

# Victorian Climate Change Grants 2015

## Plantation Waste to Energy

**A partnership project between Alpine Shire Council  
and HVP Plantations**

**This project is supported through funding from the Victorian  
Government Climate Change Grants Program**



## Contents

|  |    |
|--|----|
| <b>Victorian Climate Change Grants 2015</b> .....                                  | 1  |
| Plantation Waste to Energy.....  | 1  |
| 1. Background .....  | 3  |
| 2. Objectives and Outcomes.....  | 3  |
| 3. Project Process.....  | 4  |
| 3.1. Supply of residues .....  | 4  |
| 3.2. Demand for residues .....   | 4  |
| 4. Key Findings.....   | 6  |
| 4.1. Supply of residues .....  | 6  |
| 4.2. Demand for residues .....   | 10 |
| 4.2.1. Facility 1 – Bright Sports Centre.....                                      | 10 |
| 4.2.2. Facility 2 – Bright Brewery.....  | 12 |
| 4.2.3. Facility 3 – Rostrevor Hop Farm.....  | 13 |
| 4.2.4. Facility 4 – Carter Holt Harvey.....  | 14 |
| 4.2.5. Facilities 5 and 6 – Bright and Myrtleford Hospitals .....                  | 15 |
| 5. Recommendations.....  | 16 |
| Appendix 1: Formulas and calculations .....  | 17 |
| Appendix 2: Providers and funding.....   | 18 |
| <br>   |    |
| Table 1: Business and facility assessment table.....                               | 5  |
| Table 2: Key facts and figures of supply .....                                     | 6  |
| Table 3: Key facts and figures of demand .....                                     | 10 |
| Table 4: Bright Sports Centre calculations.....                                    | 11 |
| Table 5: Bright Brewery calculations .....   | 13 |
| Table 6: Rostrevor Hop Farm calculations .....                                     | 14 |
| Table 7: Myrtleford Hospital calculations .....                                    | 15 |
| Table 8: Bright Hospital calculations.....   | 16 |
| <br>   |    |
| Figure 1: Example process for harvesting and processing post-harvest residues..... | 8  |
| Figure 2: Co-gen system for a timber mill.....                                     | 15 |

## 1. Background

The Plantation Waste to Energy project aimed to assess the potential for pine plantation post-harvest residues to be used to generate energy in a behind-the-meter scheme for a business or community facility in the Alpine Shire.

The harvest process focusses on extraction of logs. Branches, and parts of the trunk not selected for logs are left behind after harvest and are referred to as post-harvest residues. Currently, HVP Plantations burn some post-harvest plantation residues in piles on-site. The energy created through post-harvest burning is released directly into the atmosphere, creating unnecessary carbon emissions and localised pollution impacting nearby communities. HVP receive a number of complaints from the community regarding burning of residues.

Post-harvest plantation residues have potential to be re-purposed for other uses. One use is in the production of energy. Use of post-harvest residues to generate energy would mitigate carbon emissions by replacing grid-sourced or LPG energy, and has the potential to improve resilience for an appropriate business or facility through providing a consistent, cheaper form of renewable energy.

Use of post-harvest residues has the added benefit of improving the utility of harvested timber, thus improving the sustainability of plantations. Re-directing post-harvest residues would reduce impact on the community from burning, would cut some human resources costs associated with preparing the site for replanting, and would lessen the amount of woody weed management necessary after burning residues. Plantation managers would lose less time to responding to community concern around burning of post-harvest residues.

## 2. Objectives and Outcomes

Key outcomes of the project were:

1. Identified businesses and facilities with the potential and willingness to make use of plantation residues.
2. Identified and understood costs and benefits of generating energy from post-harvest residues for identified businesses and facilities.
3. Clarity and understanding within involved businesses of the economic and environmental benefits and costs of using post-harvest residues to create energy, and awareness of the process they would need to undertake to implement such a system.

## 3. Project Process

### 3.1. Supply of residues

To properly understand how post-harvest plantation residues can be used in energy production we need to know details of the supply. The following questions needed to be answered as part of this project:

- How many tonnes of post-harvest residues are available annually?
- What happens during the harvesting process and what does this mean for what residues look like and how they are left at the site?
- Given how residues are created and left on site, what are the different ways in which they can be collected and processed for use in a waste-energy system?
- How are the residues transported? Should transportation happen before or after processing?
- What are the costs involved for each of the different identified mechanisms for collecting residues, transporting them, and processing them for use?

