COMMUNITY POWER HUB BALLARAT

BALLARAT RENEWABLE ENERGY AND ZERO EMISSIONS

BOUCHER CONSULTANCY

Business Plan: Woodchip Supply Enterprise

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Foreword

Between 2017 and 2019, Ballarat Renewable Energy & Zero Emissions (BREAZE) Inc. was the recipient of funding from the Victorian state government to deliver a pilot community energy project in and around the central highlands of Victoria. The same initiative was put in place in Bendigo and the Latrobe Valley and implemented by organisations similar to BREAZE. These pilots were known as Community Power Hubs (CPHs). The Community Power Hubs were required to identify community, renewable energy projects and facilitate technical, social and financial feasibility studies that, if shown to be successful, would mean the projects were ready to be funded and subsequently implemented. This business plan was prepared as part of CPH Ballarat's activities.

Co-incidentally, during 2016 and 2017, BREAZE had received other State government funds to look at using waste sawdust and wood to establish a wood briquette supply chain. The result of this investigation provided a variety of learnings but the one that is relevant to this report is that organisations considering a conversion from gas to biomass, require evidence of established, local woodchip suppliers.

CPH Ballarat undertook a variety of investigations into biomass, particularly the use of wood chips from waste timber as an energy source. Amongst other things, these investigations looked at what sort of biomass burning equipment is immediately available for installation in Victoria; what is the capacity of such units; what is their cost; and, what sort of biomass can they use as feedstock, from the range of waste wood that is around the region. It was identified that there are a variety of waste wood resources in the areas surrounding the Ballarat CBD and these range from construction and demolition waste to forest residues from timber harvesting operations to dead dying and diseased farm trees. In association with estimates made elsewhere, this report uses those figures to inform this business plan.

CPH Ballarat also contracted to have investigations made as to the specifications required for quality assured woodchips as well as the type and cost of the machinery required to process the waste wood. Again, the findings from these investigations inform this business plan.

This business plan does not present an optimistic picture of the financial viability of establishing a wood chip supply business. There are, however, a variety of assumptions built into the business plan that may be open to challenge and lead to a different result. Additionally, a potential enterprise may have some advantages that allow it to deliver a better financial outcome that this business plan suggests. One of the values of this business plan is that it outlines where subsidies could be applied as well as providing a template for enterprises that want to look at the results that they might be able to achieve, given their particular circumstances.

Another considerable impediment identified in this business plan are the zoning issues of an enterprise with 'adverse amenity potential', of which wood chips is one (along with other operations such as tanning and poultry processing). Having said that, expert assistance to seek a variation to the planning scheme's expectations might be worthwhile, if all other aspects of the business plan were positive.

There is a lot of waste wood in the Ballarat region and a solution is needed for its ultimate disposal, other than sending it to land fill or burning it in the paddock or on the forest floor, for no benefit other than to 'clean up'.

Jane Lean
On behalf of CPH Ballarat
July 2019

1. Executive Summary

Below are the key findings for a Woodchip Supply Enterprise (WSE) business plan:

- Woodchips sourced from waste wood are 43% cheaper than natural gas and one fifth the cost of LPG per hour of consumption in a boiler providing industrial heat.
- In the current scenario, there is no positive Return on Investment (ROI) for a WSE.
- Selling price has been calculated at $125 per tonne which includes; the purchase of waste wood, fixed and variable costs, and a 20% profit mark-up.
- The wood supply will be predominately sourced from municipal waste wood. Other sources of waste wood could include dead and dying trees on farms and public land, waste from roadside trimmings, and excess wood from tree felling organisations. A free, clean wood drop-off will also be developed for the public.
- Setup costs for a new start-up WSE are estimated at $2.04 million, fixed costs are $316k per annum and variable costs are $36 per tonne of woodchips.
- The WSE will need to process and sell 5,641 tonnes of woodchips per annum to break even and 5,900 tonnes per annum to make a 10% profit after tax.
- The State Planning Scheme regulates that a new WSE must be sited on 'industrial' zoned land and at least 1.5 km from any residential zoning.
- Insurance will need to be sourced through a specialised insurance underwriter due to the higher risks associated with stocking, transporting and selling a flammable product.
- In the early years, the WSE Manager will have dual responsibilities for both the operation of the WSE and for liaising with local industry and business to encourage changeover to biomass boilers.
- Within two years the WSE will need three organisations converted to biomass and within four years the WSE will need seven to eight local organisations utilising biomass.

2. Introduction

This document will present a business case to establish a Woodchip Supply Enterprise (WSE) in Central Victoria that will utilise waste wood from various sources, chipped to biomass specification, and delivered to customers who have biomass boilers designed to accept woodchips.

The energy sector is rapidly transforming both in Australia and around the world. Fossil fuels are gradually being phased out and replaced with renewable energy that reduces Greenhouse Gas Emissions (GHG) and provides lower energy costs for households and industry.

In Victoria, the current State Government has ambitious targets to lower emissions and increase the mix of renewable energy generation. For GHG emissions, the long-term target is net zero emissions by 2050, with five-yearly interim targets leading up to 2050. Victoria's current renewable energy generation is 20%[1] and the Victorian Renewable Energy Target (VRET) has three goals:

- 25% renewable energy by the year 2020
- 40% renewable energy by the year 2025
- 50% renewable energy by the year 2030

Although much of the renewable energy focus has been on wind and solar, biomass can also play a key role in reducing GHG emissions and increasing the renewable energy generation mix for Victoria.

Unlike intermittent wind and solar, biomass provides baseload 24/7 industrial heat. Although set up costs are higher, woodchips sourced from waste products are 43% cheaper than natural gas and five times cheaper than LPG per kWh.

Regional Victoria is the ideal location for a biomass expansion, as biofuel is readily available and most regional towns have no connection to natural gas and rely on expensive LPG.

For this business plan, the biofuel will primarily be sourced from waste wood through several sources including municipal waste, dead and dying farm trees, and forestry tree residue. The wood will be chipped to international and European biomass specification using a specialised biomass processor.

Currently there are only four biomass boilers operating in central Victoria that utilise woodchip biomass combustion and a WSE will play a key role in expanding the local biomass footprint. A WSE will assist local industry to transition from gas boilers to biomass for heating, steam, hot water renewable electricity and renewable gas (biogas). While not selling biomass boilers, to assist potential customers, the WSE will provide analysis, estimated capital and operating costs, and predict a return on investment for biomass conversion.

[1] https://opennem.org.au/#/region/vic/energy

3. Biomass supply business

3.1 Business profile

A WSE will be either a new enterprise, or an established business that is passionate about renewable energy and willing to diversify into woodchip supply. Although local demand for biomass energy solutions is low at present, this is probably because there is no large, reliable supply of biomass. There are few businesses that would commit to a system when the supply of the feedstock can't be identified.

A WSE will focus on two areas:

- The WSE manager will liaise with local businesses and industry and make a compelling case to changeover boilers fuelled by fossil fuels (natural gas/LPG) to biomass for industrial heat.
- The business will establish a biomass woodchip business that will supply A grade woodchips for customers with biomass boilers. The biofuel will be sourced from waste products (such as municipal waste wood, dead farm wood and forest residue), chipped to international and European biomass specifications, and delivered to customers on a timely basis.

The key elements of a WSE are:

- Employ management and staff who are passionate about growing the biomass footprint in Central Victoria. Good staff are essential for a global industry that is in its infancy in Australia. The demand for woodchips will grow as more business's covert to biomass boilers.
- Locate the enterprise in Central Victoria and close to highways and major arterial roads to connect with Ballarat and nearby towns.
- Chip local municipal waste wood, dead and dying trees from farms and roadside tree residue to international biomass standard ISO 17225-4 using a biomass processor manufactured by Jenz in Germany.
- Store both wood and woodchips in a safe manner to minimise fire risk and ensure woodchip quality does not deteriorate.
- Deliver woodchips to customers on a timely basis.

3.2 Steps to establish a business

The following steps are required when establishing a new WSE:

Business Structure - When starting a new business, the owner(s) will need to determine which form of business structure will best suit a WSE. The business can trade as a sole trader, company, partnership, collective, social enterprise or trust. Seeking expert advice from an accountant or a lawyer will assist in determining the most suitable business structure.

Australian Business Number (ABN) – A WSE will need to register for an ABN. An ABN allows a business to:

- obtain a business name
- confirm your business identity when ordering and invoicing
- claim GST on invoices
- avoid pay as you go (PAYG) tax

Registering a business name – A business name must be on the business register and cannot be the same as another business. The cost to register a business name is $36.

Register a Business – Once the preferred business structure is finalised (sole trader, partnership, company), the WSE must register the business. Registering a business is generally undertaken by an accounting firm who will complete paperwork and submit signed documents to relevant bodies.

Register for PAYG withholding – A WSE needs to register for Pay As You Go (PAYG) withholding when paying an employee's salary. This allows the business to deduct PAYG tax from the salary.

Register for GST – A WSE will need to register for GST if the annual turnover is greater than $75,000. Registering for GST will also allow a business to claim the portion of GST on business related purchases.

Register a domain name – A website will be required with a domain name registration. The cost is $116 for five years.

