

Supplemental Materials for Cluster Opportunities in Gippsland: Facilitating the Development of a Biohub



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Sponsor:
Snowy River Innovation

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Table of Contents

Table of Contents.....	1
A: Biochar Benefits for Different Applications.....	2
B: Interview Instruments.....	4
C: Stakeholder Engagement Plan.....	7
D: Authorship.....	9

A: Biochar Benefits for Different Applications

Benefit Category	Specific Benefit
<u>Soil:</u>	<ul style="list-style-type: none"> • Improved water retention • Increased soil carbon • Some fertilizing effect (provides some nutrients depending on char) • Increases crop yields • Beneficial microbes are increased in soil • Increased legume content in soil • Enhances fertilisers' effects → less fertilizers are required for same job <ul style="list-style-type: none"> ○ Since fewer nitrates needed it is possible fewer preservatives are necessary see QLD Uni study
<u>Environmental:</u>	<ul style="list-style-type: none"> • Can convert waste into valuable products, diverting from landfills or incineration, thereby mitigating emissions • Stores carbon safely underground, where it cannot reenter atmosphere • Mitigates runoff of fertilizer or contaminants • As a feed additive reduces GHG emissions
<u>Livestock Feed Additive:</u>	<ul style="list-style-type: none"> • Reduces GHG emissions • Better yields (i.e. animals grow more/have better production) • Greater fertility • Animal welfare increased because of easier digestion and psychological benefits
<u>Economic:</u>	<ul style="list-style-type: none"> • Value added byproducts bio-oil and syngas • Host of value adds to the biochar • On its own, biochar sells for

	\$700-\$1000 AUD
<u>Concrete:</u>	<ul style="list-style-type: none"> ● Overall greater strength both tensile, torsional, compressive ● 90 day strength is increased/reached earlier → construction times are decreased
<u>Graphene:</u>	<ul style="list-style-type: none"> ● Sustainable product material when biochar is sourced from waste ● Cheaper production with cyrene

B: Interview Instruments

B-1: Interview Preamble

The purpose of this project, sponsored by Snowy River Innovation (SRI) and Gippsland Climate Change Network (GCCN), is to better understand the state of bioenergy/clusters/stakeholder interest (use whichever is relevant to the professions). Our goal is to facilitate the rapid development of bioenergy in Gippsland. The information will be used to assess the feasibility of a bioenergy cluster in Gippsland. Results will be published on our university website (WPI) and our sponsors. Should you choose to participate in this interview, know that you are free to end the interview at any time, and you may choose not to answer any of the questions. You will not be identified by name in the report if you choose, a pseudonym may be used if you prefer (bioenergy expert 1, for example). In signing this form, you acknowledge your willingness to participate in the interview, which should take roughly 30 minutes. If you have further questions about this study or wish to read our final report, please contact us at gr-b19snowy@wpi.edu or our WPI faculty advisors at ldh@wpi.edu and lgdavis@wpi.edu. (signature, date)

B-2: Interview Questions for Bioenergy Experts (Semi-Structured)

Questions for Bioenergy Experts (Semi-Structured)	
1.	What are some of the newer technologies in biomass and bioenergy?
2.	What parts of the world lead the way in bioenergy?
3.	Do you know of a bioenergy project involving the timber, agricultural waste, or industrial waste? (Biomass that is plentiful in Gippsland)
4.	Are some feedstocks more successful than others?
5.	What are some of the obstacles associated with bioenergy production? (With reference to political, economic, and social implications depending expert's knowledge)
6.	Are there specific groups that you know of who have done innovative projects with biomass?
7.	What are the capital costs and operating costs associated with different conversion processes?
8.	How does feedstocks, volumes, climate, etc. affect the overall cost?
9.	Are you familiar with biochar?

	<ul style="list-style-type: none"> • If yes, see question (10,11) • If no, see question (12)
10.	Do you know of any examples of places where biochar has been successfully marketed?
11.	Could you explain some of the issues in the biochar market?
12.	Is there anyone who does know of biochar that you could refer us to?

B-3: Interview Questions for Cluster Experts (Semi-Structured)

Questions for Cluster Experts (Semi-Structured)	
1.	What are some of the most important aspects of a cluster?
2.	What are some obstacles associated with developing a cluster? (With reference to political, social, and economical implications depending on expert's knowledge)
3.	What are the costs associated with developing a cluster?
4.	What parts of the world lead the way in clusters?
5.	Do you have any knowledge of bioenergy clusters? <ul style="list-style-type: none"> • If yes, see questions 6, 7 • If no, see question 8
6.	Could you provide examples of successful bioenergy clusters?
7.	What specific aspects of those bioenergy clusters led to their success?
8.	Is there anyone who does know about bioenergy clusters that you could refer us to?

