

20 April 2018



Western Australian Legislative Assembly Economics and Industry Committee

Inquiry into Microgrids and other Technologies

Attached is a submission to the above Inquiry.

.With a long history of advocating productive use of mallee integrated agroforestry, the OMA believes this inquiry could produce important information and new perspectives on regional power options.

The OMA would welcome the opportunity to address the Committee and answer questions relating to this submission.

I wish the committee well in its deliberations.

Yours sincerely,

Lex Hardie

President, Oil Mallee Association of Australia (Inc)

A handwritten signature in black ink, consisting of a series of loops and a long horizontal stroke extending to the right.

Simon Dawkins

Director, Oil Mallee Association of Australia (Inc)

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Oil Mallee Association Submission to the Western Australian Legislative Assembly
Economics and Industry Committee Inquiry into Microgrids and other Technologies
April 2018

Submission to Microgrid Enquiry

Summary

The Oil Mallee Association of Australia believes this is a timely enquiry and believes that technological improvements over the time in which it has been advocating regional bioenergy utilising a feedstock grown in partnership with agriculture have presented new and exciting opportunities. The long period of development of methods of growing, harvesting, processing and now connection can provide new opportunities for a new industry suited to south west WA and the SWIS. We hope that this enquiry can;

- encourage more transparency on the costs of energy provision at various locations,
- guidance on the future generation mix,
- promote flexibility in relation to the best mix of technologies and their connection and location,
- evaluate the community and industrial benefits of different technologies that make up a microgrid attached to the SWIS, and
- support the trialling of projects like the Kalannie Bioenergy Hub to assess the operation of such a project on the ground.

At the same time, the OMA would expect the policy of Uniform Tariff throughout the system to be maintained.

The submission has the following components.

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A. Introduction

The Oil Mallee Association (OMA), a Wheatbelt farmer group, has been in existence for over 25 years and has sought to link remediation of the over cleared farmland through integrated agroforestry. It has advocated for support to farmers to plant trees on their property in a way that will provide protection from the wind, remove excess surface water to reduce salinity and provide shade and shelter for stock. The OMA has maintained that the trees should be integrated into cropping and grazing programs to maximise effectiveness, rather than be restricted to the fence lines or creeks.

In order to reduce the opportunity cost of these services to the farmer, the OMA has explored commercial opportunities to compensate for the loss of land to cropping and grazing, while at the same time researching the positive impact of the trees on the adjacent land. In particular, there is an expectation that if lateral water flows are mitigated with the re-introduction of trees, lower lying land will benefit from reduced water logging and encroaching salinity. In addition, the trees will introduce improved biodiversity and accompanying benefits to the whole paddock or property. Research over many years has validated many elements of these assumed benefits of mallee integrated agroforestry. Considerable research effort has been invested in investigating the impact of trees on farms and in relation to the oil mallee program. State Government Departments and agencies, the CSIRO, universities (particularly Curtin), NRM groups and landcare organisations have all contributed to a wealth of knowledge about this nationally significant project.

The opportunities for commercialising the mallee plantings have been investigated by the State Government and the OMA with partner organisations. A key focus has been the potential to create a resource for bioenergy through regular harvesting of the trees which regrow successfully.

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B. Oil Mallees and Bioenergy – a history of innovation and achievement

There have been significant developments in the progress towards fulfilling the promise offered by agroforestry of a plentiful, beneficial, sustainable and carbon neutral energy source. Fuelling this endeavour has been the regional and community benefits that have been identified by the founders and supporters of the oil mallee project. Provision of electricity, liquid fuel, biogas, heat and bioproducts such as eucalyptus oil and biochar can provide new enterprise and industrial development to regional areas. More recently it has become clear that regional bioenergy projects can also benefit the efficacy of the SWIS or stand-alone microgrids.

In order to outline the opportunity to capitalise on the achievements made to date, it is necessary to briefly describe some of the successful collaborations and developments that can demonstrate the investment and commitment to the industry over time.

ATTACHMENT 1

1. The Kansai 1000 hectare project

The Kansai Electric Company of Japan was encouraged in 2003 to plant 1000 hectares of mallees across 24 properties clustered in the northern wheatbelt. The trees were to provide cost effective carbon sequestration and enable Kansai to export carbon credits to Japan under the Joint Implementation program of the UNFCCC. This commitment enabled a demonstration as to how an international carbon market could provide sufficient incentives to farmers to use cropland to grow trees. While the project was terminated when the Tohoku Tsunami created considerable havoc with the energy market in Japan, the project stands out as an example of the use of dryland farming areas for carbon sequestration. Most of the trees planted at that time are still standing.

2. NRM, Salinity and National Heritage tree programs

During the 1990's there were a number of tree programs that provided low cost seedlings to farmers who were encouraged by groups such as the OMA to plant them strategically for the natural resource benefits widely believed to result from replacement of trees on the landscape. In the case of the OMA, the farmers were allocated seedlings and encouraged to plant them in a particular way – across the paddock. The contract that accompanied this assistance included a requirement that the farmer engage with the OMA in the event of a carbon market emerging and be ready for the possibility of a market for biomass. Harvest pans were prepared for many properties in the Narrogin area in anticipation of the trial energy plant that was proposed. 1000 farmers joined

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the OMA and planted millions of trees over an area of 14000 hectares. Several regional branches of the OMA were created to facilitate distribution of seedlings and specialised nurseries grew up around the need to seedlings for distribution and to supply a number of carbon companies seeking to plant mallees to help large energy companies meet compliance with emerging carbon targets imposed by the State and the Commonwealth Governments.

3. The OMA database

The OMA has a comprehensive database that it has maintained, complete with details of what was planted and when and what species. It is fully searchable and can provide information on potential regional supplies. The Commonwealth Government has recently provided funding under a national biomass inventory program for the database to be updated, a process that will be completed later in the year.

