Central Highlands and Wimmera Southern Mallee Biomass Supply Chain Strategy

Version No.1

Date: 19/11/2012

Sustainability Fund

State Government Victoria

Victorian Local Sustainability Accord

Contents

Executive Summary

This study was produced as part of a Regional Bioenergy Project funded by the Victorian Government under the Victorian Local Sustainability Accord. It covers the production, harvesting, processing, transport, storage and use of biomass for energy. The information comes from a number of sources and has not been verified. Anyone planning an investment in bioenergy supply or use should obtain further advice from a range of independent authorities and suppliers.

Bioenergy is renewable energy produced from biological material. Unlike fossil fuels (coal and oil) bioenergy is renewable because it comes from organic material which has recently stored sunlight in the form of chemical energy. There are three main ways biomass is turned into energy: Direct combustion, Gasification and Digestion. Direct combustion is burning the biomass in some form of apparatus and capturing the heat energy released. Gasification is burning the biomass in a low oxygen environment. A gas called Syngas is produced that has similar properties to natural gas. Digestion is the process of breaking down biomass by anaerobic bacteria in an oxygen free environment. The bacteria produce methane which can be substituted for natural gas.

At present the market for bioenergy feedstock is very small and any producer considering getting into the bioenergy market will need to work with potential users and suppliers. The two critical issues are moisture and consistency. A supplier will generally be the link between producer and the user and will be responsible for the quality and consistency of the feedstock. A present natural gas is very competitive with biomass but there are significant cost advantages in replacing LPG with biomass. Anyone considering using biomass as an energy source should be able to answer the following questions: What type of energy do I need (heat and or power), how much energy do I use (kilowatt hours) and what does it cost?

Whether you are planning to be a producer, supplier or user of biomass for energy it is important to realise that bioenergy is just starting to develop and all players must be prepared to understand and work with others in the industry. It has tremendous potential to reduce user energy costs without adding to global warming but that potential will not be realised without co-operation.

The information provided in this document is only a guide to the types of systems and resources that may be available. Always undertake research into the area you may be planning to invest in and obtain independent advice from a number of sources before making a commitment.

Introduction

This study was produced as part of a Regional Bioenergy Project funded by the Victorian Government under the Victorian Local Sustainability Accord. It is aimed at individuals businesses and organisations interested in the benefits bioenergy may have for them.

The study covers the production, harvesting, processing, transport, storage and use of biomass for energy. The information contained has come from a number of sources and has not been verified. Anyone planning an investment in bioenergy supply or use should obtain further advice from a range of independent authorities and suppliers.

What is bioenergy?

Bioenergy is renewable energy produced from biological material. Humans have used bioenergy for thousands of years in the form of wood fires. Other basic types include vegetable oils as well as animal fats, oils, bone and dung. It is still the primary energy source for millions of people around the world.

Unlike fossil fuels (coal and oil) bioenergy is renewable because it comes from organic material, usually referred to as biomass, which has recently stored sunlight in the form of chemical energy. Plants store energy from sunlight in a process called photosynthesis. Sunlight, water and carbon dioxide are combined within green plants to form simple sugars which the plant uses to grow. The cellulose in the leaves and stems is how this energy is stored.

When biomass is burned the process is reversed and the carbon dioxide together with water vapor and energy in the form of heat is released. When plants are regrown, as with crops, the carbon dioxide is reabsorbed by the growing plants and the cycle continues. In this way bioenergy is renewable because the carbon is recycled and does not add to atmospheric carbon dioxide.

Types of biomass feedstock

Biomass is the generally solid organic material used for production of heat and electricity

Biofuel is usually liquid transport fuel derived from plant material, vegetable oils and animal fats but may also include biogas (methane) processed for use in gas powered vehicles.

As a fuel, biomass may include wood, wood waste, straw, manure, sugarcane, and many other by-products from a variety of agricultural processes. One of the advantages of biomass fuel is that it is often a by-product, residue or waste-product of other processes, such as farming, animal husbandry and forestry. In theory this means there is no competition between fuel and food production, although this is not always the case.