### 3.2. Demand for residues

The first step in assessing whether post-harvest residues can be used in a waste to energy scheme was to identify businesses with an interest in exploring the use of post-harvest residues to create energy. Initially letters were sent inviting 37 of the larger businesses and facilities in the Alpine Shire to express interest in being involved in the project and to attend a forum on energy use and renewable energy sources.

Only one business expressed interest in being involved in the project.

As such, the project team identified seven businesses or facilities that, on the outside, had a high potential for having a positive business case for use of post-harvest residues to create energy. Criteria used to assess businesses or facilities include the following:

1. The business or facility must be reasonably large and involve activity that is high in energy use.
2. The business or facility should ideally incorporate a need for significant amounts of heat.

Seven businesses or facilities were identified and the Project Manager called and met with all seven to present the project, goals of the project, potential benefits for the business, and examples where bio-waste to energy systems have been successfully implemented in Victoria.

**Table 1: Business and facility assessment table**

| <i>Business or facility</i> | <i>Justification and assumptions</i>  |
|-----------------------------|---|
| Bright Brewery              | <ul style="list-style-type: none"> <li>• Had indicated an interest when initial project letters were sent out.</li> <li>• Undertaking significant business expansion and building new brew house.</li> <li>• Brewing process requires substantial heat inputs.</li> </ul> |
| Bright Hospital             | <ul style="list-style-type: none"> <li>• Significant heat need to keep hospital at constant temperature.</li> <li>• Similar size and business activity to Beaufort Hospital – which successfully installed a timber residue boiler in 2014.</li> </ul>                    |
| Myrtleford Hospital         | Similar to Bright Hospital  |
| Gapsted Winery              | <ul style="list-style-type: none"> <li>• Large business with high energy demand in wine production.</li> <li>• Size of the enterprise relative to others operating in the Alpine Shire lends itself to explore co-generation bio-waste to energy systems.</li> </ul>      |
| Bright Sports Centre        | <ul style="list-style-type: none"> <li>• Operates an indoor heated pool open through the year.</li> <li>• High electricity bills relative to other facilities in the Alpine Shire.</li> </ul>   |
| Rostrevor Hop Farm          | <ul style="list-style-type: none"> <li>• Drying rooms requiring extensive heat inputs used in processing hops harvested and processed onsite.</li> </ul>  |
| Carter Holt Harvey          | <ul style="list-style-type: none"> <li>• Timber processing facility operating a timber kiln requiring extensive heat inputs.</li> </ul>   |

Businesses were initially approached and invited to participate in the study. Gapsted Winery was quickly eliminated from further enquiry as energy costs form a small part of their overall business costs (4%), making the investment difficult to justify, and because their energy use appears better suited to more cost-effective solar.

Alpine Health declined to be involved in the study despite extensive approaches outlining the potential benefits. As such, the study does not include actual usage data and heat requirements for the hospitals, however, information on their website has allowed for a preliminary assessment to be made.

The next step in the process involved touring identified businesses and facilities with an expert in bio-energy systems to determine:

- Details of energy requirements and current technological solutions for each of the identified businesses.
- Data on LPG use, and, if necessary, energy use for the last year.
- Output capacity required to meet the current and future heat or energy demand.
- Appropriately sized and proven biomass solutions that could work for each of the businesses and facilities.

- The size and need of the boiler house, fuel storage, and buffer tank required, if appropriate.
- Estimated installation and commissioning costs, and maintenance and operating costs and needs.

## 4. Key Findings

### 4.1. Supply of residues

**Table 2: Key facts and figures of supply**

#### **Key Facts and Figures:**

25,000 tonnes of post-harvest residues are created annually. There are varying costs of extracting this material depending on location and characteristics of the coupe. Some of it would be economically unviable due to high costs of access or low quality of the resource.

Approximately 40% of harvesting in the Bright area is via full tree processing at roadside (cheaper to collect residues as they are brought to the edge of the coupe with the tree), 60% is harvested at the stump (more expensive to collect residues as they need to be collected from across the coupe).

A Bruks Chipper is one solution to process residues that are spread throughout the coupe. Bruks chippers cost \$1.2 million to buy new. There is one in Tumut owned by Grant Sawmills available for contract use. Prices vary depending on time required. This machine has been used by HVP in their 2013 trial. Other methods of extraction include a second forwarder to collect large residues from across the coupe, and a separate chipper. Cable harvesting operations would only require a chipper at the collection zone at the edge of the coupe.