B-4: Interview Questions for Business Leaders (Semi-Structured)

Questions for Business Leaders (Semi-Structured)	
1.	What processes do you have to process biomass? <ul style="list-style-type: none"> • If they use pyrolysis, see question 2, 3, 4 • If they don't use pyrolysis, see question 5
2.	How much biochar do you produce through pyrolysis? if so how much do you sell the biochar?
3.	How much do you sell the biochar for?
4.	Who do you sell the biochar to?

5.	What types of feedstock do you need to process biomass?
6.	How does feedstocks, volumes, climate, etc. affect the overall cost?
7.	What are the capital costs and operating costs associated with different conversion processes?
8.	What marketing plans do you have in place to sell your product?
9.	Could you explain the problems you see in the biochar market?
10.	<p>Open-ended topics:</p> <ul style="list-style-type: none"> a. Biochar b. Bioenergy c. Problems of a cluster d. Economics e. Industry viability

C: Stakeholder Engagement Plan

First Name	Last Name	Where they are from	Category/Categories	Priority	Contact Person	Contact	Contact Method	Comments
Nick	Chrissant	SV	Technology Providers	0	RD			
James	Joyce	Pyrocal	Technology Providers	0	PY			
Nigel	Murphy	Earth Systems	Technology Providers	0	PY		Face to face	
Doug	Pow	Pow Brook	Feedstock Providers	0	AJF			
Shaun	Scallan	Circa	Research Entities	0	TS			
Heidi	Lee	Beyond Zero Emissions	Consultants	0	PY			more for biohub study, networking
Graham	Moore	MLB Uhi	Technology Providers	0	RD			
Dr. Karen	Aarons	Ellen Bank Research	Research Entities	0	RB			
Nigel	Blair	E Agri	Research Entities	0	PY			*only if he is available
Tom	Miles	USDA	Research Entities	0	TS			
Domink	Dunst	Charline	Technology Providers	0	BR			biochar feeding additives specific to animals
Stephen	Kimber	NSWDPI		0	AJF			go thru JL
Stephen	Joseph	NSWU	Research Entities	0	BR			research on feeding biochar mineral complexes to animals (rumen fermentation), talks about treated biochar
Lorraine	Pugh	Montash Uhi	Research Entities	0	BR			biosolids relating to cows
		Grayson AU		0	AJF			
		Activated Carbon	Technology Providers	0	RB			
		Agri Protein		0	BR			
		Cool Planet	Technology Providers	0	RB			
		National Carbon Technologies		0	TS			
		Carbon Gold		0	AJF			
		Ecotopic		0	TS			
		Humvers (India)	Technology Providers	0	RB			
Rafael	Naracio		Research Entities	1				soil guy
Kelley	Wickham	AREMI	Technology Providers	1				
Noel	Barton	Capricorn Power	Technology Providers	1				
Brandon	Clark	Drop and Leave	Feedstock Providers	1				John L. knows him get info off JL, timber waste
Graham	Cock	ACE	Study Partners	1				
Simon	Cock	ACE	Study Partners	1				
John	Macdonald	SRI/DesignInc	Research Entities	1				as a support
Danny	Williams	GDP		1				
Jennifer	Albert	JPL		1				
Sigfali	Aktar	RMIT	Research Entities	2				"Influence of Pyrolysis Preparatory Conditions (temperature, residence time and heating rate) on Characteristics of Biosolids Derived Biochar"
Geoff	Andrews	SRI/Genesis Now	Technology Providers	2				as a mentor
Euan	Beamont	Energy Farmers AU	Consultants	2				Developments & Projects in Western AU
Julie	Bird	SV (AREMI)	Technology Providers	2				
Jim	Bland	Enecon	Consultants	2				connection with Rowan
Peter	Burges	Rainbow Bee Eater	Technology Providers	2				Rubberised biochar as a bitumen additive
Rowan	Doyle	Capricorn Power	Technology Providers	2				as a mentor
Kathleen	Draper	International Biochar Institute	Research Entities	2				focus on using biochar in cement, quick email
Mike	Hodgkinson	Capricorn Power	Technology Providers	2				as a support
Rob	Mallinson	Living Energy	Technology Providers	2				
Morag	McKay	Latrobe Valley Authority	Research Entities	2				Energy Officer LVA - biochar/bioenergy interests
Bhawana	Bhatta	University of Melbourne	Research Entities	3				
Justin	Borevitz	Australian National University	Research Entities	3				
Liz	Clay	Piedmont Organic Farm	Feedstock Providers	3				regenerative farming, organic farmer
Annette	Cowie	Bioenergy Australia	Research Entities	3				Rubberised biochar as a bitumen additive
Kathy	Dawson	Biochar Network of WA	Research and Project Funding	3				biochar- reducing livestock's carbon footprint
Ruy	de la anaya Rosa	Pacific Biochar Initiative	Research and Project Funding	3				Biochar for the Pacific - Certified Organic and Ethical Production Initiatives"
Diane and Ian	Haggerty	Haggerty Farm		3				
Heidi	Hamm	SV		3				Gippsland Region Project Coordinator
Kua	Ham Wei	Uni Singapore	Research Entities	3				speaker at ANZBI who used biochar in concrete
Peter	Hughes	Earth Systems	Technology Providers	3				
Adrian	Morphett	Earth Systems	Technology Providers	3				
Jennifer	Patterson	Yarra Energy Foundation	Consultants	3				
Sarah	Rees	VIC Forests		3				great forest national park
John	Sanderson	Earth Systems	Technology Providers	3				
Ian	Stanley	Rainbow Bee Eater	Technology Providers	3				Clean low cost Renewable Gas for Industry, Carbon Sequestration for our Planet.
Kristin	Tripp	USDA	Research Entities	3				
Luke	van Szeeten	NSWDPI		3				
Nick (Engineer)		Genesis Now		3				biohuks from india
Michael	Crook	Evo Energy Technologies		4				
Gerald	Dunst	Sonnenerde Austria	Technology Providers	4				talk at ANZBI: carbon credit system for humus increasing in soil
Domink	Dunst-Charlin	Biochar Network of WA	Research and Project Funding	4				Biochar - reducing livestock's carbon footprint
Dennis	Enright	BNZ	Research and Project Funding	4				Biochar activity in NZ: a case study and other emerging opportunities
Alan	Finkel	AU Chief Scientist	Research Entities	4				
Mauro	Giorcelli	Politecnico di Torino	Research Entities	4				An innovative use for Biochar: humidity sensor
Evert	Hale	Frontier Impact Group	Consultants	4				
David	Halliday			4				biogas solutions