Biomass is often used for home heating by burning the material open fires, heaters and stoves. It can also be used for heating larger buildings through boilers. Electricity can be produced from biomass via combustion in steam boilers or Sterling Engines or via gasification. Gasification can be through anaerobic digestion to produce biogas or a type of incomplete combustion process which produces a gas called syngas.

Types of bioenergy technology

There are three main ways biomass is turned into energy: Direct combustion, Gasification and Digestion.

Direct combustion

This is simply burning the biomass in some form of apparatus and capturing the heat energy released. The type of burning system used depends on the type of biomass to be used as a fuel. Wood is the most common form of bioenergy fuel and can be used in log form, split block, chipped and pelleted. Log and split wood is used in manually fed combustion heaters, stoves and boilers. Wood chips allow some degree of automated feed, particularly in larger boiler systems.

Wood pellets are highly processed wood that has been pressed into uniform pellets. This allows easier transportation and storage of the material as well as the use of fully automated burner systems.

Wood Pellets

Other types of biomass such as straw, bagasse, grain husks, agricultural and plantation residue, short rotation crops and municipal waste can be pelleted.

Gasification

This is burning the biomass in a low oxygen environment. A gas called Syngas is produced that has similar properties to natural gas. It can be used to for heating and industrial application but is generally used in engines to generate electricity. Syngas is high in carbon monoxide and can be dangerous or even fatal in confined spaces. Gasifiers are generally rated by the size of generator they could power or kilowatts of electricity produced (kWe). Gasifiers generally use wood but can be designed to run on other forms of biomass.

Digestion

This is the process of breaking down biomass by anaerobic bacteria in an oxygen free environment. The bacteria produce methane which can be substituted for natural gas. Biomass suitable for digestion includes animal wastes, food and abattoir waste, shredded green plant material (green waste). Digesters need to be designed for the material they will use and the resulting gas can be used for heating and electricity production.

How to use this study

To use this study decide if you are a potential biomass producer, supplier or user then look at the tables in the appendices. They will give you an idea of the potential income or saving you could make. If the potential income or savings look worthwhile contact the organisations listed in appendix 4.

Bioenergy is most applicable to situations where the user has access to low cost or free biomass. It can also be applicable if waste disposal costs are high. An individual or organization paying to dispose of organic waste could use bioenergy to both dispose of the waste and save on energy costs.

Issues for Biomass Producer

Understanding the market

At present the market for bioenergy feedstock is very small and any producer considering getting into the bioenergy market will need to work with potential users and suppliers. The two critical issues are moisture and consistency.

Moisture

Unless the feedstock is destine for anaerobic digestion, the moisture content of a potential feedstock is critical for the successful use of biomass as an energy source. The lower the moisture content the better. This can be a double edged sword for the producer as the product is normally sold by weight so lower moisture content will mean less weight per volume. The flip side of this problem is lower moisture content means a higher quality feedstock and therefore more valuable.

Find out what moisture content your market requires.

Consistency

This is the other critical factor. This means consistency in both product and supply. Most bioenergy systems are designed to use a particular class of material. This usually refers to the size, shape and range of the individual fuel particles. Material outside that range can cause blockages to feed systems. Contamination can damage all parts of the bioenergy installation.

A consistent supply is also important. Biomass is bulky and installations generally do not have large storage capacity. Regular deliveries of feed stock are important if the bioenergy system is to be reliable.

Type of biomass produced (crops, crop residue, plantations)

The type of biomass a producer wants to sell is often decided by their current operation. Harvesting and selling a by-product of current operations is the least risk option for most producers. Growing a bioenergy crop or plantation requires a significant investment and confidence in the future market.

For a cereal grower, harvesting a percentage of the cereal straw may be a good option. For a plantation owner, harvesting thinning's and sawlog residue may be applicable.

The potential to produce biomass should not be limited to growers. By-products and waste from saw mills, timbers and food processors and even sewerage treatment plants can be used.