3.3 Business site

The WSE site for a new business will require the following features:

- physically located in the Central Highlands region. Suggested areas include the Ballarat or Creswick region as these locations are close to the municipal waste wood supply
- a minimum of a one to two hectares of land
- land zoned 'industrial' as per the Victorian Planning Scheme
- located more than 1.5km from a residential zone (as per Victorian Planning Scheme)
- accessible to highways and major arterial roads
- capacity to store vehicles, trailers, biomass processor, plant and equipment, stock of wood, stock of woodchips and office space
- capacity to construct an undercover woodchip storage facility, 25 metres length x 15 metres width x 6 metres high
- appropriate heavy vehicle access to drive-in load or unload, and drive-out without reversing
- chain wire security fence around perimeter of property
- office space, toilets and carparking amenities for four to five staff. Office space can be constructed onsite or demountable

3.4 Required plant & equipment

Jenz biomass processor

A recent report by Boucher Consultancy on woodchippers recommended the purchase of a Jenz Biomass Processor for chipping waste wood[2]. The German manufactured Jenz BA 725 biomass processor can chip waste wood, contaminated wood, tree roots with soil residue, clean farm wood, and tree residue in the one machine.

Horizontal grinders can also process both waste wood and clean forest residue, but they cost considerably more (approximately $1.5 million) and the changeover process from chipping waste wood to forest residue takes several hours to two days depending on the manufacturer. The Jenz Biomass Processor has interchangeable blades for processing waste wood and clean wood. This changeover process from chipping waste wood to forest residue takes one to two hours.

The Jenz BA 725 can process up to 100 tonnes of biomass per hour, however chipping to 25mm – 30mm biomass specification will slow down processing to 22 tonnes per hour. The biomass processor will consume approximately 79 litres of diesel per hour equalling 3.6 litres of diesel to create 1 tonne of 25-30mm woodchips.

Jenz biomass processors are manufactured as either: towable dual axle, towable triple axle, stationery, or tracked models with remote control. The tracked model with remote is the preferred option. This model is more expensive, however the remote control feature allows the chipping process to be carried out by one person. Other models require two people for operation.

Some large woodchippers from the United States and Europe have not complied with the Australian Design Rules (ADR) and VicRoads certifications when imported into Australia. ADR and VicRoads compliance specifically relates to towing a woodchipper with a prime mover. An alternative to towing is to carry a biomass processor on a low loader trailer.

https://www.vicroads.vic.gov.au/business-and-industry/heavy-vehicle-industry/oversize-light-vehicles

[2] Wood Processing Equipment, Boucher Consultancy, 11 March 2019

Jenz BA 725 biomass processor details

Item	Description
Model	Jenz Biomass process BA 725
wheels	Dual and triple axle and tracks with remote control
Stationary model	Yes, available on permanent stand
Cost	From $670,000 ex GST
Weight	20 tonnes
Production (tonnes per hour)	22 tonnes – waste wood chipping to biomass specification
Max tree diameter	820 mm
Electric motor	Yes, optional electric motor 200 kW
Engine	Mercedes-Benz diesel 390 kW
Screen included	Yes, chip to 20mm – 30mm

tracked model with remote

triple axle model

duel axle model

Stationary model

Additional equipment requirements

Wheel loader

A WSE will require a wheel loader with both a bucket and log grapple attachments. Waste wood from a waste recycler can be loaded with a bucket. A log grapple is used for longer length logs such as dead farm wo hardwood telephone poles, or tree residue.

Price new $115,000, Price used $60,000

Tipper truck & dog trailer

A tipper truck and trailer can transport a combined 32 tonnes of woodchips (12 tonne truck and 20 tonne trailer) and the trailer can be removed for smaller deliveries. By removing the trailer, a tipper truck has the capacity to tow a wheel loader on a towing trailer.

Price new $340,000, Price used $160,000

Motor vehicle

A 4x4 diesel dual cab will be purchased for staff business related travel.

Price new $50,000 Price used $25,000

Diesel storage (onsite)

The Jenz biomass processor will consume 79 litres of diesel per hour when chipping and the WSE will require an onsite diesel storage of up to 2,000 litres and fuel pump. The onsite storage facility will be refilled by a mobile fuel company such as Bonney Energy.

Price new $18,000 Price used $8,500

(Hire) prime mover & low loader trailer

A prime mover and low loader trailer will be required if the Jenz biomass processor requires transportation for off-site chipping. A prime mover and low loader would have limited use and is recommended to hire than purchase.

Price hire $180 per hour

Woodchip storage facility

A woodchip supplier will require an inventory of woodchips available for immediate delivery. Storing woodchips undercover and on a concrete base is the preferred option as woodchips without cover will absorb moisture and may cause the following impacts:

- High moisture woodchips produce 50% less energy compared to dry woodchips at 10% - 20% moisture. Keeping woodchips undercover prevents moisture gain[3].
- Biomass boilers are designed to accept dry biofuel or wet biofuel but not a mixture of both. Feeding a biomass boiler with woodchips outside the manufacturer's specifications can potentially damage the boiler and void the warranty.
- Woodchips stored with a higher moisture content have a greater risk of spontaneous combustion and mould growth.
- Woodchips stored on the ground can absorb dirt and grit. Dirt and grit imbedded in woodchips will reduce the biomass boilers performance.

Price new $82,500 (25m x 15m x 6m dimensions)

Price for concreting $37,500 (based on $50 per m^2)

Fire safety and protection

A WSE has a higher fire risk due to the storage of combustible material and processing of wood into woodchips. A biomass supplier is likely to have a supply of wood onsite, storage of woodchip and the creation of dust and wood fines when processing wood into woodchips.

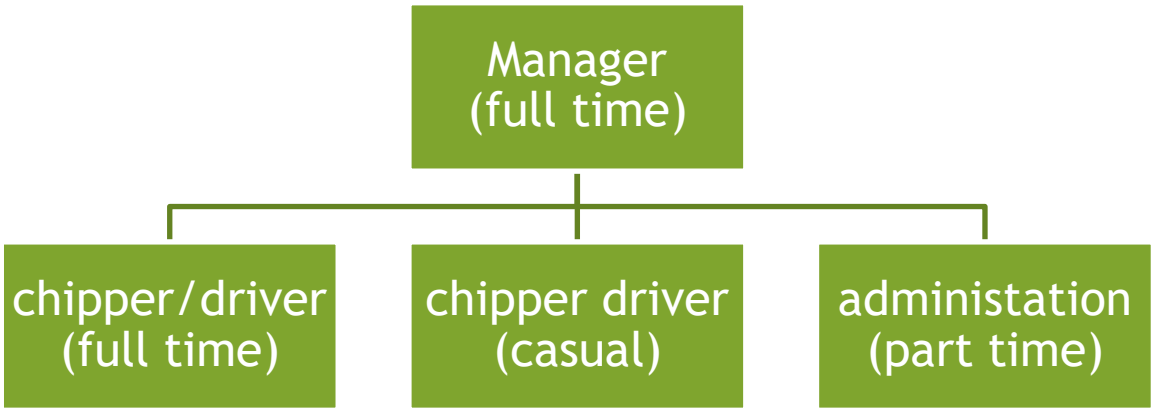
Victoria has legislation for commercial operations regarding fire safety and the clearing of an area around a commercial operation. The key highlights of the legislation are:

- a 40-metre clearance (fire break) of flammable material from a commercial operation
- in a reticulated water area (town water supply), the premises must have standard fire hydrants, standard hoses and nozzles, and standard fittings
- in a non-reticulated water, the premises must have a mobile tank of at least 200 litres, a standard pump, standard hose, fire rakes and grubbing hoes

The Country fire Authority (CFA) recommends, a Fire Safety Plan be developed by the WSE. $50,000 has been allocated for fire protection in the establishment cost budget.

[3] Report prepared for the Ballarat Community Powerhub titled 'Ensuring Woodchip Quality from Waste Wood report' dated 5 February 2019

3.5 Staff structure



Business owners - To be confirmed

Manager

A Manager will be employed full time. The role of the Manager is to oversee the operation of the WSE and staff. A Manager will need to build good relationships with suppliers and source dead farm wood and tree residue. For two days per week the Manager will liaise with industry and relevant organisations to encourage the purchase of biomass boilers in central Victoria. The Manager will approach organisations that use large amounts of natural gas or LPG and assist to calculate establishment costs, running costs and return on investment to replace gas boilers with biomass. A manager will hold a combination of managerial experience, sales experience and experience in the biomass industry.

Wood processing and delivery staff

Two staff will be employed (one full time and one casual) to purchase waste wood, chip waste wood to biomass specification, and deliver woodchips to clients. The wood chipping and delivery staff will require the following licences:

- heavy vehicle licence
- wheel loader/front end loader licence
- chainsaw ticket (certificate of competency)

Experience in the wood chipping/sawmilling industry would be an advantage. Advanced training will be provided in biomass processor operations. Occasionally staff may need to cut and collect waste wood from nearby private properties and public land.

Administration staff

An administration officer will be employed at a 0.6 load and their role will be to manage accounts receivable and payable, BAS statements, staff payroll and other financial duties. Experience in MYOB, Microsoft word and excel will be required.

3.6 Major suppliers of waste wood

The major suppliers/stockers of waste wood in the central highlands will be:

Vic Waste Solutions - receive over 7,800 tonnes of waste wood annually. Moisture content is dry <20% and there is no bark on the wood. The wood is graded (grade one and two) by staff as it enters the recycling station, there are separate piles for each grade. Grade one is clean wood that is suitable for biomass combustion. The wood is 90% pine and 10% hardwood and is sourced predominately from housing demolition and shipping pallets. Metals such as nails and screws will be removed by magnets once chipped. Vic Waste Solutions are in Coronet St Wendouree.