4. Research into the growth dynamics of mallee species

In the early 1990's the (then) Department of Conservation and Land Management (and its successor organisations) undertook research into the breeding of mallees to advance the properties most likely to be associated with biomass and eucalyptus oil production. This breeding program which included several nurseries throughout the wheatbelt continued until relatively recently, but remains a source of important information and a foundation of further research.

5. The Narrogin Bioenergy Trial

Following the election of the Gallop Government in 2001 Western Power was divided into three new utilities, Verve Energy, responsible for creating renewable energy opportunities, initiated the Narrogin Integrated Wood Processing (IWP) project to test all the principles of bioenergy from locally grown mallee biomass. The trial was a success but that technical matters prevented it continuing in operation beyond the trial period. It is possible that some aspects of the chosen technology were not ready for deployment and adaptations to the process required intensive management. This project proved that a regionally based bioenergy system could be developed using locally sourced biomass and also produce charcoal, biochar, ethanol.

ATTACHMENT 2

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6. The Kalannie Distillery for Eucalyptus Oil

In the mid 1990's a group formed in Kalannie, a town in the northern Wheatbelt, to produce eucalyptus oil. After many trials to secure efficient transport, harvesting and production, a stable set of processes were developed that applied to the circumstances in that part of the State. In addition a substantial grant was secured by the OMA for the Royalties for Regions program to purchase a large wood fired boiler in order to utilise the significant amount of chipped biomass used in the process and reduce heating costs. The management of the Eucalyptus plant is now in the hands of a private company with some local involvement, and significant amounts of oil are being produced with the prospects for large orders being contemplated. In addition more production plants are being built to meet this demand.

This experience provides evidence that local industries can emerge from the use of biomass while also aiding the farmer by reducing competition of the trees with the crops by regular harvesting.

7. Future Farm Industries Cooperative Research Centre

In 2006 the Future Farm Industries Cooperative Research Centre (CRCFFI) emerged from the Salinity CRC carrying with it a strong emphasis on woody crops (Program 4) which highlighted the oil mallee program. This major CRC was based at UWA and therefore had significant access to governmental research and management expertise in addition to strong links to the CSIRO. Significant agricultural and industrial economic analysis and integrated research was conducted by the CRC over a seven year period with many bold and hopefully lasting legacies to pass on to the oil mallee industry. The focus of effort of program 4 was on producing viable methods of growing and extracting energy from mallee biomass. This included a multi-million development of a prototype harvester that could mimic the continual harvesting processes of agricultural machinery. This prototype harvester was never able to be fully tested in WA as quarantine regulations prohibited it from travelling here after it was operated on infected trees in northern NSW. The project has been terminated.

Apart from many published papers on the subject of agricultural economics and mallees and valuable field trials, the other major output of the CRC was an investigation into the efficacy of producing aviation fuel from mallee biomass. This report demonstrated the potential for sustainable jet fuel to be produced prior to distillation at Kwinana and the potential for industry to develop on the back of an accessible and integrated biomass resource.

ATTACHMENT 3

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8. Rainbow Bee Eater Pty Ltd

Rainbow Bee Eater (RBE) was created following an international Biochar Conference in Terrigal NSW in 2007. The potential for biochar was reaching a significant level of interest and this conference included the mechanisms for producing biochar as a byproduct of pyrolysis – the heating and transformation of biomass in a limited oxygen environment. Now with their own Australian developed and manufactured international patents pending technology (ECHO₂), RBE produces a fuel gas (syngas) in commercial quality and quantity at its operation in Kalannie. RBE has attempted to meet all the conditions for grid connection so that it could produce electricity from the syngas, but the regulatory conditions and costs imposed have prevented this from happening. Instead they are in the process of commissioning heat and electricity plants in South Australia and Victoria (see attached summary). While these plants will use other local timber residues (not mallee), it has always been the hope of RBE that electricity and biochar will be produced from locally grown mallees. Indeed at the rate of growth of the eucalyptus oil demand and resulting stockpiles of chipped biomass, there is potential for a bioenergy hub at Kalannie and the business case for a 0.5 MWe pilot plant has been developed that would lead to multiple other 0.5 to 5MWe distributed generation hubs. RBE would be pleased to present this business case to the committee.

ATTACHMENT 4

9. Curtin University Fuels and Energy Technology Institute

The Curtin University Fuels and Energy Technology Institute (FETI) had its origins in research into mallee bioenergy in 2005. The Curtin researchers lent their enthusiasm and analytical insights on many occasions to the OMA through attendance at seminars and road trips to talk about the prospects for sustainable energy production from biomass. Over the last ten years FETI has researched the production of biofuels with strong and extensive support from the Commonwealth and have produced a production facility at Curtin strictly using mallee biomass on all experiments and trials. This demonstration of a capacity to produce oils and other products for energy production is a very valuable contribution to the field of bioenergy and in particular energy from mallee biomass. It is recommended that the committee visit the facility.

ATTACHMENT 5

10. Narrogin revisited

At the invitation from a large electricity consumer in Perth, the OMA investigated the potential for the Narrogin site to become an electricity production site for direct purchase in Perth. Regional bioenergy production facilities have been undertaken in the UK and being explored in New south Wales. The analysis by an experienced energy engineer provided evidence that with all current considerations taken into account, including line rental costs, that the project was most likely viable with a return on capital in five to seven years. This return was considered too long for the client involved. Had there been support to bring the time period down, the client may well have considered becoming an energy producer and engaged in the project. One reason for considering the Narrogin site was the proximity to a transformer substation, a critical and otherwise very costly piece of necessary equipment. The site has been decommissioned and no one of the former equipment was planned for use in this scenario.