Harvesting systems

Below are a few examples of biomass harvesting systems that growers and land managers may be able to use to produce biomass.

Biobaler harvesting eucalypt plantation residue

Biobaler harvesting woody weeds

Combined harvest and residue baling operation (Glenvar Bale Direct).

Prototype Mallee harvester (Biosystems Engineering)

Issues for Biomass Transport, Processing and Storage

Understanding the market

Anyone considering becoming a bioenergy feedstock supplier must understand the market and the needs of potential users. At present the bioenergy market in Victoria is very small and suppliers will have to work with both potential feedstock producers and users. The supplier will generally be the link between producer and the user and will be responsible for the quality and consistency of the feedstock. A present natural gas is very competitive with biomass but there are significant cost advantages in replacing LPG with biomass. A supplier should target those areas without natural gas and those using large quantities of LPG.

Transport

Biomass feedstock can be transported in bulk with conventional systems currently used in the grain, wood chip and fodder industries. The issue that suppliers should consider is the delivery to the end user. Most bioenergy systems will be using less than a tonne of feedstock per day and have 10 to 20 days on site storage. Access to these storage sites may also be limited to small trucks. Flexible auger and ducting systems should be considered to allow material to be delivered easily and without dust or spillage.

Processing

Further processing of biomass adds both cost and value to the product. Screening chips to ensure there are no oversize pieces will ensure the customer system is reliable. Supply contracts usually specify the acceptable size and consistency of the feedstock and the supplier may be liable for any damaged caused to the customers system by oversized material. Other types of processing can include pelleting and briquetting of the biomass. This increases the density of the feedstock making it easier and more cost effective to transport but it is costly and energy intensive. It can turn fine material (sawdust, husks, shells, etc.) into a more usable product.

Chipping whole logs allows the material to be used by automatic feed systems and is less costly than pelleting. The resulting chips still need to be screened to ensure the material is consistent and won’t cause problems in the customers feed system.

Quality assurance (consistent type, grade, moisture, no contamination)

As stated earlier, moisture and consistency are the critical elements for biomass feedstock. Feedstock must be stored undercover during the wetter months to ensure the moisture content is kept low. This is especially important for pellets which degrade if they become damp.

Wood chips need to be stored initially in low windrows to allow initial air drying then in piles less than 10m high to avoid spontaneous combustion and mould. Adequate screening of the chip is important to avoid oversized and long pieces that will jam feed systems. Careful handling of the chip will reduce the amount of fine material and other contamination such as gravel and stones.

Wood sources from municipal waste must be carefully screened to avoid contaminates such as treated timber, nails, paint, plastics and glues.

Regular testing of the feedstock at delivery time will ensure the customer gets a uniform, quality product and protect you from any implication if they have problems with their bioenergy system.

The other area of consistency is reliability of supply. With limited onsite storage, customers will rely on the supplier to make regular deliveries to ensure they don't run out of fuel, particularly in the colder months.

Issues for Biomass User

Energy Required

Anyone considering using biomass as an energy source should be able to answer the following questions:

1. What type of energy do I need (heat and or power)?
2. How much energy do I use (kilowatt hours)?
3. What does it cost?

When looking at your energy use consider the time of day you use the most energy and the time of year. A detailed record of your energy use may be available from your energy supplier. Knowing what your energy costs are will allow you to compare systems.

A bioenergy system supplier will be able to use this information to design an appropriate system for your needs. Remember that an average usage level may not be the peak load. Look at your usage pattern and choose a system that will deliver the level of supply you need. A back up system that can also cover the occasional peak load make be a lower cost option than one that can handle the peaks but runs most of the time below maximum efficiency. A buffer tank on a hydronic heating system can prevent the boiler cycling at the minimum (inefficient) output. Your system supplier should be able to advise the best option.

Available feedstock

The next question when considering bioenergy is what types of biomass do I produce or are easily available in my area?