Cleanaway - receive over 4,000 tonnes of clean waste wood annually. Moisture content is dry <20% and there is no bark on the wood. The wood supply is in Brooklyn (western suburbs of Melbourne). Wood delivery is via a semi-trailer with a walking floor. 30 tonnes of clean waste wood can be delivered per trip. Delivery costs is $1,080.

Ballarat Regional Industries (BRI) – BRI are in Ballarat and they can potentially supply up to 30 tonnes per week or 1,500 tonnes per annum. The wood source is waste wood (used/broken shipping pallets) and made predominately from pine and some hard wood. Moisture content is dry <20% and there is no bark.

Tree felling businesses – Central Victorian tree felling businesses often have excess wood when removing large trees. The trees could potentially be delivered chipped or unchipped to WSE. Woodchips from felled living trees would be classified as wet biofuel >40% moisture and will need to be dried or sold to a biomass user that can accept a high moisture woodchip.

Dead farm wood – Large quantities of dead farm wood (particularly cypress) are prevalent in central Victoria due to canker disease and drought. A tree audit conducted by Community Power Hub in 2019 found over 3,000 tonnes of dead wood in the Ascot, Coghill Creek region alone. The WSE may be required to collect and transport dead wood from private properties. This may require towing a wheel loader via a low loader trailer and prime mover.

Free wood drop-off – the WSE could offer a free drop-off service for A grade clean wood that is suitable for chipping and biomass use. Clean wood could include shipping pallets, tree trimmings, tree removal, construction and demolition wood.

Pile of clean wood suitable for chipping at Vic Waste Solutions in Ballarat

3.7 Products and services

As Australia doesn't have its own standard in relation to woodchips, it is proposed that all biomass woodchips must comply with International Standard ISO17225-4 Solid biofuels – fuels specifications and classes - woodchips and European Standard EN 15234-4 fuel quality assurance, woodchips. Waste wood is chipped to biomass dimensions (20mm – 30mm), and woodchips are stored undercover to prevent deterioration. The products offered are:

Dry woodchips – Woodchips sourced predominately from Ballarat's municipal waste wood stream and dead or dying trees on private or public lands. Municipal waste wood contains clean wood from the commercial and industrial sector, construction and demolition sector, and used shipping pallets. Treated, painted, rotten or wood with dirt is separated on entry at the recycling station. Metals such as nails and screws are removed after the chipping process through magnets. The moisture level is between 10% - 20%. One kilogram of dry woodchips will generate the equivalent of 4kWh (14.4 MJ) of energy in a biomass boiler. For the purpose of the business plan, dry woodchips will cost $125 per tonne delivered within 50km from Ballarat. The price will increase by 2% per annum.

Wet woodchips – are sourced from forest residue or tree felling/roadside residue and the moisture content is greater than 40%. One kilogram of wet woodchips will generate 2 kWh (7.2 MJ) of energy. Wet woodchips can only be used with a biomass boiler designed to accept a high moisture woodchip. Wet

woodchips will cost $125 per tonne delivered within 50km from Ballarat. The price will increase by 2% per annum.

Product	Description	Price
Dry woodchips	Woodchips sourced from waste wood. Moisture <20%	$125 per tonne
Wet woodchips	Woodchips sourced from roadside tree residue, tree felling and forest residue. Moisture >40%	$125 per tonne

3.8 Distribution system

The distribution of woodchips will be carried out by staff with the appropriate heavy vehicle licences and a tipper truck with dog trailer. The combined capacity of the tipper truck and trailer is 48 m^3 of woodchips or 19 tonnes (with seven tonnes carried by the truck and 12 tonnes carried by the trailer). Both truck and trailer have hydraulic lifters to unload woodchips into a hopper or undercover storage. The table below shows the diesel consumption and cost per 100 kilometres of travel, dependent upon tonnage. This data was extracted from the Forest Industry Research Centre (FIRC).

Payload (tonnes)	Litres used per 100km	$ per 100kms of travel
20	41.8	$62.7
27	48.1	$72.6
30	50.4	$75.6
40	59.0	$88.5
50	67.6	$101.4

http://research.usc.edu.au/vital/access/manager/Repository/usc:25028/SOURCE1

Delivery rates for woodchips will be:

- free within 50kms
- $400 additional charge between 50km and 99km
- $500 between 100km and 150 km

3.9 Quality assurance - woodchip testing

Woodchip testing is to be carried out bi-annually by laboratories in accordance with standard EN 15234-4, Quality assurance - woodchips. Woodchip testing measures the following areas:

Woodchip diameter – diameter according to International Biomass Standard ISO 17225-4. Woodchips will be measured in the following classifications P16, P31, P45, P63 and P100.

Moisture content – one of the key parameters for woodchips as a high moisture content will negatively impact on heat and performance.

Ash – the mineral residue remaining after a complete combustion. A high value results from a low-quality woodchip and will require higher maintenance and ash removal. Chipping wood with bark will increase ash content.

Calorific value – the energy content of the woodchips measured in MJ/kg.

Bulk density – the weight of the woodchips. Density may impact on the capacity of storage units, augers and feeders. Hardwoods generally have a higher density than softwoods.

Trace metals – can determine if the woodchips are contaminated by measuring metals such as arsenic, chromium and mercury. This test is necessary when utilising waste wood.

HRL Technology Group are a laboratory located in Melbourne (Mulgrave) that specialise in biomass analysis. To analyse woodchips in accordance with EN15234-4, HRL Technology Group quoted a cost of $1,290 (as of December 2018). Every six months, suppliers need to send a woodchip sample to HRL Technology Group in a sealed plastic bag. See Appendix 2 for the lab testing proforma.

EPA Victoria requirements

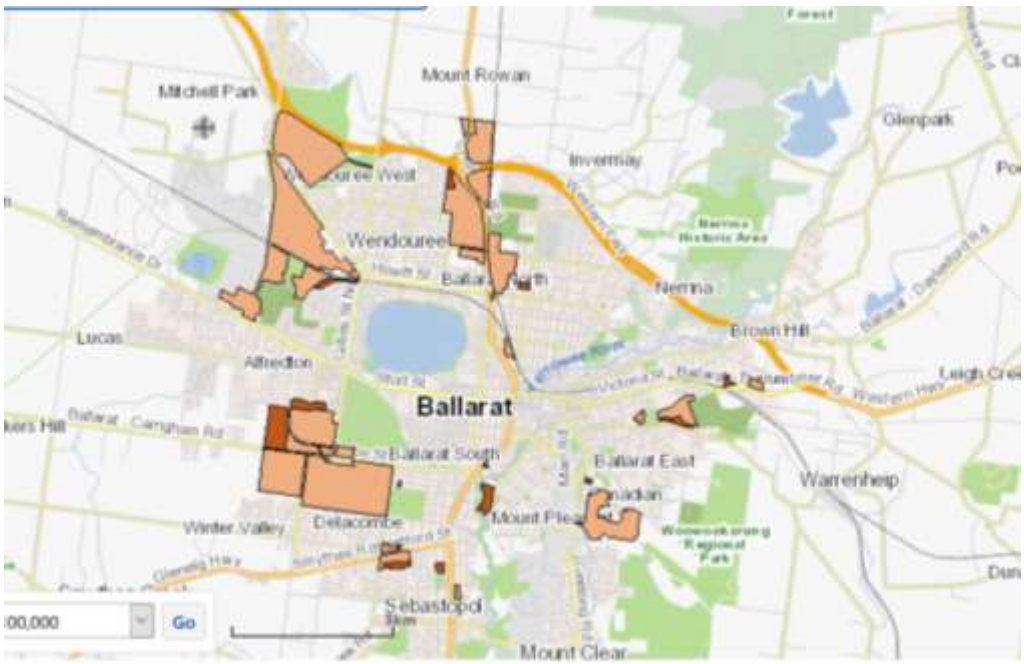
A WSE that utilises municipal waste wood must ensure their woodchips are free of chemicals and contaminants prior to burning in a biomass boiler. Failure to do so may breach the Environmental Protection Agency (EPA) Victoria emission regulations under the Environmental Protection Act 1970. Under the EPA waste to energy guidelines, waste streams which pose minimal risk to the environment and human health, and are considered acceptable biofuel for energy recovery include:

- biomass from agriculture
- residues from plantation forestry and sawmilling operations
- untreated wood waste
- recycled oil that meets the specifications and standards set out in the Product Stewardship (Oil) Regulations 2000
- vegetable residue from virgin pulp production and from production of paper from pulp.

3.10 Licences, registrations, permits & insurance

Zone Requirements – All local councils in Victoria abide by the State Planning Scheme and the Planning scheme will only permit a WSE to establish a business on land that is zoned 'industrial' in Victoria.

Industrial zones within the City of Ballarat



Industrial zone

The industrial zone map of Ballarat shows several areas to the north west, north and south of the CBD. Once a site has been chosen, a local council will check for any overlay controls that may prevent use of a site. E.g. aboriginal sensitive areas, bushfire overlays or flooding risk. These overlays would need to be examined on a site by site basis.