The processing method cannot be assumed without understanding the end use.

HVP generate approximately 25,000 tonnes of raw post-harvest residues annually in the Ovens area (Bright-Myrtleford) spread across a range of coupes. This material is left over from two different types of harvesting operations, is created on a variety of sites with different access constraints and associated costs, and is created at varying times throughout the year. These variations mean the collection and processing costs are considerably varied from one harvesting operation to another and impossible to quantify without a comprehensive trial across a range of different sites.

The two different types of harvesting operations are:

1. Harvesting at the stump – where trees are harvested and de-limbed at the stump. Logs are then taken to a truck and residues are left at the stump. This accounts for 80% of harvesting, but around the Bright area terrain constraints reduce this to about 60% of harvesting.

2. Full tree processing at roadside – used in steep terrain. Full tree lengths are brought to a roadside processing site using cable systems or ground based machinery. The harvest residues are concentrated in a few locations making it easier to recover and utilise. Around the Bright area up to 40% of harvesting is undertaken in this manner due to the quantity of steep terrain.

A typical harvest at the stump process involves a 'harvester', which cuts the tree, de-limbs it, and cuts it into logs of varying sizes. A 'forwarder' then picks up the logs and takes them to the collection area along the road at the edge of the coupe. Trucks pick up the logs and transport them to a mill.

Cost-effective collection and processing of residues is central to the viability of using post-harvest residues to create energy. There are a number of parameters that have an impact on the cost-effectiveness of processing. Principally these revolve around sourcing of appropriate machinery at the lowest cost possible and running a process that adds the least amount of time to the harvesting process.

The equipment needed to chip branches, tops of trees and to deal with the dirt and stones that may be mixed in, is expensive. Targeting larger residues that are easier to recover, such as tree tops and bends in the trunk will mean residues can be kept cleaner and will be easier to recover. It is also important that small branches and needles are left on site to retain nutrients on site. This will mean the machinery required to process the residues can be cheaper, and the time to recover the residues will be less, but the percentage of material recovered will be less. It also means 'bundling' piles of residues for transport to a central processing site is not optimal as small material would be removed from the site.

Generally forestry companies would either pay a contractor to chip residues, the costs of which vary considerably with distance and which are subject to economies of scale, or transport material to the end user in log form, which decreases the volume that can be transported in one load. Front-end costs vary according to the site. The further the tree is from the landing at the edge of the coupe, the more expensive it is to recover the residues from that tree.