Bioenergy systems are generally designed to use a particular type and size of biomass and there are systems available to use almost any type of biomass. Keep in mind that a system designed to use one type of fuel may not be able to use other types. For example, a heater designed to use wood pellets will not be able to use course wood chip and a boiler designed to run on wood chip will not be able to use straw (although it will work with pellets).

Choosing appropriate technology

Most small bioenergy systems are available in either manual or automatic feed systems. Manual feed systems are generally cheaper but require constant attention. If labour is available or the usage is limited then a manual system may be appropriate.

Feedstock supply and storage

The type of feedstock to used and its availability will determine what supply system and storage facility is required. If the feedstock is waste produced continually on site, e.g. offcuts in a timber processing facility, then the storage and supply system will be minimal. On the other hand, if the feedstock must be transported some distance then a large fuel bunker may be warranted to minimise transport costs. You need to confirm the supply of fuel for your bioenergy system. An unreliable supplier or source could leave you either without heating or using your backup system more than you should.

Final step

Once you have decided on each of the issues about you can then approach a bioenergy system supplier to install a system for you. Start with the type of biomass you want to use then the type of system to produce the type of energy you want and finally the size of unit needed to produce the amount of energy you need. Remember that an average usage level may not be the peak load. Look at your usage pattern and choose a system that will deliver the level of supply you need. A back up system that can also cover the occasional peak load make be a lower cost option than one that can handle the peaks but runs most of the time below maximum efficiency. A buffer tank on a hydronic heating system can prevent the boiler cycling at the minimum (inefficient) output. Your system supplier should be able to advise the best option.

Conclusions

Whether you are planning to be a producer, supplier or user of biomass for energy it is important to realise that bioenergy is just starting to develop and all players must be prepared to understand and work with others in the industry. It has tremendous potential to reduce user energy costs without adding to global warming but that potential will not be realised without co-operation.

The information provided in this document is only a guide to the types of systems and resources that may be available. Always undertake research into the area you may be planning to invest in and obtain independent advice from a number of sources before making a commitment.

Appendix 1 - Potentially Biomass Availability

Region	Resource Type	Location	Resource Condition	Available Quantity - tonne/year	Onsite Price - $/tonne
Central Highlands	Sawmill Residue	Pyrenees Sawmill - Chute	Chipped green to G50	1,600	$ 63.00
	Sawmill Residue	Other Ballarat Mills	Chipped green to G50	2,450	$ 63.00
	Sawdust	Timber Mills/Processors	Mixed	3,038	$ 14.00
	Molder Shavings	Timber Processors	Dry	1,011	$ 14.00
	Dockings	Timber Processors	Dry, mixed size	1,011	$ 30.00
	Bark	Timber Mills/Processors	Mixed	2,026	$ 30.00
	Post Peelings	McVilly Timber	Green peelings to G100	500	$ 75.00
	Harvesting Residue - Pine	Plantation < 50km from Ballarat	As left by harvesting	6,739	$ 2.00
	Harvesting Residue - Blue Gum	Plantation < 50km from Ballarat	As left by harvesting	64,193	$ 2.00
	Crop Stubble	Cropping < 100km from Ballarat	As left by harvesting	560,000	$ 5.00
	Municipal Green/Wood Waste	Central Highlands Council Transfer Stations	As collected or deposited	23,000	$ -
	Sewerage Sludge	Treatment Plants	Dry	2,600	$ -
	Animal Waste	On farm	Wet	40,000	$ -
	Municipal Waste	Landfill	Processed into RDF	31,000	$ -
Wimmera Southern Mallee	Crop Stubble	Throughout Region	As left by harvesting	472,157	$ 5.00
	Municipal Green/Wood Waste	Throughout Wimmera	Potential kerb side collection and transfer stations	11,310	$ -
	Sewerage Sludge	Treatment works	Dry	9,500	$ -
	Animal Waste	On Farm	Wet/Dry	85,853	$ -
	Municipal Waste	Landfill	Processed into RDF	11000	$ -
	Processing Waste	At plant/abattoir	Wet	21,063	$ -
	TOTAL			1,348,451	