Victoria Planning Scheme clause 53(10) - Clause 53(10) of the Victorian Planning Scheme identifies industries that may pose an 'offence and unacceptable risk' to nearby residents and limits the distance that industry is permitted to the nearest residential zone. A WSE is classified under "Wood-fibre or wood-chip products" and the minimum distance is 1,500 metres from residential zones. Effectively, a WSE cannot establish a business on Industrial zoned land in Victoria if that property is within 1.5 kilometres of residential zones.

An exemption can be obtained from the Environmental Protection Agency Victoria (EPA), if the preferred parcel of industrial zone land is within 1.5 kilometres from a residential zone(s). The EPA has the authority to overrule the Victorian Planning Scheme clause 53(10) in some cases. The EPA will examine the nature of the business and determine the risks to residents or nearby businesses. Risks can be eliminated

or minimised through various actions such as noise barriers, dust minimisation measures, fire safety measures or odour minimisation. If the EPA is satisfied that the business will not affect residents within 1.5km or nearby businesses, then a ruling will permit a WSE to undertake a business on the site.

Building permit – A building permit will be required for the construction of woodchip storage shed, perimeter fences and offices through the local council. A permit will need drawings, description of intended use of buildings, soil report and land title. A building permit will cost $1,030. Once building works are completed, a certificate of final inspection is undertaken.

Corangamite Catchment Management Authority – Once a site has been chosen the Corangamite CMA will examine the site for flood risk. They will then make recommendations for where to site buildings and flood minimisation measures.

Country Fire Authority (CFA) – Pre-consultation with the local CFA is recommended, regarding the combustible material onsite and management of wood and woodchips. The CFA may offer guidelines on the appropriate storage and handling of wood and woodchips.

Permit to place signs – Local councils require a permit to place an advertising sign, banner or flag on a building, road or footpath. For example, a business sign on a building will require a permit.

Premises Licence – EPA Victoria may require a premises licence which permits a business to create and handle waste on a property. The waste held on the property is municipal waste wood. A WSE will need to complete an Approvals Proposed Pathways Form and the EPA will determine if a premises licence is required. Processing this form takes 60 days.

Insurance requirements

A WSE is classified as a higher risk business due to the storage and transportation of flammable material and use of specialised equipment such as a biomass processor. Insurance for a WSE will be more expensive than a typical business and an insurance broker will request a specialised underwriting agency to insure a WSE. An underwriting agency will have expertise in wood processing enterprises such as sawmills. There are three types of insurance required for a WSE:

Public liability insurance – Public liability insurance protects a business from being sued for personal injury, death or damage to their property. A WSE will have $20 million public liability cover. The quoted cost for public liability is $2,200 per annum from a Queensland based underwriter.

Plant, equipment & vehicle insurance - All plant, equipment and vehicles will be insured through an insurance agency that specialises in prime movers and large plant and equipment insurance. The quoted cost to insure all plant and equipment, trucks and vehicles is $33,835.

Property insurance – Property insurance insures the buildings, woodchip storage facility, fencing etc. This insurance will come at a premium due to the storage of wood and woodchips onsite. The quoted price for property insurance is $6,500 per annum through an underwriter located in London.

3.11 Risk management

Below are the major risks associated with operating a WSE:

Business Risks

Cashflow – The major risk for a WSE is cashflow in the first four years of operation. Positive cashflow will be achieved if several local organisations convert their boiler systems to biomass boilers. The WSE Manager will dedicate two days per week to assist businesses in transitioning from natural gas/LPG to biomass boilers.

Demand – A WSE may not be financially sustainable unless businesses transition from fossil fuels to biomass for industrial heat. Demand for woodchips for biomass is essential. A biomass sales forecast is detailed on page 34.

Use of fossil fuels in the process – One tonne of woodchips requires approximately 4.1 litres of diesel to process wood into woodchips (p.9) and approximately 41 litres of diesel (p.16) to deliver locally (within 50 kilometres), including the return journey. The return journey, where the trailers are empty, will use less diesel than the outward journey but the estimate has been left at 41 litres, to account for the diesel used to get the woodchipper to site. The question arises as to how much energy is in 45 litres of diesel and would it be better to just use the diesel as energy rather than use it to produce woodchips for burning. The energy content of 1L of diesel as approximately 36 MJ[4] meaning that the energy content of 45 litres of diesel is about 1,620 MJ. The energy of 1 tonne of woodchips with a 30% moisture content is approximately 12,500 MJ[5]. This indicates that it is worth processing the wood to make chips rather than just using the diesel directly for energy and with drier wood, a higher figure could be achieved.

The WSE is budgeting to consume 32,630 litres of diesel per annum. Increases in diesel and energy could lead to an increase in the price per tonne for woodchips.

Diversion of feedstock - Waste wood is predominately used for mulch and manufactured wood such as chip board and particle board. Utilising waste wood for biomass will increase demand and reduce supply on waste wood. This demand/supply push could potentially increase prices.

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[4] https://www.world-nuclear.org/information-library/facts-and-figures/heat-values-of-various-fuels.aspx

[5] https://www.forestresearch.gov.uk/tools-and-resources/biomass-energy-resources/reference-biomass/facts-figures/typical-calorific-values-of-fuels/

Social licence - A communication plan detailing the benefits of biomass from waste wood as the raw material will need to be developed. The communications plan will explain the benefits of using waste wood as opposed to using forest timber which has environmental impacts include habit loss for native animals, transportation costs, and potential soil erosion once the trees are removed.

Health & Safety Risks

Noise impacts – Chipping wood generates approximately 107 dB of noise during typical use[4]. This noise can impact both the chipping operator and nearby residents or businesses. Noise can be mitigated by adopting the following measures:

- construct a built facility where wood is chipped indoors
- adding sound barriers to absorb sound at the WSE site
- ensure staff wear appropriate ear protection when chipping wood

Asphyxiation - Woodchips stored in confined spaces with no airflow may produce dangerous (toxic) levels of carbon dioxide. Combining moist woodchips with warm temperatures and limited airflow can cause rapid decomposition and produce high concentrations of carbon dioxide. Entering a confined storage of woody biofuel has caused asphyxiation with 14 fatalities in Europe between 2002 and 2011.[5] To minimise asphyxiation from woodchip storage a WSE must:

- ensure the storage space is well ventilated
- monitor the temperate inside the woodchip pile. Higher temperatures above 40^0 can increase carbon dioxide levels
- regularly 'turn over' woodchip piles to minimise temperature build up
- ensure staff and/or clients are aware of the potential dangers
- restrict access to woodchip piles by unauthorised persons
- ensure appropriate signage is installed to highlight dangers within storage spaces

Mould Spores – Moist woodchips, warm temperatures, and restricted airflow may produce mould spores. Inhaling mould spores can lead to health problems (such as aspergillosis in the lungs). Mould will not occur in woodchips that have a moisture level <10%. To prevent mould spores a WSE must:

- store woodchips in a ventilated area
- monitor woodchip pile for mould
- provide staff training on the dangers of mould in woodchips
- provide staff with masks, if mould is suspected
- educate staff regarding mould spores and prevention measures
- regularly 'turn over' woodchip piles to minimise mould growth
- restrict access by unauthorised persons to woodchip piles

[4] http://www.hse.gov.uk/research/rrpdf/rr618.pdf

[5] http://www.hse.gov.uk/research/rrpdf/rr1077.pdf

- monitor woodchip pile temperature. Higher air and woodchip pile temperatures increase the likelihood of mould.

Woodchip Dust - Wood dust is generated during the chipping process and subsequent handling. Woodchip dust can cause irritation of the lungs, skin disorders and asthma. To minimise woodchip dust a WSE must:

- staff to wear a filter mask with a P3 filter when chipping wood
- use wood chipping equipment that incorporates dust extraction and collection

Dust explosions and fires – In some instances dust has been proven to be as flammable as other accelerants such as petroleum. Dust explosions are common within the wood processing industry. Factors which contribute to dust explosions include:

- fine dust particles
- dust particles suspended in the air
- oxygen
- enclosed or partly enclosed space which creates a pressure effect
- ignition source

Wood with a low moisture content (e.g. waste wood) will create more dust than wet wood. To prevent dust explosions a WSE must:

- reduce the generation of dust. This can be achieved by utilising dust extractors
- remove and clean any accumulation of dust. Dust cannot accumulate on equipment or any horizontal surface
- train staff regarding the risks of dust explosions and safety procedures
- seal plant and equipment to minimise mechanical friction
- remove dust from hot surfaces such as lights and heaters
- reduce the generation of dust by keeping speeds low and designing dust-minimising chutes
- avoid the use of compressed air to clean dust accumulations. This will create dust clouds and increase the risk of explosion
- ensure fire alarm systems are integrated allowing for shutdown of plant and heating, ventilation and cooling (HVAC) equipment
- ensure fire hydrants are located externally

Spontaneous combustion - Occurs when decomposing material generates enough heat to ignite without a source. Once enough heat is generated, the risk of spontaneous combustion is extremely high. Oxygen can cause the woodchip to ignite and spontaneously combust. Woodchips with a higher moisture content or moist woodchips mixed with dry woodchips have a higher risk of spontaneous combustion. Moist woodchips stored for a long period of time are at higher risk of spontaneous combustion. To reduce the risk of spontaneous combustion a WSE must:

