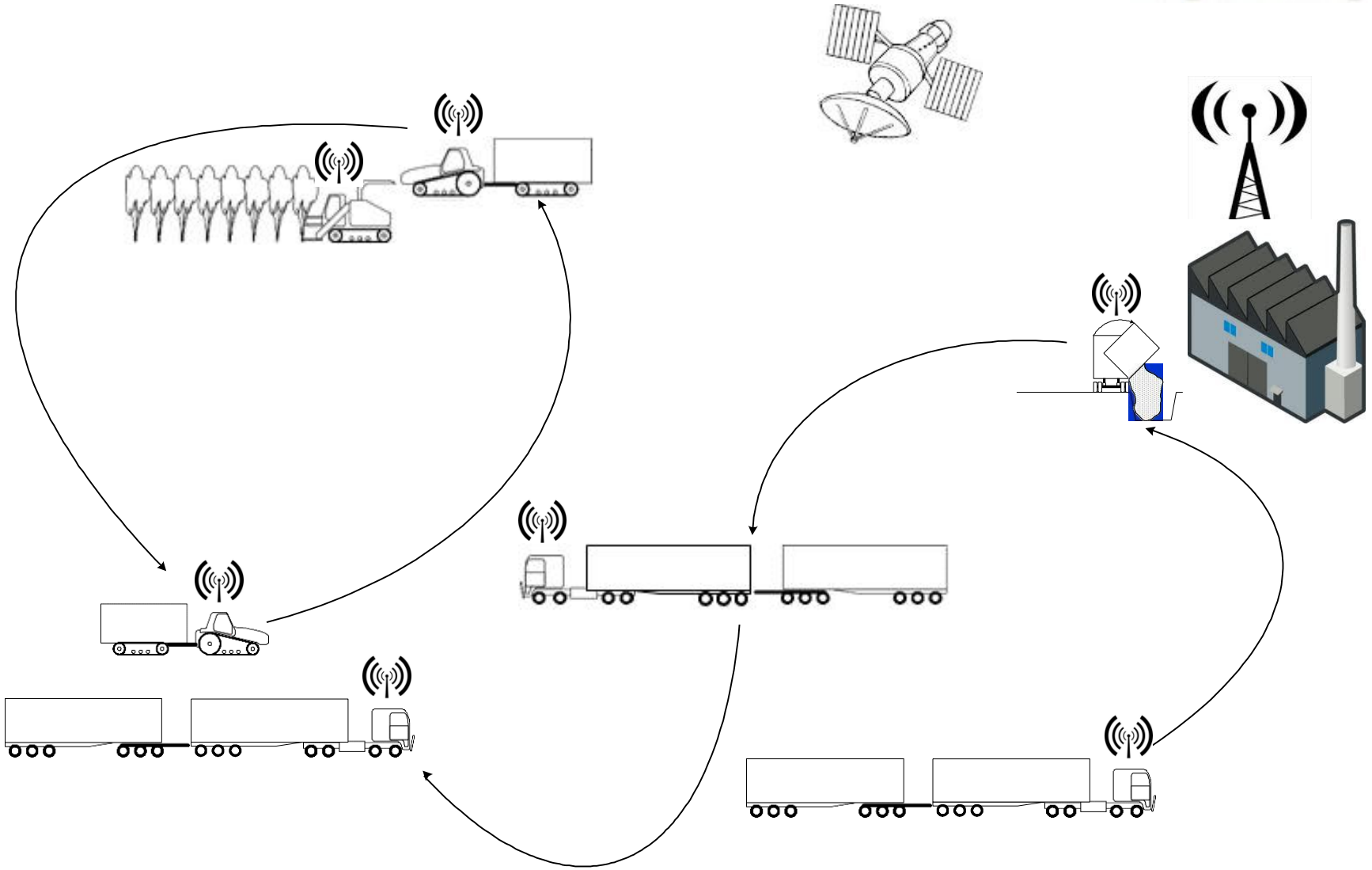
Initial commercial indicators

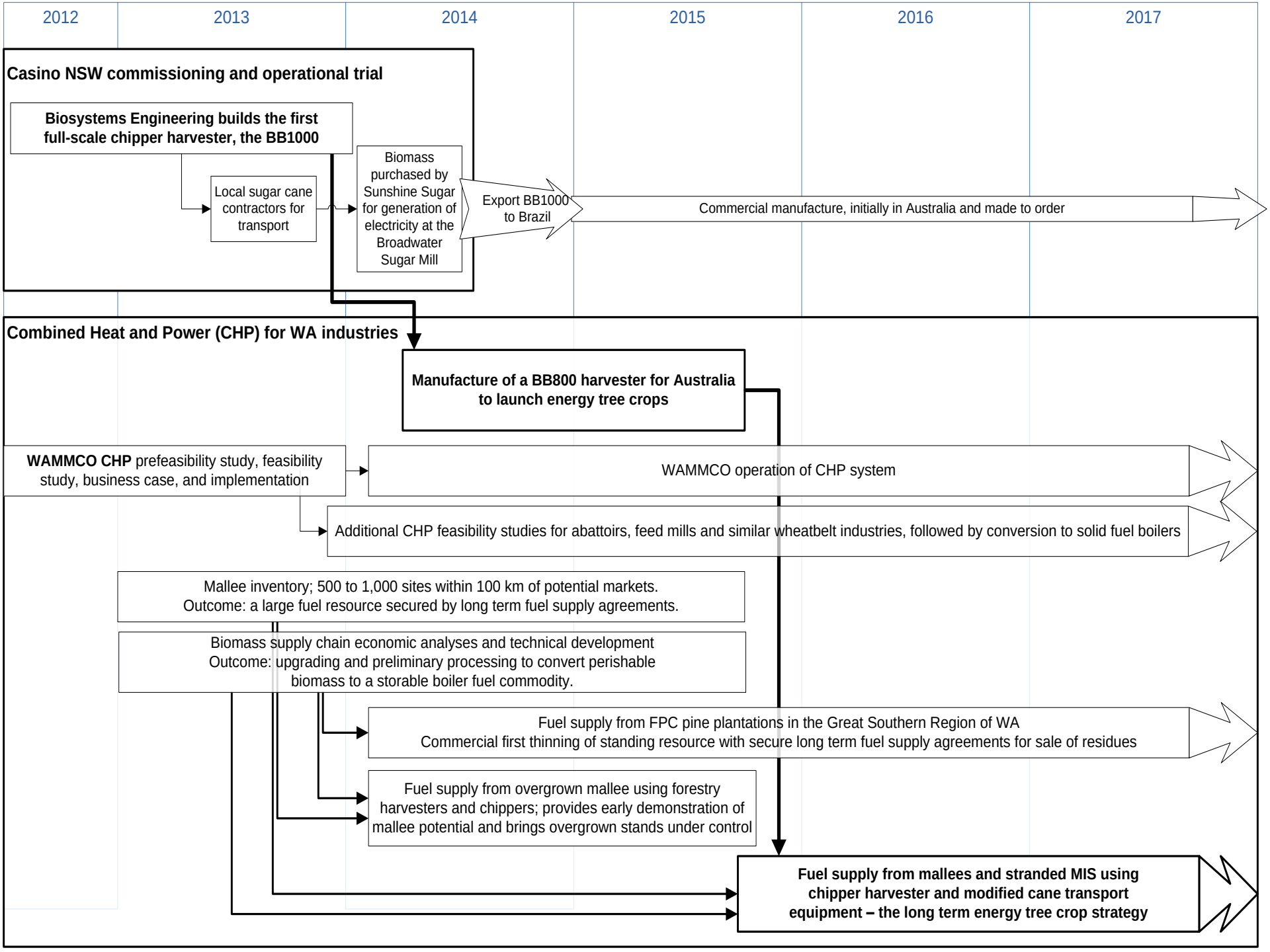
	TRADITIONAL FORESTRY	BIONIC BEAVER (P1)	BIONIC BEAVER (BB1000)
Harvest Rate (g.t/hr)	25	35	60
Total Harvested per Year @ 10hr/day (g.t)	91,250	127,750	219,000
CAPEX(A$)/g.t/Year)	$16	$9	$6
CAPEX + OPEX (A$/g.t)*	**$35**	**$16****	**$11****
Clean up after harvest (A$/g.t)	$2	$0	$0
Road Transport Cost (A$/g.t)	$15	$15	$15
Chip Market Value (AUD$/g.t)	$40	$40	$40
Gross Margin (AUD$/g.t)	**-$12**	**$9**	**$14**
* Landed Price in Transport			
** Includes Haul Out Cost			

Cost data based on a recent comparative trial in New South Wales between traditional forestry equipment and the Bionic Beaver in Short Rotation Eucalypts .

Plantation spaced on 4x2m with tree sizes up to 12m tall x 15cm DBH

Future research objectives




2012
2013
2014
2015
2016
2017
Casino NSW commissioning and operational trial
Biosystems Engineering builds the first full-scale chipper harvester, the BB1000
Local sugar cane contractors for transport
Biomass purchased by Sunshine Sugar for generation of electricity at the Broadwater Sugar Mill
Export BB1000 to Brazil
Commercial manufacture, initially in Australia and made to order
Combined Heat and Power (CHP) for WA industries
Manufacture of a BB800 harvester for Australia to launch energy tree crops
WAMMCO CHP prefeasibility study, feasibility study, business case, and implementation
WAMMCO operation of CHP system
Additional CHP feasibility studies for abattoirs, feed mills and similar wheatbelt industries, followed by conversion to solid fuel boilers
Mallee inventory; 500 to 1,000 sites within 100 km of potential markets.
Outcome: a large fuel resource secured by long term fuel supply agreements.
Biomass supply chain economic analyses and technical development
Outcome: upgrading and preliminary processing to convert perishable biomass to a storable boiler fuel commodity.
Fuel supply from FPC pine plantations in the Great Southern Region of WA
Commercial first thinning of standing resource with secure long term fuel supply agreements for sale of residues
Fuel supply from overgrown mallee using forestry harvesters and chippers; provides early demonstration of mallee potential and brings overgrown stands under control
Fuel supply from mallees and stranded MIS using chipper harvester and modified cane transport equipment – the long term energy tree crop strategy

Conclusions

- The harvester has achieved all the key performance indicators specified for the project.
- In terms of mass flow rate, the capacity of the harvester was nearly double that specified for this milestone.
- The trials were conducted in a plantation of trees that exceeded 10m in height, with a high centre of gravity, and crowns more affected by wind.
- **We are now looking for commercial projects in the USA and Brazil to trial the next generation of this harvester in 2014 and onwards.**

Yep...it's still a forage crop!...Questions?

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