Source: Biomass quantities from Central Highlands Bioenergy Scoping Study 2009 (CHBSS) and Wimmera Bioenergy Resource Audit 2010. Onsite biomass prices from CHBSS or estimated. Cartage and storage rates from AWB 2012 for Berry Bank. Refuse Derived Fuel (RDF) price average for US ($13 - $67). Harvesting rates based on Weekly Times Contractor Rates and US forestry websites. UB gas and electricity data supplied by UB Sustainability Officer, Dale Boucher.	(yellow)	15% of average yield – DPI
	(green)	50% of average yield - CHBSS

Appendix 2 - Potential Biomass Transport, Processing and Storage Opportunities

Resource Type – Central Highland	Available Quantity - tonne/year	Onsite Price - $/tonne	Harvesting Cost - $/tonne	Cartage Cost - $/tonne	Processing Cost - $/tonne	Storage Cost - $/tonne	Total Delivered Value
Sawmill Residue	1,600	$ 63.00	$ -	$ 17.00	$ -	$ 23.00	$ 164,800
Sawmill Residue	2,450	$ 63.00	$ -	$ 17.00	$ -	$ 23.00	$ 252,350
Sawdust	3,038	$ 14.00	$ -	$ 17.00	$ -	$ 23.00	$ 164,052
Molder Shavings	1,011	$ 14.00	$ -	$ 17.00	$ -	$ 23.00	$ 54,594
Dockings	1,011	$ 30.00	$ -	$ 17.00	$ -	$ 23.00	$ 70,770
Bark	2,026	$ 30.00	$ -	$ 17.00	$ -	$ 23.00	$ 141,820
Post Peelings	500	$ 75.00	$ -	$ 17.00	$ -	$ 23.00	$ 57,500
Harvesting Residue - Pine	6,739	$ 2.00	$ 21.00	$ 17.00	$ 8.00	$ 23.00	$ 478,469
Harvesting Residue - Blue Gum	64,193	$ 2.00	$ 21.00	$ 17.00	$ 8.00	$ 23.00	$ 4,557,703
Crop Stubble	560,000	$ 5.00	$ 25.00	$ 17.00	$ -	$ 23.00	$ 39,200,000
Municipal Green/Wood Waste	23,000	$ -	$ -	$ 17.00	$ 50.00	$ 23.00	$ 2,070,000
Sewerage Sludge	2,600	$ -	$ -	$ 17.00	$ -	$ 23.00	$ 104,000
Animal Waste	40,000	$ -	$ -	$ 17.00	$ -	$ 2.00	$ 760,000
Municipal Waste	31,000	$ -	$ -	$ 17.00	$ 40.00	$ 23.00	$ 2,480,000
Resource Type – Wimmera Southern Mallee							
Crop Stubble	472,157	$ 5.00	$ 25.00	$ 17.00	$ -	$ 23.00	$ 33,050,990
Municipal Green/Wood Waste	11,310	$ -	$ -	$ 17.00	$ 50.00	$ 23.00	$ 1,017,900
Sewerage Sludge	9,500	$ -	$ -	$ 17.00	$ -	$ 23.00	$ 380,000
Animal Waste	85,853	$ -	$ -	$ 17.00	$ -	$ 2.00	$ 1,631,207
Municipal Waste	11000	$ -	$ -	$ 17.00	$ 40.00	$ 23.00	$ 880,000
Processing Waste	21,063	$ -	$ -	$ 17.00	$ -	$ 2.00	$ 400,197
TOTAL	1,348,451						$ 87,916,352

Source: Biomass quantities from Central Highlands Bioenergy Scoping Study 2009 (CHBSS) and Wimmera Bioenergy Resource Audit 2010. Onsite biomass prices from CHBSS or estimated. Cartage and storage rates from AWB 2012 for Berry Bank. Refuse Derived Fuel (RDF) price average for US ($13 - $67). Harvesting rates based on Weekly Times Contractor Rates and US forestry websites. UB gas and electricity data supplied by UB Sustainability Officer, Dale Boucher.	(yellow)	15% of average yield – DPI
	(green)	50% of average yield - CHBSS