- not mix wet and dry biomass within the same storage pile
- measure the temperature and moisture levels of stored woodchips and monitor temperature trends. This should be conducted twice per week
- ensure staff are trained regarding the causes of spontaneous combustion and follow safety procedures
- use a thermal imaging camera to detect combustible hotspots within the woodchip pile
- not compact a woodchip pile. Woodchips can be compacted by equipment and vehicle traversing over the pile

Fire Protection – Wood and woodchips are extremely flammable and can ignite from external accelerants (such as cigarettes and embers from bushfires). To reduce the risk of fire a WSE must:

- store woodchips undercover
- install an emergency sprinkler system and firefighting hoses, pumps and extinguishers in accordance with standard AS 2441 – '*Installation of fire hose reels*'. The installation of fire hydrants in accordance with standard AS 2419 '*Fire hydrant installations*'
- watch for ember attack if bushfires are nearby. Embers can travel up to 6km from a bushfire
- keep other combustible material away from woodchip piles
- woodchip piles should be kept to a manageable size. There are no regulations on woodchip pile size in Australia, but the United States regulate 20 metres in height, 100 metres wide and 170 metres long under standard fire standard NFPA 230[6]
- ensure staff are trained regarding bushfire risk and prevention

3.12 Fire management plan

As required by the Victorian Fire service, A Fire Management Plan will be developed for the WSE by the Manager. The Fire Management Plan will include:

- map of the WSE showing location of wood, woodchips
- map showing fire-fighting equipment
- activities on days of total fire ban day
- plans for fire or bushfire and use of irrigation system to mitigate a fire at the WSE
- maintenance schedule of fire-fighting equipment

3.13 Environmental strategy

[6] https://s0.hfdstatic.com/sites/the_hartford/files/wood-chip-mulch-storage.pdf

A WSE will prepare an Environmental Management Plan that will set environmental targets and actions to minimise the environmental footprint. The strategy will focus on the following four areas:

Fire prevention – Measures to minimise fires due to the storage of wood and woodchips and fuel (diesel).

Waste minimisation – handling of screenings, leaves, soil, stones, metals and other contaminants when chipping wood to woodchips. A strategy for dealing with contaminated wood, such as painted wood. Recycling facilities are available for paper, plastics and metals and utilize the City of Ballarat's recycling facilities for e-waste, oil, fluorescent globes and batteries

Energy consumption – Install solar panels on the woodchip storage facility to help offset the buildings energy use for heating, cooling, hot water and security lighting.

Water harvesting - Harvest rainwater from the woodchip storage facility that will be used for fire prevention and wash down facilities for equipment.

3.14 Biomass waste (ash)

Combustion of woodchips in a biomass boiler creates a bi-product (ash) and the volume of ash per tonne of woodchips can vary depending on the wood type and the quantity of fines (bark and leaves) in the woodchips. In general terms, ash will make up 0.5% - 2% of the original volume of wood burned.[7] Woodchips sourced from waste wood does not contain fines therefor the ash content will be approximately 0.5% of total woodchips burnt. Uses for ash include fertiliser, a raw material for cement, additive to compost. Based on 5,510 tonnes of waste wood woodchips being burnt per annum, the ash volume would be 275 tonnes per annum.

Ash is rich in lime, calcium and potassium and can be used in organic fertilizers and cement manufacturing. On contacting local fertilizer producers, they would accept a free drop of ash if independent analysis showed potassium in the ash. A cost of $10 per tonne has been budgeted to transport waste ash to local fertilizer producers.

4. Biomass market

4.1 Pricing strategy (woodchips per tonne)

The total input costs and mark-up of 20% have been calculated to achieve a woodchip selling price of $125 per tonne. To achieve this price the underlying assumptions have been made:

[7] https://www.cse.org.uk/pdf/guide%20to%20small-scale%20wood-fuelled%20heating.pdf

- a loan to fund all establishment costs and cover losses for the first 6 years of operation ($ 3 million) has been sought and the interest payments are included as an input cost
- all wood is purchased for $25.64 per tonne
- depreciation has been excluded as an input cost

A lower selling price could be achieved by purchasing used equipment and part funding with private equity. Also, an existing business with established land, buildings, storage space, equipment and staff would sell woodchips at a cost lower than $125 per tonne due to lower input costs.

Item	Cost per tonne
Waste wood purchase (tonne)	$25.64
Fuel (Jenz biomass processor)	$5.39
Fuel trucks etc	$5.00
Direct staff (chipping/delivery)	$10.86
Management salaries	$17.52
Administration salaries	$5.07
Marketing	$1.60
Equipment maintenance	$4.80
Insurance	$6.73
Utility costs	$0.80
Rates	$0.40
Ash removal	$0.44
Interest on loan (loan on $4 m)	$18.91
Total costs	$103.52
Mark-up 20%	$21.22
Woodchip sale price per tonne	**$125.28**

The price will start at $125 per tonne in year one and increase by 2% per year afterwards.

4.2 Competitor analysis

In a report prepared by Boucher Consultancy for the Ballarat Community PowerHub titled 'Biomass burning equipment for Victoria' on 30 November 2018, the following types of organisations were willing to sell woodchips per tonne delivered to the Ballarat region.

Supplier	Selling price per tonne delivered	Seasonal or constant supply	Moisture levels	Comment
Waste Processor	$75	constant	dry	
Plantation	$88	constant	wet	Chip tree plantations. Currently exported overseas for paper production. 50% moisture content
Disability Employer	TBA	constant	dry	Waste shipping pallets
Waste Collector	$97	constant	dry	Haven not sold woodchips to biomass industry
Primary Producers	$110	seasonal	dry	Not yet operational
Local Sawmill	$170	constant	<30%	Small quantity sales to a Hospital

4.3 Fuel input costs - Woodchips vs natural gas/LPG

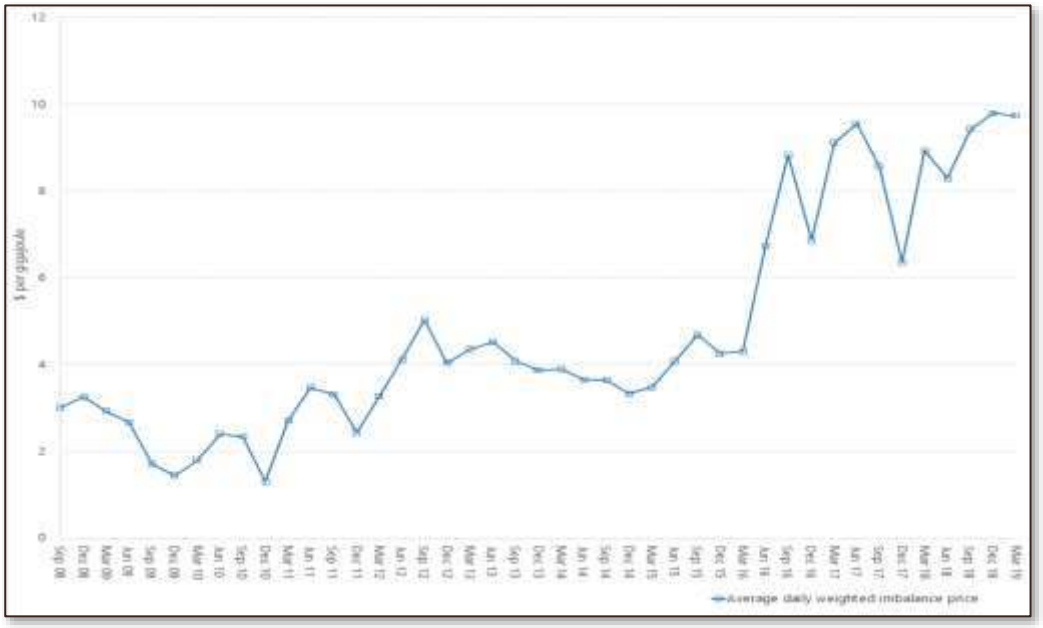
The main advantage of biomass over natural gas and LPG is the cheaper fuel costs when burnt in a boiler for industrial heat. Compared to woodchips at $125 per tonne, LPG is five times more expensive and natural gas is 43% more expensive per hour of operation in a boiler (see Appendix 2 for detailed calculations).