11. Farming Together Consultation

The OMA has successfully applied for support form the Commonwealth through the Farming Together program. Under this program the OMA has received support to engage an experienced agricultural consultant to identify opportunities available to the industry. One session has taken place which identified the unmanaged plantings of mature mallee plantings as a key problem. Various options for managing these plantings have been discussed and a range of solutions proposed. A second session has been agreed where trials will be conducted to determine how the mature trees can be cost effectively “groomed” and the biomass resource processed if possible. The new growth of the trees can be made available for eucalyptus oil production. The economics of this process will reveal some options for farmers to preserve their plantings rather than destroying them to remove the competition with adjacent crops. It is hoped programs such as this can lead to the identification of biomass suitable for a bioenergy hub.

At the same time the OMA has been seeking to have the “Avoided Deforestation” (AD) CFI methodology applied to the mallee plantings. While up to 50% of the ACCUs purchased at each ERF auction are derived from the AD methodology, it is not available in WA due to strict clearing provisions. In the case of the mallee plantings however no clearing ban is in place but they are not considered a suitable class of remnant vegetation for application of the AD methodology. A modified Farm Forestry methodology to suit the AD approach is required to help preserve the plantings for future biomass supply.

C. Microgrids and Associated Technologies

The OMA wishes to make several points in relation to the Enquiry.

C. Locational pricing and Strategic Reinvestment

D. Cost reflective pricing and Location

E. Greater recognition of the benefits of end-of-grid applications

F. Sustainability including positive externalities

G. Regional, Community and industry benefits considered

1. Locational pricing and Strategic Reinvestment

Within the framework of the uniform tariff policy, there could be scope for using the significant hidden subsidy of regional electricity prices more effectively. The averaging of all costs across the SWIS hides the difference in local electricity provision and the cost in the metropolitan centres. More transparency is required on locational pricing to ensure competitive supply arrangements can be developed. Once the marginal cost of service is determined at key locations throughout the SWIS, a tender process could determine if any providers were capable of producing electricity at less than this regional marginal cost. The current subsidy at different locations could be used to facilitate the capital establishment of new regional services, even if the cost was more than the average cost but lower than the marginal cost. Potential service providers could be informed that the support would be limited and be reduced over time.

2. Cost reflective pricing and Location

Cost reflective pricing may relate more to the Tariff Adjustment Payments (TAP) than the Tariff Equalisation Charges (TEC) but the same principle can apply to locations on the grid. Similar to the point above, it is difficult to determine the efficacy of energy provision while the cost of delivery is not transparent.

3. Greater recognition of the benefits of end-of-grid applications

A cost reflective pricing policy could also ensure that the positive impact of end of grid energy sources on line losses as well as a realistic cost of maintaining grid connection over long distances and how this is provided.

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4. Sustainability including positive externalities

The UNFCCC maintains that bioenergy and Bioenergy Capture and Storage (BECS) will be needed to meet the target of not exceeding 3 degree increase in global temperature. Bioenergy at any scale has special properties that makes BECS possible. One of these capacities is the strategic use of biochar, displacement of other heat sources and capture of CO₂. In other words bioenergy can produce negative emissions. In addition to this, the CFI Farm Forestry Methodology under the ERF, provides a measurement methodology to track the increase in carbon sequestered in plantations dedicated to provide feedstock biomass to the bioenergy facility. The regular harvesting of the trees by coppicing, enables the “below ground” carbon to be accumulated in the rootstock. This characteristic is not unique to the long living mallee eucalypt species, but they do have a strong capacity for continual sequestration in the root stock despite regular harvesting. Foresters have commented that the trunk of the mallee is largely below ground. Combined with other strategic tree planting, integrated agroforestry has the capacity to improve farming ,and at scale, macro studies have shown that forestry can improve water quality and other benefits across the whole catchment.

5. Regional, Community and industry benefits considered

Some of the developments in the list provided in this submission have indicated how the provision of energy and other services and products can generate industry at a local level. If it can be demonstrated that the cost of energy at a location using bioenergy is the same or less than the grid connected supply, including the labour force to manage the energy supply chain, then the town or regional centre benefits significantly. This benefit spreads to the farming community and to a range of services developed to ensure a reliable biomass supply.

D. Summary and Recommendations

The OMA commends the Economics and industry Committee for this investigation into Microgrids and Other Technologies and for including considerations relating to the community industry impact of these innovative processes for electricity generation. We anticipate that an outcome will be a better understanding of the rules governing the establishment of grid connected microgrids identify if there is benefit in changing some of these regulations.

The OMA believes that if the State Government believes it should facilitate investment in new forms of generation, it should also include broader environmental, community and industrial benefits following from adoption of a particular technology. There should be a special investigation into whether the Strategic Reinvestment of the current hidden supply subsidies in the SWIS can reduce the burden on urban householders and businesses over time. This assessment may need to look at the role of Local Government as well as the potential for economic development in the region.

The OMA looks forward to talking to the Committee about its vision for a number of bioenergy operations across the WA Wheatbelt that can stimulate integrated agroforestry, utilise the existing resource and provide new services based around bioproducts as well as providing sustainable electricity to local communities and larger centres.

RECOMMENDATIONS:

1. That the stable and baseload capacities of bioenergy be recognised.
2. That the community, employment and industrial benefits of bioenergy be acknowledged.
3. That transparency be required when addressing the cost of service delivery to specific regional centres and that locational pricing be adopted to facilitate the connection of additional mid and end of grid sources of generated electricity.
4. That a review be held into the overlapping and confusing regulatory and legislative conditions relating to connection to the grid.
5. That a trial of the Bioenergy Hub concept be established at Kalannie.