Appendix 3 - Potential Biomass Users

User (Potential)	Demand - Type (Heat/Power)	Amount - kWh/year	Current Fuel Type	Current Cost (estimated)	Bioenergy Alternative	Biomass Quantity - tonne/year	Bioenergy Fuel Cost
Beaufort Hospital	Heat	771,708	LPG	$ 82,683.00	Wood Chip	222	$ 22,866.00
Ararat YMCA Indoor Pool	Heat	2,766,944	Natural Gas	$ 109,571.00	Wood Waste	791	$ 71,150
Ararat YMCA Indoor Pool	Power	321,120	Electricity	$ 87,826	Wood Waste	387	$ 34,820
University of Ballarat - Ararat Campus	Heat	52,493	Natural Gas	$ 2,520	Wood Chip	15	$ 1,545
University of Ballarat - Ararat Campus	Power	50,249	Electricity	$ 7,939	Wood Chip	61	$ 6,236
University of Ballarat - Camp St Campus	Heat	1,613,835	Natural Gas	$ 77,464	Wood Chip	461	$ 47,493
University of Ballarat - Camp St Campus	Power	661,983	Electricity	$ 104,593	Wood Chip	798	$ 82,150
University of Ballarat - Horsham Campus	Heat	358,736	Natural Gas	$ 17,219	Straw	90	$ 6,278
University of Ballarat - Horsham Campus	Power	503,839	Electricity	$ 79,607	Straw	752	$ 52,640
University of Ballarat - Mt Helen Campus	Heat	12,358,554	Natural Gas	$ 444,908	Wood Chip	3,531	$ 363,695
University of Ballarat - Mt Helen Campus	Power	4,820,909	Electricity	$ 761,704	Wood Chip	5,808	$ 598,257
University of Ballarat - SMB Campus	Heat	240,592	Natural Gas	$ 11,548	Wood Chip	69	$ 7,080
University of Ballarat - SMB Campus	Power	1,947,865	Electricity	$ 307,763	Wood Chip	2,907	$ 299,448
GWM Water	Power	10,137,250	Electricity	$ 2,772,538	Straw	15,130	$ 1,059,116
Pyrenees Shire - Municipal Offices	Power	168,000	Electricity	$ 39,967	Wood Chip	251	$ 25,827
Burnside Road Poultry Farms - Bannockburn	Heat	1,750,000	LPG	$ 87,000	Wood Chip	500	$ 51,500
Lethbridge Incineration /Cogeneration (Bamganie Group) - Lethbridge	Heat- co-gen potential	4,200,000	LPG	$ 450,000	Wood Chip	1,200	$ 123,600

Below is an example of a bioenergy option using the tables above.

250kW Bioenergy System Annual Budget

ITEM	CAPITAL COST	INCOME	EXPENDITURE
BTOLA 250 kW IFGT System - located at University of Ballarat Mt Helen Campus	$ 850,000.00		
Labour – Refill fuel bunker -2 hrs per week @ $40/hr, System maintenance - 64 hrs/year @ $100/hr			$ 10,560.00
Fuel - green/wood waste shredded and dry - 1,800 tonne @ $50/tonne			$ 90,000.00
Equipment Maintenance			$ 10,000.00
Generator service items (oil, filter, etc)			$ 1,000.00
Overhead costs including capital recovery over 15 years			$ 100,000.00
Electricity Sales - 1,700,000kWh @ $0.16/kWh		$ 272,000.00	
Heating value - 3,400,000, kwh @ $0.05/kwh		$ 170,000.00	
TOTALS	**$ 850,000.00**	**$ 442,000.00**	**$ 211,560.00**

*Net Profit - **$230,440** or 27% on investment (3.6 year payback).*
Potential Mt Helen CHP plant - Current annual usage - 4,820,909 kWh of electricity and 12,358,554 kWh of natural gas. Bulk of electricity and gas used during day (peak load times). One system would cover a third of annual usage.