First Name	Last Name	Where they are from	Category/Categories	Priority	Contact Person	Contact	Contact Method	Comments
Gordon	Hirst	Chang Mai University	Research Entities	4				Practical application of a biochar derived fertilizer for use in paddy rice cultivation.
Shahla	Hosseini	University of Central QLD	Research Entities	4				Soil nitrogen, organic carbon and crop yield after biochar application – a meta-analysis
Dean	Hurlstone	Conhar	Consultants	4				Making a value added product from dewatered sewerage sludge & Wood Biochar
Steve	Ingrouille	SRI/Going Solar	Technology Providers	4				
Ryan	Jansz	Boral	Technology Providers	4				
Michael	Jeffrey	Soil for Life	Community	4				
Christian	Jirkowsky	Politechnik Biomass Energy	Technology Providers	4				Polytechnik - Green Carbon
Louisa	Kiely	Carbon Farmers of AU	Authorities & Agencies	4				Mainstreaming the benefits of Biochar in soils using the Carbon Farming Markets
Andrew	Lang	Enriva		4				
Stuart	Larsson	Soft Agriculture	Technology Providers	4				Biochar for Soil/Plant/Tree health. Use in indoor growrooms with neutral/negative benefits.
Roger	Leakey	Novel Forestry and Crops Unit		4				
Robie	Mangubat	Carbon Activated AU		4				
Paul	Martin	Grown Fuel Biodiesel Consultancy		4				
Scott	McArdley	LVA		4				
Michael	McGuire	Governor's Office Call	Authorities & Agencies	4				
Scott	Morgan	Governor's Office Call	Authorities & Agencies	4				
Nelsa	Olsen	SoilKee Renovator	Technology Providers	4				
Pia	Otte	Institute for Rural and Regional Research	Research Entities	4				
Lokesh	Padhye	University of Auckland	Research Entities	4				Producing effective adsorbents from biomass waste by understanding and manipulating surface chemistry through different treatments
Jorge	Paz	RMIT	Research Entities	4				Recent advances on biochar research
Gedf	Prodor	Ironwood Technologies	Technology Providers	4				Ironwood Technologies - An Update
Robert	Quirk	Cane Grower	Feedstock Providers	4				
Nimesha	Rathnayake	RMIT	Research Entities	4				Kinetic Parameter Estimation for Slow Pyrolysis of Biosolids
Melissa	Rebeck	Climate Agriculture & Support	Consultants	4				dung beetles & outreach to farmers
Mohammad	Reza Ghaffariyan	University of Sunshine Coast	Research Entities	4				
Frank	Sanders	Pacific Biochar Initiative	Research and Project Funding	4				
Chris	Scheurs	Scheurs & Sons	Feedstock Providers	4				
Emily	Scoles	EnviroMicroBio	Consultants	4				
Ekaterina	Selezneva	RMIT	Research Entities	4				Pyrolysis of Biosolids: Process modelling and Economic Analysis
Kalpt	Shah	RMIT	Research Entities	4				Recent advances on biochar research
Patricia	Sharkey	Heat is Power Association		4				
Shannon	Smith	Gippisland Logging and Earth Moving (GRE)	Feedstock Providers	4				
Frank	Stie	Terra Preta Developments	Technology Providers	4				Why Do It? PyCCS - Biochar co-generation & ProSilva: Responsible Forest Resource Management
Sara	Tahery	NSWU	Research Entities	4				A comparison between the effect of NPK granules and NPK coated biochar on soil properties
Nigel	Thomas	Oceania Clean Energy Solutions		4				Biorefining of lignocellulosic biomass to biofuels and activated carbons
Andre	Van Zyl	CarbonCor Australia	Technology Providers	4				100ts of biochar consumed safely per km of road. How?
Tom	Vogan	Energy Farmers AU	Consultants	4				
John	Williams	Biodiesel		4				
Zhanying	Zhang	QLD Uni of Technology	Research Entities	4				
Christos		Pyrotechnology		4				
		HALS (TAZ)		4				
		Curica (MLB)		4				Cyrene
		HRL (herman research lab)	Research Entities	4				
		AJ Brown, Drouin		4				
		Radfords		4				
		Fonterra		4				
		Saputo		4				
		Rabo Bank		4				
Don	Coyne	ANZBI	Research Entities					organized conference, talk to JL about how to rank him priority wise
Mara	Seeds (NSW)							
lan	Southall	GCCN						CEO GCCN
	Romy	Zyngier	Research Entity	1				
	Richard	Edkhard	Research Entities	1				MLB Uhi
Ash	Wallace and RD Armstrong, Belyaeva ON, Harris RH (research team)		Research Entities	1				soil research N2O