Simon Dawkins
Director

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E. ATTACHMENTS

1. http://www.fpc.wa.gov.au/content_migration/_assets/documents/plantations/industry_plans/oil_mallee_idp.pdf

www.oilmallee.org.au

2. http://www.aphref.aph.gov.au_house_committee_arff_forestry_subs_sub68-2.pdf

3. https://www.researchgate.net/publication/274961815_Mallee_Aviation_Biofuels_Life_Cycle_Assessment

<https://onlinelibrary.wiley.com/doi/full/10.1002/wene.221>

<http://www.futurefarmonline.com.au/research/new-woody-crops/sustainable-jet-fuel.htm>

4. <http://www.rainbowbeeater.com.au/>

See two documents attached to this submission

- RBE Ballarat AIEN Waste to Energy Conference (Presentation)
- Kalannie Bioenergy Hub (Feasibility)

5. <http://energy.curtin.edu.au/>

http://renergi.net/why_biomass

<http://news.curtin.edu.au/rdnow/stories/from-little-things-big-things-grow/>

Simon Dawkins

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0412563388



Introducing ECHO₂



ECHO₂

- Renewable Energy from organic residues
- Base Load, Low Cost, Carbon Negative, Local Jobs
- Suitable for any business or community using a few hundred kW of energy or more



Rainbow
Bee Eater

Single purpose Australian owned
company. 2007 Origins.

*Develop and supply modular 'biomass
to energy systems' with benchmark
cost, environmental and social benefits*



SDA Engineering



**Rainbow
Bee Eater**

AusIndustry[™]
BUILDING BUSINESS · POWERING PRODUCTIVITY

11 years development - support from SDA, AusIndustry, other State and Federal government and industry

Potential world best in class - RBE owned patent pending - no known barriers to up-scaling 10X or more

Australian manufacture by SDA Engineering

1st public release of information July 2017

2007 Origins: 'find a system'



Ian Stanley

sustainable land use

biomass residue

regional jobs

"Which biomass to energy system?"



Peter Burgess

energy intensive

offset carbon risk = jobs

many biomass residues not valued

which business model?

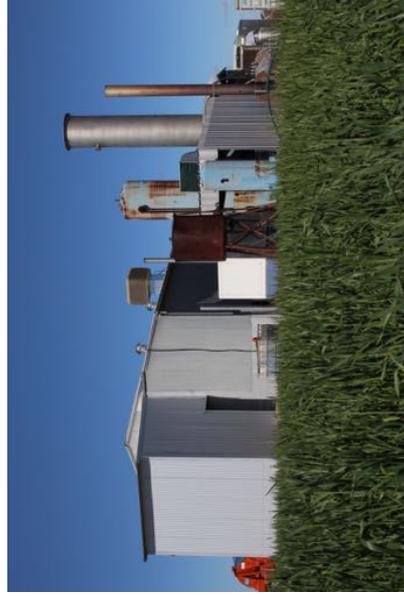
"Which biomass to energy system?"

what is our ideal system?

1. uses low value residues
2. not reliant on subsidies
3. automated and on demand
4. uncomplicated, clean, quiet, safe
5. affordable, 2 to 8 year capital return
6. very low emissions, very carbon negative



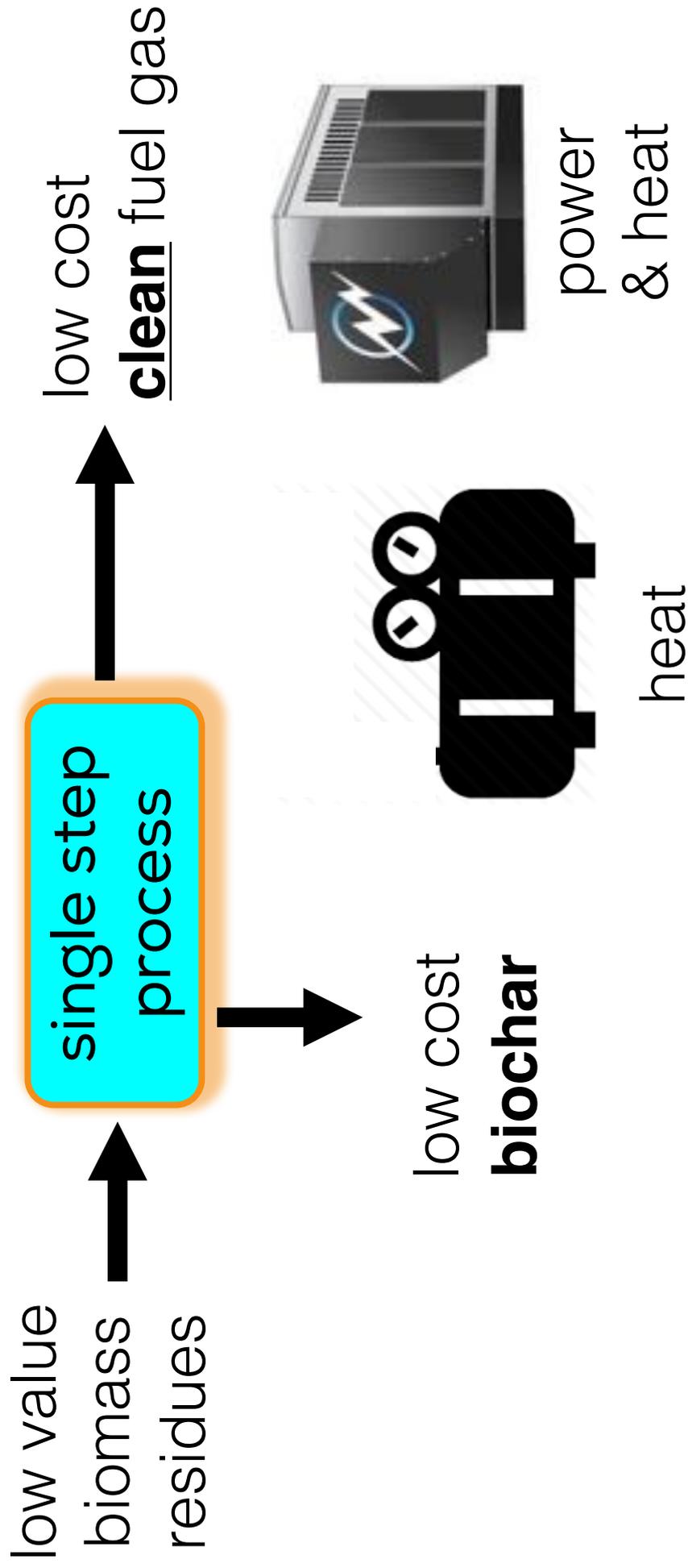
2008 - 2014 global technology search & testing