Boiler	Calorific Value (mj/kg)	Boiler efficiency	Consumption per hour (mj)	Input costs	Boiler cost per hour of operation
Biomass (woodchips)	17	90%	1,600	$125 tonne	$13.89
Natural gas (large user rates)	47	85%	1,694	$14.4 per GJ	$24.44
Natural gas (small user rates)	47	85%	1,694	$19.6 per GJ	$33.17
LPG	51	85%	1,694	$1.10 per litre	$ 74.24

Compared to stable woodchip prices, the future of natural gas prices is uncertain due to supply factors impacting on prices. In the past four years natural gas prices have risen by 60%, from $4 per gigajoule (GJ) in 2015 to $10 per GJ in 2019. The Australian Competition and Consumer Commission (ACCC) released a report on 30 May 2019 warning that manufacturing plants will be forced to close if gas prices stay above $10 GJ.[8]

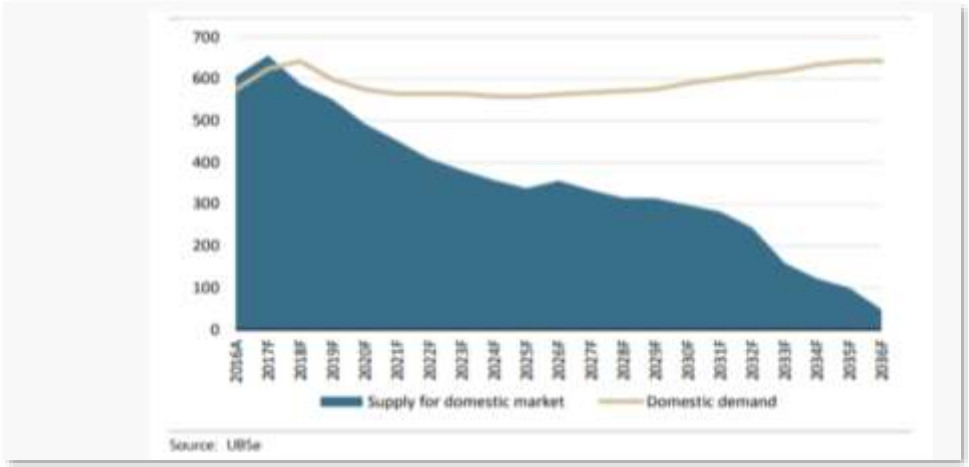
[8] https://www.accc.gov.au/media-release/east-coast-gas-prices-need-to-follow-export-prices-down

Historical natural gas price 2008-19



Source: *https://www.aer.gov.au/wholesale-markets/wholesale-statistics/victorian-gas-market-average-daily-weighted-prices-by-quarter*

Australian east coast demand v's supply



https://www.abc.net.au/news/2017-10-23/the-case-for-an-east-coast-gas-reservation-policy/9074896

The drivers of natural gas price increases are due to dwindling gas supplies along the east coast of Australia and the increasing export of liquid natural gas (LNG) to overseas markets. A report titled 'Victorian Gas Planning Report Update March 2019'[9] finds Gippsland natural gas production will reduce by 22% and Port Campbell natural gas production will reduce by 74% over the next five years.

A WSE can supply woodchips at half the price of current natural gas prices per hour of boiler operation and the future prices of woodchips will only rise by 2% per annum.

[9] *https://www.aemo.com.au/-/media/Files/Gas/National_Planning_and_Forecasting/VGPR/2019/2019-VGPR-Full-Report.pdf*

4.4 Government environmental targets

Federal, State and Local Governments are committed to reducing GHG emissions across all sectors and the Victorian State Government also has targets for increasing the portion of energy generated by renewable sources in Victoria. These targets at all levels of government will assist the biomass industry.

Federal Government targets

The current Federal Government has the following environmental targets:

- 26%-28% reduction in GHG emissions by 2030 (on 2005 levels)

State Government targets

The current Victorian State Government has the following GHG emission targets:

- 15 – 20% reduction by 2020 (on 2005 levels)
- 2025 target is not yet established. Target will be set by March 2020
- 2030 target is not yet established. Target will be set by March 2020
- Net Zero emissions by 2050

The current Victorian State Government also has renewable energy electricity generation targets for Victoria:

- 25% of renewable energy generation by 2020
- 40% renewable energy generation by 2025
- 50% renewable energy generation by 2030.

Local Government targets

Local councils (City of Ballarat and Hepburn Shire) have set targets to be carbon neutral by 2025 and source 100% renewable energy for Council activities[10]. Waste to energy is mentioned by both councils.

4.5 Large Generation Certificates (LGC's)

Another advantage of biomass over fossil fuels is the ability to generate income back through LGC's if biomass is used for electricity generation. Under the Renewable Energy Electricity Regulations 2001, biomass that sources 'waste wood' to generate electricity is classified as 'renewable energy' and eligible for LGC's which currently pay $31 per megawatt hour. LGC prices will decline in future years as more large scale renewable energy is connected to the national grid. A definition of waste wood is included in

[10] http://www.ballarat.vic.gov.au/sites/default/files/2019-04/Council%20Plan%202017-21.pdf

division 2.2.8[11]. Forest residue and dead farm wood is not classified as waste wood and not eligible for LGC's.

4.6 Baseload energy

Biomass is the predominant form of renewable energy that can supply continuous industrial heat. Other forms of renewable energy such as wind and solar provide intermittent power which can help to offset electricity consumption or provide Price Purchasing Agreement (PPA's) for cheaper electricity prices. For industry, biomass can complement wind and solar to reduce fossil fuel consumption and utility costs.

4.7 Potential customers

There are two areas where biomass can grow in regional Victoria:

Firstly, industry consumes 40% of Victoria's gas supply[12]. Central Victorian industries include, food processing and manufacturing industries. Other large users include aquatic centres, aged care centres, hospitals, commercial linen cleaning companies, wood kiln operators, brick manufacturers, poultry farms, and large-scale glasshouses.

Secondly, there is growing interest in using biomass to make renewable gas or biogas. Biogas is popular in Europe but there are no biogas plants in Australia. Biogas would complement the diminishing supply of natural gas reserves from Port Campbell and the Bass Strait. A plants fuel burners may need to be changed to burn biogas.

Potential biomass customers have the following qualities:

- **large natural gas users** – Large gas users use natural gas for making steam, hot water or heat. Woodchips are 43% cheaper than natural gas (at current prices) and switching to biomass could provide a return on investment below 6 years.
- **not connected to the natural gas grid** - Several towns in regional Victoria are not connected to the natural gas grid and biomass has a price advantage over LPG. These organisations might be small manufacturers, hospitals and aged care facilities.
- **industry** – food processing and manufacturing industries require industrial heat (heat, steam and hot water) and biomass can supply baseload 24/7 heat.

The following central Victorian businesses could potentially benefit from biomass:

Industry classification	boiler purpose	use	Estimated annual woodchip consumption (tonnes)

[11] https://www.legislation.gov.au/Details/F2017C00269
[12] https://www.energy.vic.gov.au/gas/about-the-gas-sector

Disability service provider	Building heat	Part year	50 tonnes
Disability service provider	Workshop heat	All year	300 tonnes
Aquatic Centre	Swimming pool	All year	550 tonnes
Regional Hospital	Building heat	Part year	140 tonnes
Regional Hospital	Building heat	Part year	140 tonnes
Private secondary school	Swimming pool	All year	300 tonnes
Linen	Linen cleaning	All year	
Food manufacturing	Food processing - steam and heat	All year	
Brick manufacturing	Manufacturing	All year	
Paint manufacturing	Manufacturing	All year	
Board manufacturing	45,000 GJ of natural gas per year	All year	

4.8 SWOT analysis

Strengths - internal resources or capabilities of your business that are better than your competition	**Weaknesses** – internal resources or capabilities of your business that are less than those of your competitors

• abundant supply of waste wood and dead wood in regional Victoria all year round • unlike intermittent wind and solar, biomass is baseload 24/7 energy • State and Federal Governments have clear targets for renewable energy and GHG reductions • waste wood has a low moisture content and no bark and leaves resulting in woodchips with a low ash content • biomass has a price advantage over natural gas and LPG for fuel costs • biomass and biogas are likely to expand in Australia in the coming years	• high capital costs of biomass boilers and associated equipment • unlike solar, there is no government assistance (subsidies) in reduced purchasing costs for biomass • currently little demand for biomass in Victoria with only four biomass plants operating within a 50 km of Ballarat, using woodchips as biofuel • higher risk of contaminants in woodchips when sourcing municipal waste wood. Eg plastics, metals etc • lack of expertise in the biomass industry in central Victoria • biomass is reliant on assistance from governments to make it viable. Such as emission targets, subsidies etc • collecting dead farm wood may be time consuming with high labour and transport costs
Opportunities – external factors or conditions that the business can exploit to build success	**Threats -** external factors that could adversely affect the success of your business

• biomass that generates electricity and utilises waste wood as the biofuel is eligible for LGC certificates of currently $31 per MWh generated. The LGC certificates are expected to be $23 in 2020, $15 in 2021 and $10 in 2022. • dwindling natural gas supplies in Victoria could allow a biogas market to grow in regional Victoria • purchase a wood pellet machine to manufacture wood pellets and retail to householders with pellet heaters • develop a free drop centre for clean wood e.g. shipping pallets • introducing a price on carbon (carbon tax) will benefit biomass by making fossil fuels (natural gas/LPG) more expensive.	• competition from other biomass sources e.g. waste wood, straw • competition from other renewable energy sources, particularly solar • demand for waste wood from other sources. Such as chipboard manufacturers

5. Future market

Vision statement

Our vision is to turn a waste product into renewable energy that local business can use as a replacement to fossil fuels.

Mission statement

To supply renewable energy (woodchips) sourced from waste products that is a sustainable alternative to natural gas and LPG for generating industrial heat (heat, steam, hot water or electricity). This form of renewable energy will help to reduce operating costs and an organisations environmental footprint.

Goals

- encourage and promote the uptake of biomass boilers in central Victoria

- source a reliable supply of waste wood that can be chipped to A grade woodchips suitable for biomass combustion
- maintain quality assurance of biofuel by:
    - eliminating all contaminants from the raw material
    - safe storage to minimise woodchip degradation
    - ensure prompt delivery to minimise risk of running out of biofuel
- assist is making the Ballarat region the new renewable energy hub in Australia

6. Financial strategy

6.1 Establishment costs - site costs

Site costs including a parcel of land, fencing and undercover woodchip storage is budgeted to cost $858,672.