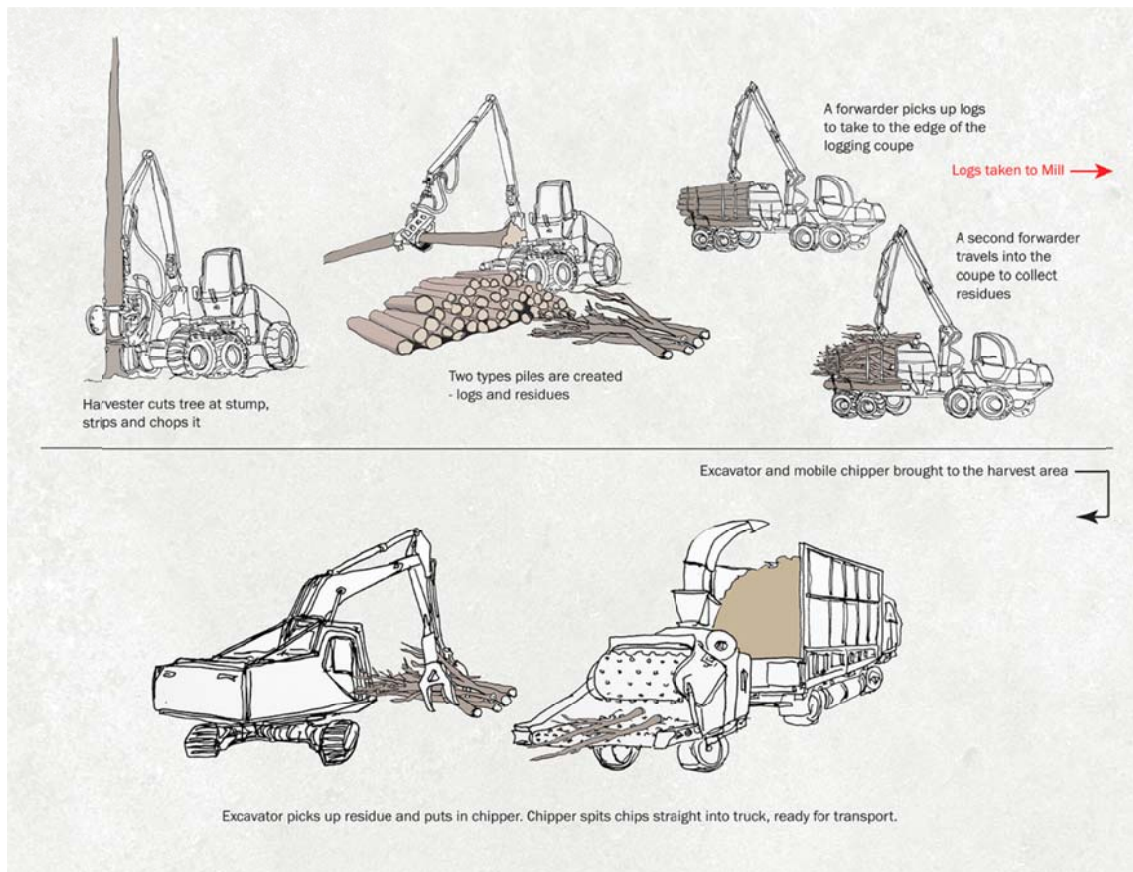
An efficient way to collect residues from the stump is to employ a 'bruks chipper', which is a chipping unit attached to a forwarder, to travel the coupe and collect all useable residues, chipping them into an attached receptacle as it is collected. Once the receptacle is full it can travel to the edge of the coupe and, ideally, offload into a waiting truck or container for transport. This machine allows for residues to be collected after the harvest process and requires no additional work by harvesting machinery during the harvest process. It also means that more residues can be collected in one trip by the forwarder, lessening time lost to travel to and from the edge of the coupe. A bruks chipper maximises the material collected as it can take large branches as well as de-limbed pieces of trunk. It eliminates the need for the excavator and mobile chipper depicted in Figure 1 by combining the forwarder and chipper machinery. A bruks chipper is expensive, so it is better suited to larger quantities.

For smaller quantities it may be more efficient to use cheaper machinery. In this case it would be best to direct the harvester to put the bits of the tree that are not turned into logs into a separate pile at the stump. These pieces would include the top of the trunk and any

bends in the trunk that are discarded. A forwarder would need to go and collect the piles and transfer them to the edge of the coupe, making a pile of 'residues' separate from the log piles awaiting collection. This would add a small amount of time to that spent harvesting the tree, and more time for the forwarder to make one or two more trips to the stump to collect the residue pile. Ideally a second, lesser quality, dedicated forwarder would be used. Workers would have to ensure that residue piles remain largely free from mud and debris.

If the residues are being processed prior to transport they then need to be processed into chips and loaded into a truck with an open roofed container on the back. To do this, an excavator and a chipper are needed after the harvest process. Most log collection points are constrained in size and it is unlikely a log collection process and residue collection process could run side by side, meaning the excavator is in addition to that needed to load the logs onto trucks. An excavator would pick up the residues and load them into the chipper. The chipper would preferably feed straight into a waiting truck.

This process is outlined in Figure 1, below. If using a bruks chipper the bruks chipper replaces the forwarder collecting residues and the excavator and mobile chipper as the one unit collects, chips, and loads.



**Figure 1: Example process for harvesting and processing post-harvest residues**

Cleaner chip could be collected by using a 'tumbler' to clean the residues before it goes through the chipper. A tumbler could result in very clean high-quality chip that could be directed to other higher-value uses such as MDF.

Sites harvested using a tree-to-the-roadside method are the most efficient sites to harvest residues as the whole tree is brought to the edge of the coupe. Non-harvested timber can be piled and left for processing by a cheaper mobile chipper once the sawlogs are piled and harvesting machinery is removed.

Generally, a biomass system requires wood chips that are reasonably uniform in size and reasonably dry – at least 30% moisture content or less. Some bio-waste systems can cope with more contamination, greater variability in chip size, and more variable moisture content, than others. When a facility is considering putting a biomass boiler in place it should consider the type of biomass available and choose a system best suited to the inputs.