Contact information, such as emails and phone numbers, has been redacted, but will be available to future WPI teams through Snowy River Innovation

D: Authorship

	Robert Batista	Alec Jensen-Fellows	Rebecca Richard	Trey Sheridan
Role	Project Manager	Archivist	Editor	Designer
Research Topics	Bioenergy, types of biomass, biochar, stakeholder engagement, biochar market in AU	Clusters, types of biomass, methods of processing biomass, Pyrolysis, Gasification, biochar market in AU and US	Case studies, benefits of biochar, sponsor background, biomass in Gippsland, biochar market in AU and EU	Biochar and its benefits, case studies, stakeholder and resource mapping, US and AU biochar market
Written Sections	Cluster Opportunities in Gippsland: Facilitating the Development of a Biohub			
Introduction	The Escalation of climate change	Sentence-level edit	Organizational edit	The Escalation of climate change
Background	Current Sources of Bioenergy	The Cluster model	Market analysis, potential partners	Climate Change, Bioenergy, Biochar
Methodology	First Objective Methods, Second Objective Methods: Defining and prioritizing key Stakeholders, Biochar Market report	Second Objective Methods: Stakeholder interviews	Third Objective Methods	Second Objective Methods: Resource and Stakeholder Mapping
Results	Organizational edit	Sentence-level edit	Sentence-level edit	Summary of the key Outcomes from the cluster and biochar reports
Recommendations	Sentence-level edit	Sentence-level edit	Summary of recommendations from biochar and cluster report	Organizational edit
Conclusion	Conclusion of report and findings	Sentence-level edit	Sentence-level edit	Organizational edit
Final booklet compilation	N/A	N/A	Final sentence-level editing	Booklet Design and Organization

Biochar Report	Background, Potential Biochar Markets in Australia	Introduction, Biochar's Evolution in the US	Biochar's Evolution in the Australia, International Outlook, executive summary	Key insights, Recommendations
Cluster report	Introduction, Valuestack, Methodology, Cluster selection criteria	Background, Building strategic partnerships	Next steps, Executive Summary	Resource mapping, Proposal for Grantville
Tasks	Weekly progress report, research, writing, note taking	Meeting minutes, organized drive, updated slides, research	Updated slides, research, formatted documents, Writing quality control	Sponsor outreach, slide design/animation, Presentation review
Presentations	Created slides as needed	Created slides as needed	Created slides as needed	Presentation Quality Control, Revised and created slides
Interviews	Note taking	Lead interviewer	Note taking & Lead interviewer	Note taking & Lead interviewer
Graphics	Created graphics as needed	Created graphics as needed	Created graphics as needed	Revised and created graphics as needed