Plant and equipment list	Purchase price	Link
Land zoned commercial	$495,000	https://bit.ly/2HJv6ZO
Office space (demountable)	$36,000	https://bit.ly/30GR474
Toilet facilities (demountable)	$33,000	https://bit.ly/2YJRxE0
Security (lighting CCTV)	$2,000	
Perimeter fencing	$54,606	https://bit.ly/2VIEeBL
Site preparation	$50,000	
Storage shed with concrete floor and 3 walls (25m x 15m)	$120,000	
Fire protection infrastructure	$50,000	
Signage	$1000	
Website development	$5,000	
Business establishment costs	2,066	
Office equipment	$10,000	
Total	**$858,672**	

Plant and equipment

Below is a list of equipment required to transport and chip wood for biomass specification.

Plant and equipment list	Purchase price	Link
Jenz BA725 biomass shredder	$670,000	https://bit.ly/2VsMCVH
Wheel loader with log grapple	$115,000	https://bit.ly/2WiqAcZ
Tipper truck with trailer	$340,000	https://bit.ly/2wyNMoB
Motor vehicle (dual cab 4wd)	$50,000	
Diesel storage tank	$8,500	
Total	**$1,183,500**	

Annual fixed costs

Item	Cost	link
Salaries - General manager (full time)	$100,000	https://bit.ly/2KbuFJr
Salaries - chipping & delivery (1 full time, 1 part time)	$61,968	https://bit.ly/2QzOWJV
Salaries - administration (3 days per week)	$28,954	https://bit.ly/2WEdPtz
Salary on-costs	$21,001	
Hire truck and low loader	$5,000	
Equipment maintenance	$30,000	
Accounting and legal fees	$3,000	
telephone	$1,800	
Marketing and advertising	$10,000	
Staff training	$5,000	
Insurance	$42,085	
Utility costs	$5,000	
Rates	$2,500	
Total	**$316,308**	

Variable costs (per tonne of woodchips)

Item	Cost
Waste wood per tonne	$25.64
Fuel - Jenz BA725	$5.39
Fuel - trucks and excavators	$5.00
Ash removal	$0.44
Total cost per tonne of woodchips	**$36.47**

6.2 Sales forecast

Biomass boiler woodchip quantities

Below are examples of existing biomass boilers operating in Victoria. These examples have been used to determine the number of biomass boilers needed in central Victoria for a WSE to make a reasonable return on investment and the expected volumes of woodchips and sales revenue per annum.

Boiler size	Woodchips consumption per hour	Woodchips - consumption per week	Woodchips - consumption per year
110 kW (Hospital)	17 kg	2.8 tonnes	144 tonnes
240 kW (Dairy)	36 kg	6 tonnes	314 tonnes
650 kW (Aquatic Centre)	97 kg	16 tonnes	852 tonnes
1000 kW (Sawmill)	150 kg	25 tonnes	1,310 tonnes
3000 kW (Flowers Grower)	450 kg	76 tonnes	3,931 tonnes

Below is the WSE sales forecast from year one to year seven. The underlying assumption is that local industry and businesses start a transition from natural gas/LPG boilers to biomass boilers due to the lower operating costs of biomass. For the purpose of this business case, and as a conversion target for the WSE representative liaising with industry, each year three small systems will be installed, and one larger biomass system will be installed every second year.

Year	Biomass installed in central Victoria (kW)	Woodchips sales per annum (tonnes)	Price per tonne $	Woodchip sales per annum ($)
Year 1				$0
Year 2	2 x 50 kW boilers &1 x 300 kW boiler	524	$125	$66,810
Year 3	2 x 50 kW boilers & 1 x 300 kW boiler & 1 x 1000 kW boiler	2,359	$127.5	$306,788
Year 4	2 x 50 kW boilers &1 x 300 kW boiler	2,883	$130.5	$382,433
Year 5	2 x 50 kW boilers & 1 x 300 kW boiler & 1 x 1000 kW boiler	4,717	$132.7	$638,229
Year 6	2 x 50 kW boilers &1 x 300 kW boiler	5,242	$135.3	$723,449
Year 7	2 x 50 kW boilers & 1 x 300 kW boiler & 1 x 1000 kW boiler	7,076	$138.0	$996,091

6.3 Break-even analysis

Woodchip sales (tonnes) to break-even

The table below shows the quantity of woodchips (tonnes) to be sold to break-even when the selling price is $125 per tonne.

	$125 per tonne
Cost of goods sold (woodchips)	$163,620
Interest on loan	$225,175
Fixed costs	$316,308
Total costs	$598,108
Sale of woodchips (tonnes) per annum to break even	**5,641**

Woodchip sales (tonnes) for 10% Profit after tax

The table below shows the quantity of woodchips (tonnes) to be sold for a 10% profit after tax of 27.5%.

	$125 per tonne
Total Revenue	$862,500
Total costs (including COGS and interest)	$739,843
Profit before tax	$122,657
Profit after tax @ 27.5%	$88,926
Sale of woodchips (tonnes) per annum for a 10% profit	**6,900**

6.4 Return on investment

Under the current scenarios there is no positive return on investment in the first 20 years of operation.

6.5 Projected Cashflow

	Year 1 ($000)	Year 2 ($000)	Year 3 ($000)	Year 4 ($000)	Year 5 ($000)	Year 6 ($000)	Year 7 ($000)	Year 8 ($000)	Year 9 ($000)	Year 10 ($000)	Year 11 ($000)	Year 12 ($000)	Year 13 ($000)	Year 14 ($000)	Year 15 ($000)	Year 16 ($000)	Year 17 ($000)	Year 18 ($000)	Year 19 ($000)	Year 20 ($000)
Total sales	$0	$67	$307	$382	$638	$723	$996	$1,016	$1,036	$1,057	$1,078	$1,100	$1,122	$1,144	$1,167	$1,190	$1,214	$1,239	$1,263	$1,289
Fixed costs	$316	$326	$336	$346	$356	$367	$378	$389	$401	$413	$425	$438	$451	$465	$478	$493	$508	$523	$538	$555
Variable costs	$0	$19	$90	$112	$186	$211	$291	$296	$302	$308	$315	$321	$327	$334	$341	$347	$354	$361	$369	$376
Interest on loans (5.5%)	$128	$154	$178	$195	$210	$225	$219	$210	$201	$192	$181	$171	$159	$147	$135	$122	$111	$96	$79	$64
Other costs	$8	$0	$0	$3	$0	$0	$3	$0	$0	$3	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Depreciation (straight line)	$128	$128	$128	$128	$127	$117	$117	$117	$117	$117	$43	$43	$43	$43	$31	$5	$5	$5	$5	$5
Total expenses	$580	$627	$731	$783	$880	$920	$1,007	$1,013	$1,022	$1,033	$965	$973	$981	$989	$984	$967	$978	$985	$991	$1,000
Year end result	-$580	-$560	-$425	-$400	-$241	-$197	-$11	$3	$15	$25	$114	$127	$141	$155	$183	$223	$236	$254	$272	$289
Accumulated operating profit (loss)	-$580	-$1,141	-$1,565	-$1,965	-$2,207	-$2,404	-$2,415	-$2,412	-$2,397	-$2,373	-$2,259	-$2,132	-$1,991	-$1,836	-$1,653	-$1,430	-$1,194	-$941	-$668	-$380
Loan repayment capacity at 80% of operating surplus	$0	$0	$0	$0	$0	$0	$0	$2	$12	$20	$91	$102	$113	$124	$146	$179	$189	$203	$218	$231

6.6 Projected balance sheet

	year 1 (000)	year 2 (000)	year 3 (000)	year 4 (000)	year 5 (000)	year 6 (000)	year 7 (000)	year 8 (000)	year 9 (000)	year 10 (000)	year 11 (000)	year 12 (000)	year 13 (000)	year 14 (000)	year 15 (000)	year 16 (000)	year 17 (000)	year 18 (000)	year 19 (000)	year 20 (000)
Current assets																				
Cash & term deposits	-$302	$257	$917	$1,326	$1,840	$2,076	$2,404	$2,049	$1,931	$1,764	$1,702	$1,554	$1,395	$1,224	$1,054	$884	$672	$450	$213	$23
accounts receivable	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2
Inventory	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10
Non-current assets																				
Land	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495	$495
buildings	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244	$244
less accumulated dep'n	-$10	-$20	-$30	-$40	-$50	-$60	-$70	-$80	-$90	-$100	-$110	-$120	-$130	-$140	-$150	-$160	-$170	-$180	-$190	-$200
storage shed	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120
less accumulated dep'n	-$2	-$5	-$7	-$10	-$12	-$14	-$17	-$19	-$22	-$24	-$26	-$29	-$31	-$34	-$36	-$38	-$41	-$43	-$46	-$48
plant and equipment	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184	$1,184
less accumulated dep'n	-$26	-$43	-$69	-$95	-$120	-$146	-$172	-$198	-$223	-$249	-$275	-$301	-$326	-$352	-$378	-$404	-$429	-$455	-$481	-$507
Total assets	$1,714	$2,243	$2,865	$3,236	$3,712	$3,910	$4,200	$3,806	$3,650	$3,445	$3,345	$3,158	$2,961	$2,752	$2,544	$2,336	$2,086	$1,825	$1,550	$1,322
Current liabilities																				
accounts payable	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2	$2
Loan to cover shortfall		$580	$1,141	$1,565	$1,965	$2,207	$2,404	$2,094	$2,029	$1,961	$1,890	$1,814	$1,734	$1,649	$1,560	$1,465	$1,366	$1,260	$1,149	$1,031
Non-current liabilities																				
long term Loan	$2,292	$2,221	$2,147	$2,069	$1,986	$1,898	$1,805	$1,707	$1,604	$1,457	$1,340	$1,216	$1,084	$946	$800	$645	$482	$309	$127	$0
Equity																				
retained earnings	-$580	-$560	-$425	-$400	-$241	-$197	-$11	$3	$15	$25	$114	$127	$141	$155	$183	$223	$236	$254	$272	$289
Total liabilities and Equity	$1,714	$2,243	$2,865	$3,236	$3,712	$3,910	$4,200	$3,806	$3,650	$3,445	$3,345	$3,158	$2,961	$2,752	$2,544	$2,336	$2,086	$1,825	$1,550	$1,322

6.7 Funding options

Borrowed funds

Borrowing $3 million on a 20-year loan at 5.5% interest will add an additional $1,363,058 in interest payments over the life of the loan. Interest charges will cost $118,180 per annum from year one and decrease to zero by year 20.