2008 - 2014 global
technology search & testing

**No existing system
met our 6 ideals**

what enables an ideal system?





2014 – 2017

'develop ECHO₂'

ECHO₂ Prototype

SYNGAS

BIOMASS

PROCESSOR

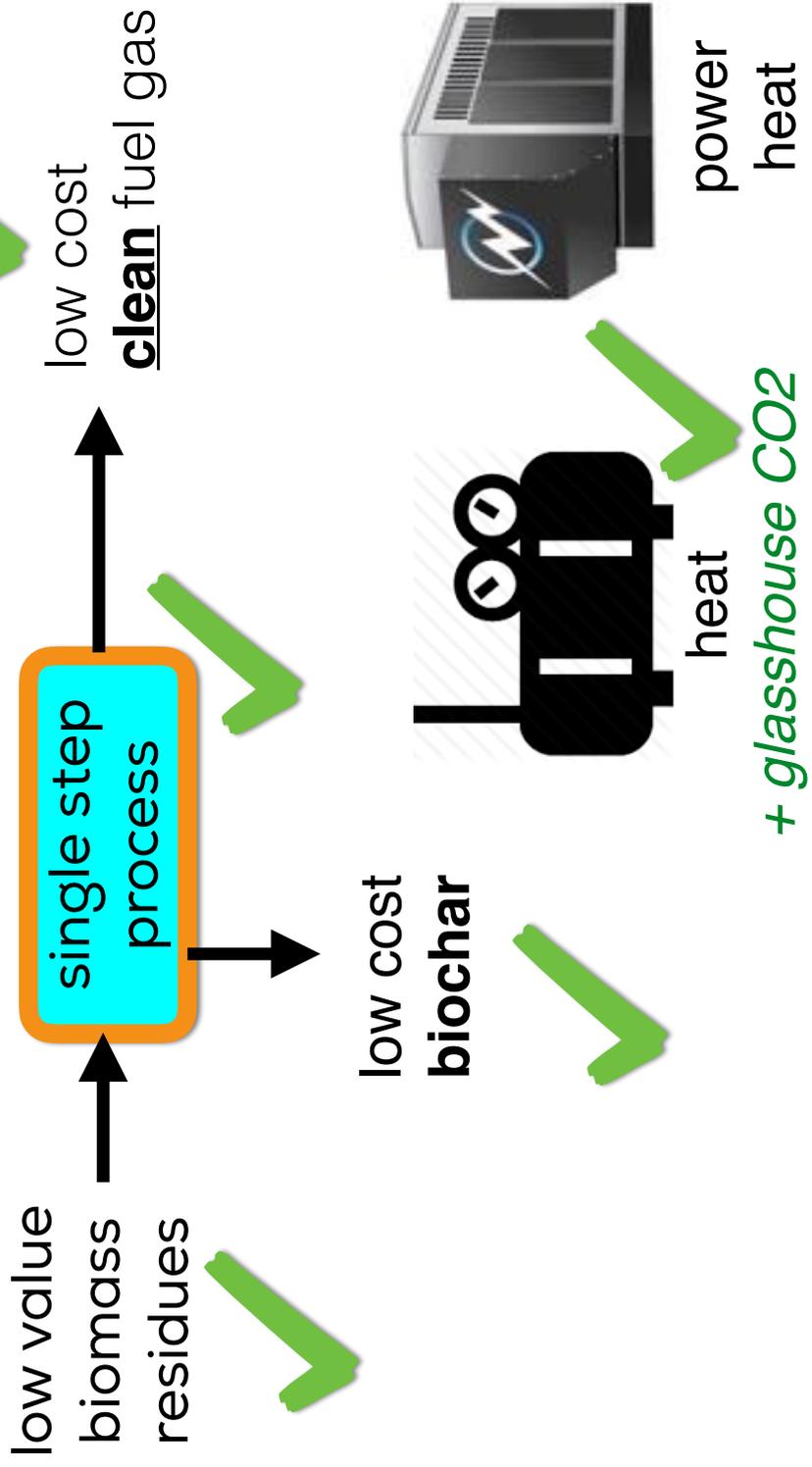
BIOCHAR

CONTROLS





does ECHO₂ = our ideal system?