HVP have previously conducted two trials processing post-harvest residues. The most recent (2016) involved the processing of cable-harvested residues through a grinder to produce mulch or shredded residues. Estimated costs of this trial indicate a processing cost of approximately \$25 per tonne. It is important to note that a grinder is typically more expensive to operate than a chipper – the grinder used in the trial was \$900 per hour to run, but the material produced could also be used in a biomass boiler.

In 2013 HVP extracted post-harvest residues from Ovens harvesting operations, chipped the material using a bruks chipper, and transported it to Benalla – a distance of approximately 120 km from Bright plantations and 90 km from Myrtleford plantations. Results of this trial indicated that post-harvest residues may be available for purchase for between \$45 and \$60 per tonne (including transport), depending on the moisture content of the material and distance from coupe to site.

Based on these figures, for the purposes of this study we have very conservatively assumed that HVP would sell its post-harvest residues as transported chip (total cost) for \$70 a tonne. As stated previously, actual extraction and processing costs would vary widely across harvesting operations, and the cheapest method of extraction would also vary depending on the quantity of the material available and the geography of the sites.

#### *Alternative processing systems:*

Transport of whole residue logs and processing in a large (quick) stationary chipper may reduce costs in some circumstances. Chipping costs would be considerably less if the chipper is available on site at the end-user. However transport costs per tonne increase as the material transported is less dense.

Regardless of how the material is processed, it always needs to be transported off-site. Transport costs are always the same as a function of volume. The denser the load the greater heat capacity the load will have, which is why it is usually cheaper to process the material into chips on-site and transport denser loads. For very short distances and large quantities transport of logs may be a cheaper option if a large (and quick) stationary chipper is available on site, or if the biomass boiler can take whole bundles. This may be an option for a large facility processing large quantities of material. Currently there are no facilities in the Alpine Shire for which this option is economically viable.

## 4.2.Demand for residues

To assess viability for use of post-harvest residues by selected facilities the heat needs of the facilities were assessed and biomass equivalents were calculated. The formulas and calculations involved in this are detailed in Appendix 1.

**Table 3: Key facts and figures of demand**

| <b>Key Facts and Figures:</b> |   |
|-------------------------------|---|
| Bright Sports Centre          | Thirty year (conservatively estimated) payback on a 60kW system plus a 30 kW system (to be used in winter) to supplement solar heating for the swimming pool. This system would require 95 tonnes of biomass annually.                      |
| Bright Brewery                | Thirteen year payback on small 50kW system to create hot water to feed the LPG boiler that creates steam. This system would require 11 tonnes of biomass annually, and considerable LPG would still be used to create steam from hot water. |
| Rostrevor Hop Farm            | Twelve year payback on 2.5 MW indirect heating system incorporating recycling of warm air. This system would require 500 tonnes of biomass annually. This payback period halves if LPG costs rise to \$0.9 per litre.                       |
| CHH                           | Best approach is to investigate a co-gen system to create steam and electricity, and look at value-adding processes for the Mill's own high-quality residues.   |
| Myrtleford Hospital           | 2.7 year payback on a small 100kW system requiring 160 tonnes of biomass annually.  |
| Bright Hospital               | Three year payback on a small 80kW system requiring 140 tonnes of biomass annually.   |

### 4.2.1. Facility 1 – Bright Sports Centre.

The pool is an indoor pool at the Sports Centre in Bright. It is 17m x approx. 8.5m with a shallow end about waist deep and a deep end probably around 1.8-2m deep. It holds approximately 300,000 litres and is constantly heated to around 31 degrees. This temperature is necessary to support swim programs for children and for the elderly.

The sports centre also contains nine showers. The hot water for these comes from gas heating (LPG), which goes through separate heat exchangers in a slightly different location than the two heat exchangers servicing the pool.

The pool is currently heated by cycling the water through heat exchangers and through a solar hot water system. The heat exchanger runs off electricity.

There is a 30kW Photovoltaic system on the roof of the sports centre. Much of this would be used to power the heating/cooling system on the roof of the pool room. This system keeps the pool room close to the temperature of the pool to avoid condensation building up in the room.