Foresight Group

Foresight Group is an international private equity investment manager (with an office in Australia) that invest in a range of areas including renewable energy and biomass. Worldwide, Foresight Group have invested in 31 waste to energy projects totalling $1.8 billion. Foresight group have invested in solar projects in Australia and are interested in biomass investments.

https://www.foresightgroup.eu

Arena funds

The Australian Renewable Energy Agency (ARENA) is a federally funded body that invests in projects that accelerates a shift to affordable, reliable renewable energy. ARENA specifically focuses on investment in four areas:

- deliver secure and reliable electricity
- accelerate solar PV innovation
- improve energy productivity
- export renewable energy

Arena seek innovative projects for seed funding and 'energy from waste' is one of their priority portfolios. Nine bioenergy projects have been funded by Arena.

https://arena.gov.au/

Victorian energy savings program (VESP)

VESP (previously VEEC) provides financial incentives for installing energy efficient products into Victorian homes and businesses. Biomass is included in the program if the energy source is waste wood. Biomass boilers that source woodchips from forest residue would be ineligible for the program.

https://www.energy.vic.gov.au/energy-efficiency/victorian-energy-upgrades/about-the-program

Climate solutions fund

The Federal Government has established a $2 billion fund to reduce GHG emissions through several sectors including agriculture, facilities, mining and energy efficiency. Biomass is included in the fund, specifically boilers for industry heat. Financial incentives are available as carbon credits.

https://www.environment.gov.au/climate-change/government/climate-solutions-fund

Clean Energy Finance Corp (CEFC)

CEFC is a Federal Government funded body which has invested over $10 billion in renewable energy, energy efficiency and low emissions technologies. CEFC also provide finance options for new businesses too. Bioenergy is one of the key investment areas and specifically waste to energy programs. Using municipal waste wood is classified as 'waste to energy'.

https://www.cefc.com.au/

Appendix 1 – background information

What is biomass?

Biomass is organic matter (plant and animals) derived from recently living organic matter above ground. Biomass can be specifically grown (e.g. tree framing) or sourced from a by-product from food production activities (e.g. crop stubble) to provide energy.

Fossil fuels also provide energy, however the fuel is sourced below the earth's surface where it has been stored for millions of years. Brown coal in Victoria is estimated to be 30 million years old. There are three predominant sources of biomass for fuel:

- Trees (wood pellets or woodchips)
- Crops (sugarcane, corn, seaweed, hemp, bamboo)
- Waste (crop stubble, animal manure, sewerage, wood waste, olive pits, nut shells

Although biomass releases CO_2 when burnt, it is widely classified as renewable energy because the supply is not limited. On the other hand, the Australian Government only classifies biomass from waste sources as renewable energy (e.g. Crop stubble, wood waste[13]).

Biomass in Victoria

In Victoria, biomass is used in three areas: electricity generation, food production and domestic household heating.

Victoria has 12,230 MW of electricity generating capacity, comprising 4,690 MW brown coal, 3,087 MW natural gas, 2,040 MW hydro, 2023 MW wind, and 388 MW of large scale solar. The total of biomass electricity generation in Victoria is only 2 MW or 0.01% of total supply[14].

There are currently 11 operating biomass plants that generate either heat, steam or hot water to assist in food production, manufacturing and building heat. These systems range in size from 110 kW at the Beaufort hospital to 6 MW system in Gippsland for tomato production in glasshouses.

Some houses, particularly in regional Victoria, use biomass for heating their homes in winter. Sources of domestic biomass heating include; open fires, combustion heaters using solid wood, and pellet heaters using wood pellets.

[13] https://www.legislation.gov.au/Details/F2017C00269
[14] https://opennem.org.au/#/region/vic/facilities

Biomass boilers

Biomass boilers are an alternative to using a natural gas or LPG boilers, to produce steam, heat, hot water or electricity. Biomass utilises the energy stored in organic material to generate heat. Biomass boilers are suited to industries requiring a constant heat load such as heated swimming pools, hospitals or manufacturing/food processing plants operating 24/7. Biomass boilers have higher establishment costs and lower operating costs when compared to equivalent fossil fuelled systems. A fuel cost comparison is shown on page 23.

In Australia biomass boilers are imported, as there are no local manufacturers. There are currently 21 international biomass boiler manufacturers who have distributors in Australia or who deal directly with the Australian market. Each manufacturer offers varying boiler sizes from household heaters to large systems that can generate electricity for cities with populations equivalent to Ballarat.

The quantity of woodchips used in biomass boilers is dependent upon on the boiler size. Larger biomass systems in eastern Victoria consume over 100 tonnes of woodchips per week, whereas smaller systems such as the Beaufort Hospital consume two to three tonnes per week.

When purchasing a biomass boiler, the manufacturer requires information on the biofuel to be used. This assists in the construction of the boiler. A woodchip supplier will assist in the purchasing process by providing information on:

- woodchip dimensions in mm
- moisture content of woodchips
- how the woodchips are stored (e.g. Undercover or open)
- species of wood
- calorific value
- volatile matter of woodchips
- fixed carbon content
- ash content and fusion

Biomass boilers are designed to accept woodchips with either high moisture levels (35% - 60% moisture) or low moisture levels (<30% moisture). Wet and dry woodchips cannot be interchanged or combined. A boiler designed for dry biofuel will be manufactured differently to a boiler that accepts wet biofuel. Using woodchips with a moisture content not specified is likely to shorten the life of the boiler and possibly void the boiler warranty. All 21 international biomass manufacturers exporting to Australia accept woodchips as a biofuel.

240 kW biomass boiler at Meredith Dairy provides 85^0 hot water for food processing. The woodchip fuelled boiler is manufactured by Moderator in Poland.

Appendix 2 – natural gas, LPG and woodchip calculation

Below are the calculations and methodology for determing the input costs for LPG, natural gas and woodchips per hour of operation. The comparison table is shown on page 23. A boiler size of 400 kw has been used.

LPG calculation

- example, 400 kW LPG boiler
- non condensing Gas boiler efficiency = 85% https://www.energy.gov.au/sites/default/files/hvac-factsheet-boiler-efficiency.pdf
- 400 kW/85% = 470 kW input value
- convert kW to GJ - LPG consumption per hour (470 x 3.6) = 1694 mj
- LPG Energy value = 25.1 mj per litre https://www.elgas.com.au/blog/2042-how-do-i-calculate-the-lpg-propane-consumption-per-hour
- 1694 mj / 25.1 = 67 litres of LPG per hour
- 67 litres per hour x $1.210 per litre = $74.24

Natural gas (large user)

- example, 400 kW gas boiler
- non condensing Gas boiler efficiency = 85% https://www.energy.gov.au/sites/default/files/hvac-factsheet-boiler-efficiency.pdf
- 400kW/85% = 470 kW input value
- convert kW to GJ - LPG consumption per hour (470 x 3.6) = 1694 mj
- natural gas prices from Procurement Australia https://www.agl.com.au/-/media/agldata/distributordata/pdfs/pricefactsheet-agd96608ms.pdf
- 1694 mj x $.0144 mj = $24.44 cost of large user natural gas per hour

Natural gas (small user)

- example, 400 kW gas boiler
- non condensing Gas boiler efficiency = 85% https://www.energy.gov.au/sites/default/files/hvac-factsheet-boiler-efficiency.pdf
- 400kW/85% = 470 kW input value
- convert kW to GJ - LPG consumption per hour (470 x 3.6) = 1694 mj
- natural gas prices from Procurement Australia https://www.agl.com.au/-/media/agldata/distributordata/pdfs/pricefactsheet-agd96596ms.pdf
- mj x $.0196 mj = $33.17 cost of small user natural gas per hour

Woodchips ($125 per tonne)

- example, 400 kW gas boiler
- biomass boiler efficiency = 90% European stand EN 303-5
- 400/90% = 444 input value
- 1kg of dry woodchips = 4 kWh or energy (*Wood Fuels Handbook*, 2015)
- 444 input value / 4 kWh = 111 kg of woodchips per hour
- 111kg x $125 per tonne = $13.89 per hour