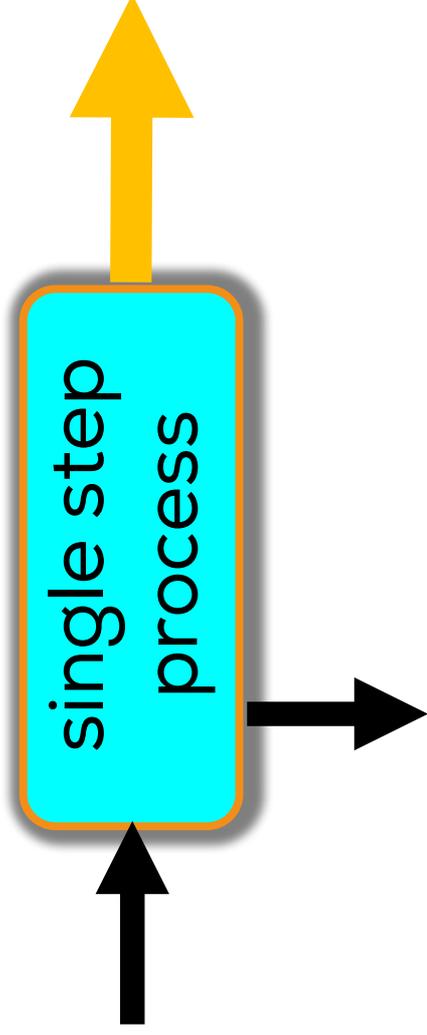


ECHO₂ and our checklist

1. utilises low value residues ✓
2. not reliant on subsidies to build or operate ✓
3. automated and on demand ✓
4. uncomplicated, clean, quiet, safe ✓
5. affordable, 2 to 8 year capital return ✓
6. very low emissions, very carbon negative ✓

ECHO₂'s major point of difference?

the single step process from
biomass to clean fuel gas



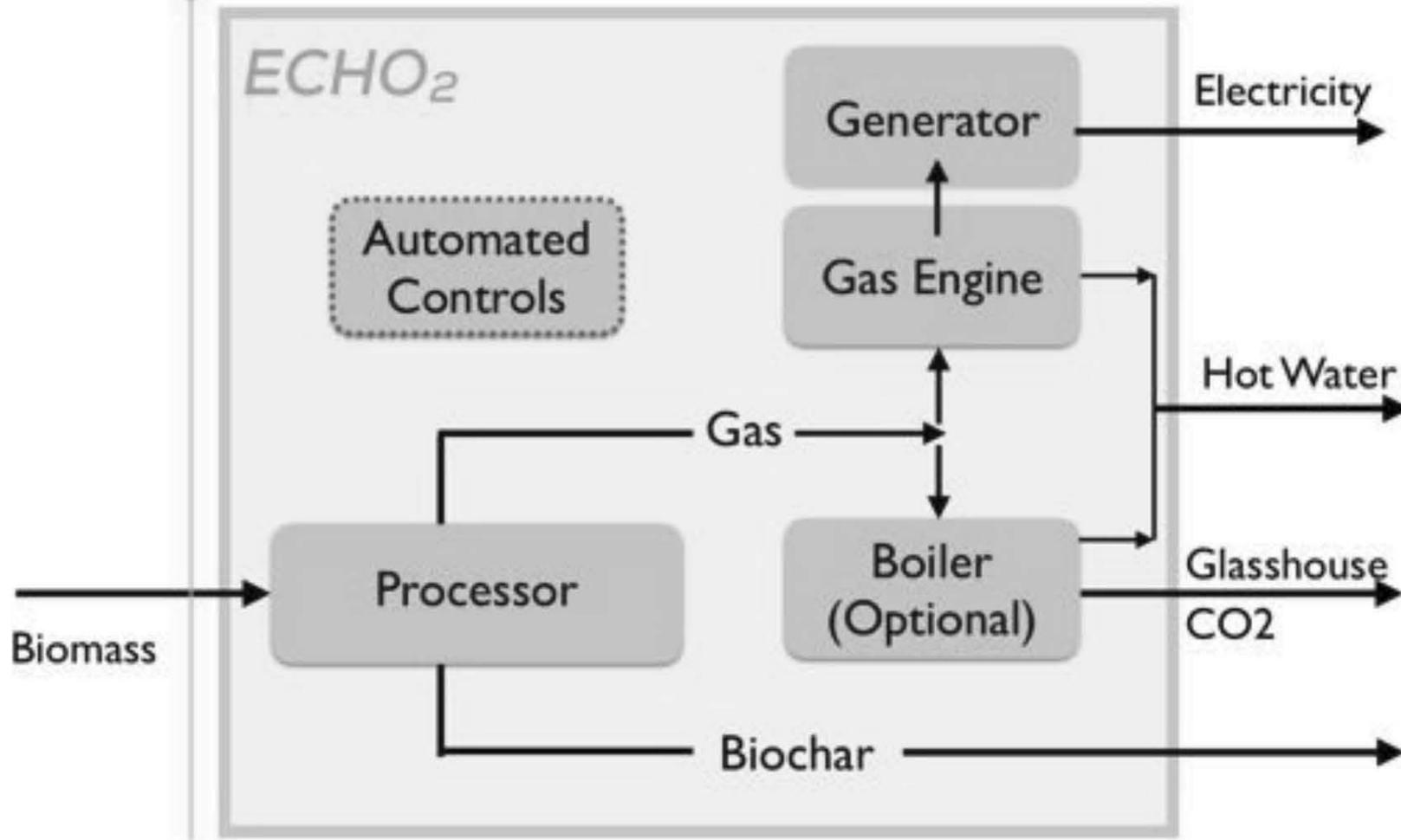
What do I get when I purchase
an ECHO₂ module?