An ideal boiler system would entirely replace the electricity use of the heat exchanger, and would also replace the LPG used by the shower units. This means that heated water from the boiler would need to be plumbed to two different locations on the north side of the building. The boiler would be situated on this side of the building as well. The boiler would require fuel containers and concreting as well as plumbing and electricity.

With regards to gas use, in the 2016/2017 financial year 5291 litres of gas was delivered at a cost of \$3,545.

A meter was installed on the heat exchangers for the swimming pool to measure their consumption in order to estimate the component of total electricity used by the heat exchangers. In October 2017 they used about 130kW h per 24 hour period. During the day when it is sunny the meters on the heat exchangers did not change. We have thus assumed that the electricity use of the heat exchangers between October and April is largely outside of daylight hours. During winter, however, the heat exchangers would also be using grid electricity during the day.

**Table 4: Bright Sports Centre calculations**

| <i>Cost of installation</i>   | <i>Fuel costs</i>                                     | <i>Annual operating cost of biomass system</i> | <i>Current electricity costs and savings</i>                          | <i>Annual saving</i>         | <i>Payback period</i> |
|---|---|--|---|------------------------------|-----------------------|
| \$140,000 - \$80,000 supply of a 30kW and 60kW system, plus \$60,000 installation costs | \$70 per tonne; 95 tonnes required annually = \$6,650 | \$9,000 (includes fuel and maintenance)        | \$33,000 (\$36,500) – estimate a \$10,000 annual saving + \$3,500 LPG | \$4,500 (\$13,500 - \$9,000) | 31 years.             |

The heat exchangers use approximately one third to one half of the daily usage at the Sports Centre. Approximately half of what the heat exchangers use is charged at peak rates and half at off-peak rates. Cost savings would be just under one third of electricity costs plus LPG costs, minus the fuel costs of the boiler system. There are many uncertainties in these cost

estimates and the payback period calculated of 31 years is a very conservative estimate. There are many aspects that may bring this period forward. These include:

1. The installation costs are largely unknown as they are site specific and no engineering report has been done. The installation estimate of \$60,000 is conservative. A full engineering report has been estimated by Foresight Engineering to potentially be in excess of \$25,000.
2. Fuel costs are likely to be lower than \$70 per tonne. They could also be reduced by using timber waste sourced from Alpine Shire Council's Transfer Stations.
3. While we know how much electricity the heat exchangers are using, it is difficult to translate this to cost savings as significant discounts are applied to our total energy bills. The numbers are conservatively estimated.

Note: This is based on purchasing an undersized system of 60kW and a second 30kW system to turn on during winter. This is cheaper than purchasing a larger oversized system of 120kW.

#### **4.2.2. Facility 2 – Bright Brewery.**

Bright Brewery has recently begun construction of a second brewing facility in Churchill Avenue in Bright. They will be installing an LPG boiler system to create steam needed for the brewing process.

The Brewery currently uses 21,000 litres of LPG for the brewing process at its established facility on Gavan Street in Bright and expects to use over 32,000 litres at its new facility. The new facility will require up to 500 kW of steam for brewing periods. Brewing initially will be for approximately 12 hours a day. The inconsistency of use and the need for significant heat to create steam are barriers for cost-effective biomass heating. The heat required to make steam requires a boiler with a larger heat output, which, as well as being more expensive, requires additional regulatory governance.

Rather than making steam from biomass, it is possible that a smaller boiler of approximately 50 kW could be installed to pre-heat the water used to produce steam via a buffer tank, thereby significantly reducing the energy required to convert water to steam. This option would also remove the need to adhere to a stricter regulatory framework.

Much more energy is required to convert water to steam, than is used to heat water to 100°C. It takes approximately 360 kJ to heat a kg of water from pipe temperature to 100°C and 2,260 kJ to turn that kg of water into vapour. Using that ratio, if the Brewery were to pre-heat all water using a small wood boiler they would replace only 5,110 litres LPG, requiring only 11 tonnes of biomass. They would still require 27,000 litres LPG to convert the hot water to steam.

**Table 5: Bright Brewery calculations**

| <i>Cost of installation</i> | <i>Fuel costs</i>   | <i>Annual operating cost of biomass system</i> | <i>Projected LPG costs for the new facility</i>   | <i>Annual saving</i> | <i>Payback period</i> |
|-----------------------------|---|--|---|----------------------|-----------------------|
| \$40,000 - \$50,000         | \$70 per tonne assumed; 11 tonnes required annually = \$4,550 | \$1,000 (includes fuel and maintenance)        | \$32,000 – only \$5,100 of this would be replaced | \$3,900              | 13 years.             |

#### **4.2.3. Facility 3 – Rostrevor Hop Farm.**

Rostrevor Hop Farm grows, harvests and processes hops, which involves drying the hop buds. The facility has large drying sheds used to dry harvested hops for four weeks annually.