The ECHO₂ Package



SDA Engineering



Indicative Performance Specs

hot water	400 - 800	kW
electricity	100 - 200	kWe
biochar	~ 200	kg/hr wet basis
CO ₂	~ 250	kg/hr (Boiler Option)
biomass	500 - 600	kg/hr@15-25% moisture nominal 5 - 15mm, clean
footprint ~ 10m x 10m		

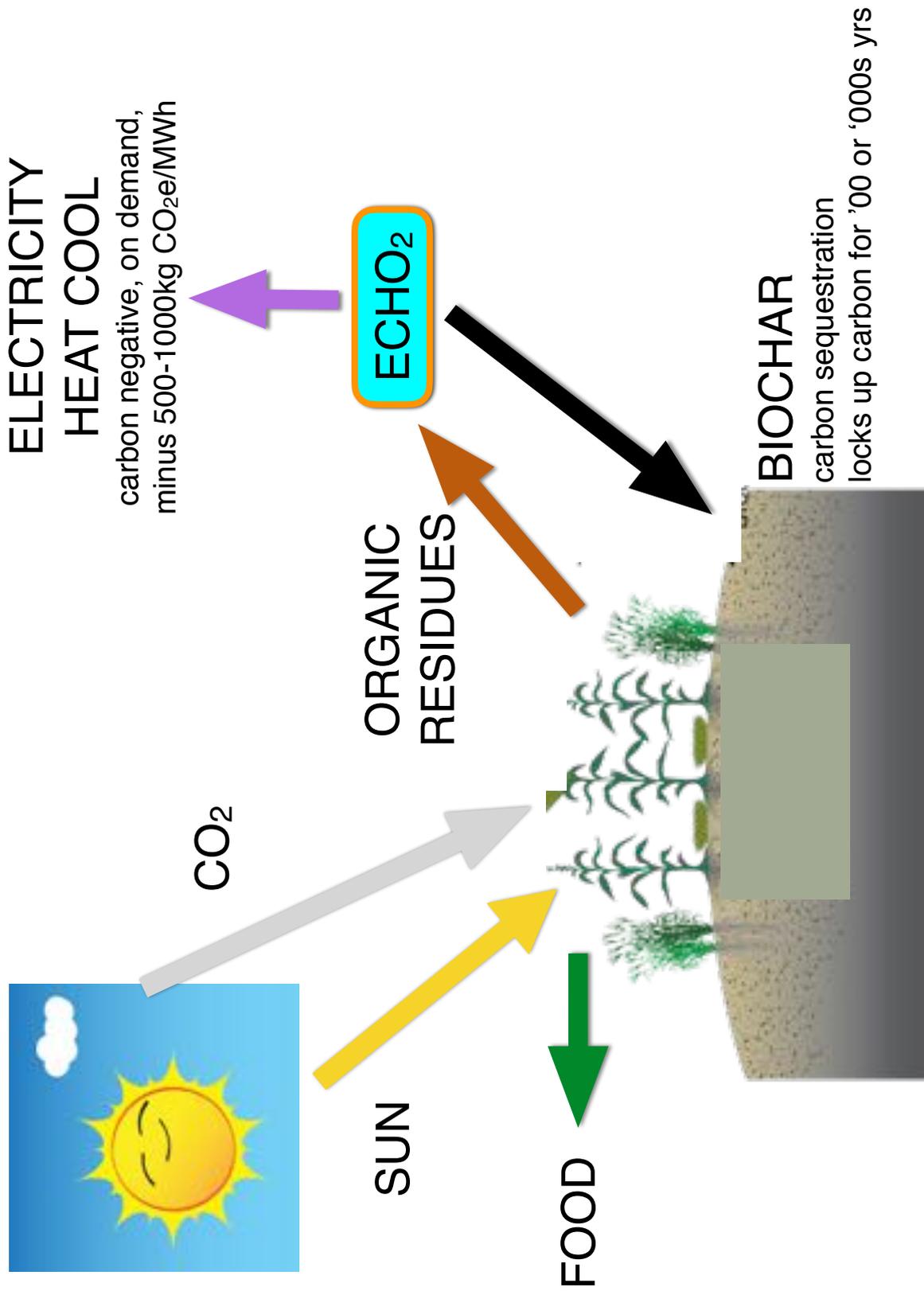
Single module specs, subject to engineering study of customer requirements and biomass characteristics

**ECHO₂ comes with a performance guarantee,
a warranty and a service agreement**

Where is the biochar market?

Biochar

- charcoal 80 – 90% Carbon
- occurs naturally in many soils (fire)
- ‘Natures Way’ of carbon sequestration – charcoal locks up carbon for hundreds or thousands of years
- increases biological activity, soil carbon and fertility of many soils (organically)
- absorbs toxins and odours



- world wide biochar market: low volume & high production cost (circa \$500 – 2000/t)
- limited by high production cost/air emissions
- multiple biochar markets emerging with high social, environmental and economic value:
 - horticulture, animal feed, animal bedding,
 - agriculture, building products, fuel etc

ECHO₂ clean fuel gas value
means low cost, low emissions
biochar

~~\$500 = 2000/t~~
\$100~200/t

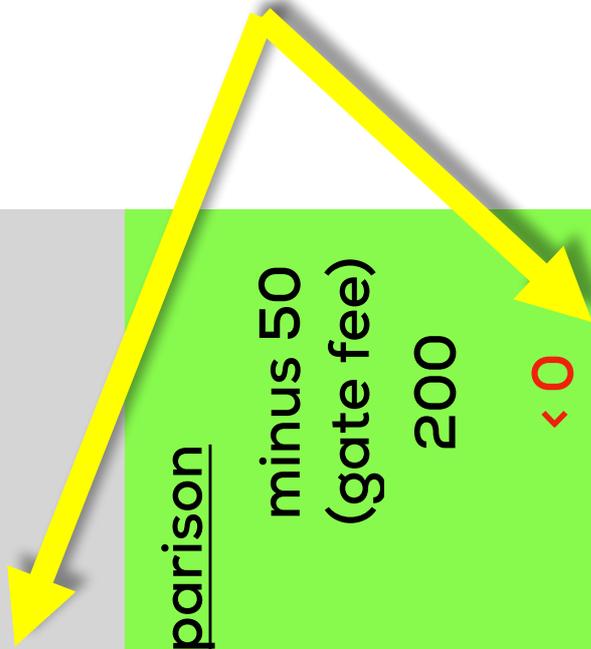
**What are the indicative
economics?**

ECHO₂: 40 hrs/week Operation

<u>Current Energy Cost</u>	
electricity \$/MWh	200
gas \$/Gj	20

<u>ECHO₂ Comparison</u>	
biomass cost \$/t	50
biochar revenue \$/t	200
electricity LCOE \$/MWh	100
gas LCOE \$/Gj	5
ROC years	10