The Hop Farm currently uses 400,000 litres of LPG during their drying period to dry approximately 680 tonnes of hops. Direct fire LPG burners with large fans force hot air at 60 to 63 degrees through the green hops. Current average heat demand during the drying period is 4.2 MW. No recycling of heated air is permitted for safety reasons.

Previously the Hop Farm had a slightly different system where they were permitted to recycle heated air back through the fan. This reduced the heat demand by 40%.

A system using indirect heating with recycled air would achieve the same heat result with 2.5 MW of heating. LPG usage would then be replaced with 500 tonnes of biomass.

Once LPG costs rise to approximately \$0.90 / litre the payback period for such a system drops to 6 years.

**Table 6: Rostrevor Hop Farm calculations**

| <i>Cost of installation</i> | <i>Fuel costs</i>  | <i>Annual operating cost of biomass system</i> | <i>Current LPG costs</i> | <i>Annual saving</i> | <i>Payback period</i> |
|-----------------------------|--|--|--------------------------|----------------------|-----------------------|
| \$1.5 - \$1.8 million       | \$70 per tonne assumed; 500 tonnes biomass = \$35,000 p/a. | \$50,000 (includes fuel and maintenance)       | \$200,000                | \$150,000            | 12 years.             |

#### **4.2.4. Facility 4 – Carter Holt Harvey.**

The Carter Holt Harvey (CHH) timber mill at Myrtleford currently uses 40,000 tonne of timber processing residues to heat their drying kilns in a large biomass boiler.

The Mill values the residues at \$40 - \$45 per tonne and would sell the residues, which are good quality, if they were able to purchase an inferior product for a lower cost for use in their boiler. It is difficult to establish a scenario where the Mill is able to procure plantation residues for a lower cost than \$40 per tonne.

The Mill may be able to add value to their timber processing residues by, for example, producing wood pellets for export, or for use in an emerging domestic market. The material could then be sold at a higher cost and plantation residues used in the Mill drying kilns.

Two independent experts have suggested that CHH would benefit significantly from a large co-gen biofuel system that creates electricity as well as the steam they require for their timber kilns. Co-gen involves burning biomass to create steam, and using the steam produced to turn a turbine. The process is detailed in the figure below. No cost estimates are available for this approach as the complexity of this arrangement is beyond the scope of this project. However, the economic benefit to CHH is likely to be significant.