minus 50 (gate fee)	200
	< 0
	< 0
	7
	6



ECHO₂: 24x7 Operation

<u>Current Energy Cost</u>	
electricity \$/MWh	200
gas \$/Gj	20
<u>ECHO₂ Comparison</u>	
biomass cost \$/t	50
biochar revenue \$/t	200
electricity LCOE \$/MWh	15
gas LCOE \$/Gj	0
ROC years	4
	minus 50 (gate fee)
	200
	< 0
	< 0
	3
	2

Estimated Local and National Job Creation

jobs per ECHO₂ module

local 3 - 5 FTE* plus

national 3 - 5* FTE

*German Govt data & RBE estimates, includes multiplier effect

<http://biomassproducer.com.au/wp-content/uploads/2013/11/01AustralianBioenergyRoadmap.pdf>

ECHO₂ Availability

- Commercial demonstration modules are now available on a 'make to order' basis
- ECHO₂ is proudly developed, designed and manufactured in Australia
- Government support may be available to assist customers with 'first of a kind' applications

1st ECHO₂ commercial module

Holla-Fresh

“FRESH START” PROJECT

Finding Renewable Energy Solutions for Horticulture



Two innovative family owned Mt Gambier SA companies



fuel oil and
purchased
electricity



replaced by

wood
residues



Nominal specs 1st ECHO₂ commercial module

BioGro

will supply: 550kg/hr sized biomass

and receive: 250kg/hr biochar

Holla Fresh

will receive carbon negative:

800kW heat

80kWe electricity

250kg/hr glasshouse CO₂





Holla-Fresh



Rainbow
Bee Eater



SDA
Engineering

AusIndustryTM
BUILDING BUSINESS · POWERING PRODUCTIVITY



May 2018



www.rainbowbee eater.com.au

KALANNIE BIOENERGY HUB (KBH) **STRAWMAN DRAFT FOR INPUT PLEASE. Version 2 28/3/18**

PROJECT CONCEPT:

Harvested mallee is stripped of its oil. The biomass residue is sized and fed into two co-located automated ECHO2 modules and converted to low cost electricity, biochar and process heat. The electricity powers Kalannie township. The biochar is sold for agriculture, horticulture and animal feed. The process heat is used to strip the oil. Location: Stanley Farms land near Kalannie. KBH is a pilot for future larger WA projects eg Narragin & Collie. The ECHO2 technology was developed in WA by RBE. The first commercial unit is being built for Holla Fresh at Tantanoola SA. This pilot project will:

1. provide the (long awaited) underpinning for a fully commercial WA oil mallee industry
2. base load low cost renewable electricity to enable a Kalannie micro grid
3. low cost biochar for agriculture, horticulture and animal feed
4. jobs: 4 or 5 permanent local jobs (FTE) plus 5 to 8 WA, SA & Victorian FTE jobs during design, manufacturing, installation and commissioning
5. reduced greenhouse gas emissions: KBH will reduce WA greenhouse gas emissions by ~7400 tonnes CO2e/year

PROJECT CONSORTIUM: RAINBOW BEE EATER, KOCHII, OIL MALLEE ASSOCIATION, NEWCO?, WA GOVERNMENT

PROJECT LEADER: IAN STANLEY

PROJECT ENGINEERS: SDA ENGINEERING

KBH COMMERCIAL STRUCTURE:

Capex funded by WA Government ~\$5M (subject to \$75k engineering study). Half by grant. Half by non recourse 3%pa loan. Kochii supply correct sized mallee residue into KBH moving floor bin. Kochii take KBH process heat for oil distillation. Newco (or Kochii) operates KBH 7 x 24. Newco (or Kochii) sells electricity via SWIS and sells bulk biochar FOB Newco (or Kochii) returns 50% of net income quarterly to WA Govt until 50% of \$5M plus 3% interest has been repaid (~5 years). Newco (or Kochii) then own the assets.

ANNUAL KBH FINANCIALS:	<u>\$/yr</u>	Indicative, subject to engineering study
Duty Cycle		7500 hours/year
Biomass Cost	\$ -	~9,000 tonnes/year, minus 25mm, just in time delivery to KBH hopper
Process Heat Revenue	\$ -	~3.3Gj/hour, swap for biomass
Electricity Revenue	\$ 506,250	7500hr x 450kWe x \$150/MWh ** price to be set by WA Govt
LGC Renewable Energy Credit	\$ 202,500	\$60/MWh
Biochar Revenue	\$ 620,000	3100 tonnes/year x \$200/t moist FOB x 7500 hrs/yr
Operating & Maintenance	\$ (247,500)	\$30/hour
Net Income	\$ 1,081,250	
Return on Capital %	22%	
Return on Capital years	4.6	

SENSITIVITY to 10% change	<u>Net Income \$/yr</u>	<u>Return on Capital years</u>
Electricity Revenue	\$50,625	0.2
LGC Credit	\$20,250	0.1
Biochar Revenue	\$62,000	0.3
O&M cost	\$22,500	0.1

Green House Gas **tonnes CO2e/year**

SWIS emission factor	0.7 kg CO2e/kWh	2363
biochar @ 40% moistu	1.8 kg CO2e/kg	5456
logistics & other emissions @5%		(391)

Total WA Reduction **7428**

subject to Life Cycle Analysis during engineering study