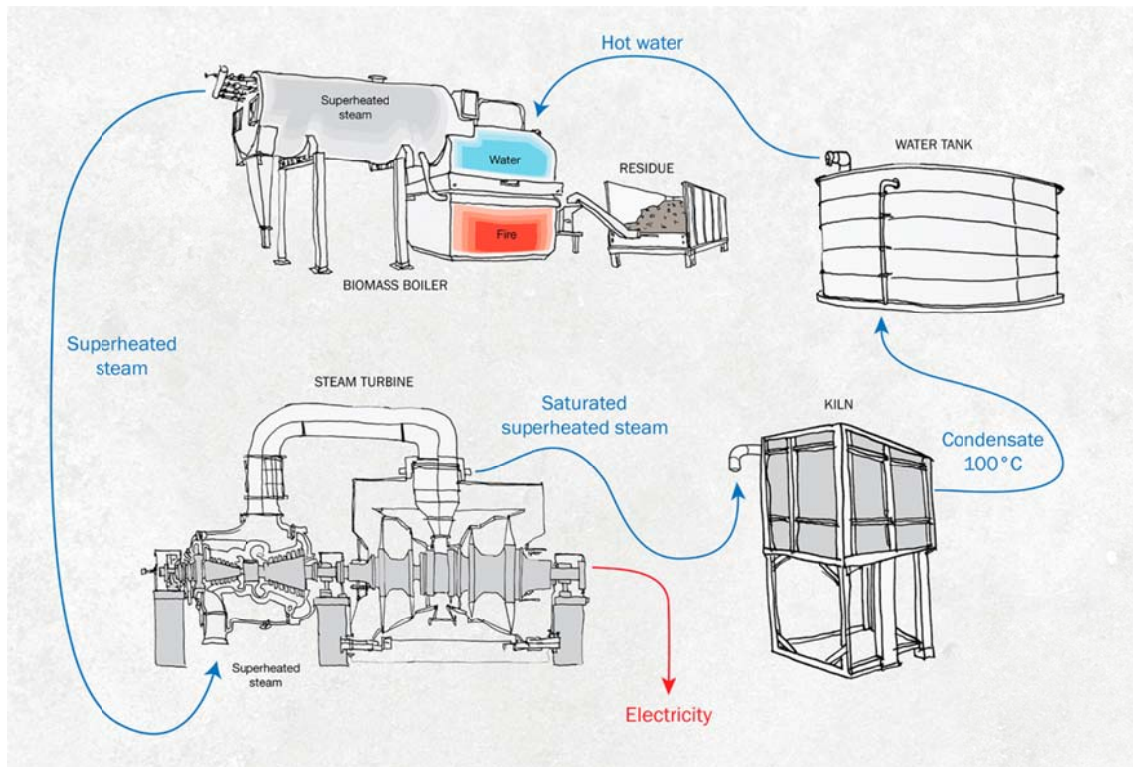


Figure 2: Co-gen system for a timber mill

#### 4.2.5. Facilities 5 and 6 – Bright and Myrtleford Hospitals

Although Alpine Health declined to be involved in the study both Bright and Myrtleford Hospitals are easily compared with Beaufort Hospital in Western Victoria, which installed a biomass boiler in 2013. Learnings from the Beaufort Hospital installation can be applied to Bright and Myrtleford hospitals.

Information available on the Alpine Health website indicates that in 2014/2015 Alpine Health used 234,000 litres of LPG at its three sites. For the purposes of this study we have assumed Myrtleford to have a slightly larger share of this usage, requiring a 100 kW boiler, with Bright requiring an 80 kW boiler.

Table 7: Myrtleford Hospital calculations

| <i>Cost of installation</i> | <i>Fuel costs</i>                                  | <i>Annual operating cost of biomass system</i> | <i>Projected LPG costs</i> | <i>Annual saving</i> | <i>Payback period</i> |
|-----------------------------|--|--|----------------------------|----------------------|-----------------------|
| \$120,000 - \$140,000       | \$70 per tonne; 160 tonnes required = \$11,200 p/a | \$14,000 (includes fuel and maintenance)       | \$66,000                   | \$52,000             | 2.7 years.            |

**Table 8: Bright Hospital calculations**

| <i>Cost of installation</i> | <i>Fuel costs</i>   | <i>Annual operating cost of biomass system</i> | <i>Projected LPG costs</i> | <i>Annual saving</i> | <i>Payback period</i> |
|-----------------------------|---|--|----------------------------|----------------------|-----------------------|
| \$100,000 - \$120,000       | \$70 per tonne assumed; 140 tonnes required = \$9,800 p/a | \$12,000 (includes fuel and maintenance)       | \$52,000                   | \$40,000             | 3 years.              |

## 5. Recommendations

The two hospitals are likely to have viable options available to make use of plantation residues in a biomass system. The total biomass required across these three facilities is 395 tonnes annually. This is considerably less than the 25,000 tonnes that HVP potentially has available.

It is possible that extraction of approximately 500 tonnes of residues could be achieved for under \$70 per tonne if the process is conducted in a careful manner, maximising efficiencies. This would require careful planning to ensure residues could be processed in one period, and would require facilities to have storage capacity for a year's worth of supply. If this is achieved then a contractor could be brought in once a year only to chip collected residues.

A better approach would be for HVP to pursue alternative uses and buyers for clean chip from harvest residues. There may be larger facilities outside of the Alpine Shire, and facilities that can use the chip in other processes such as particle board production. Establishing buyers for larger quantities of chip will mean that the economies of scale for extraction costs will improve. It will also mean that use of the resource will be maximised, improving the sustainability and utility of the plantations.

HVP could also begin discussions with CHH and with investors to further assess the viability of significant co-generation infrastructure. A project of that magnitude would maximise use of the resource, and would improve the sustainability of the CHH Myrtleford Mill by substantially reducing electricity use.

## Appendix 1: Formulas and calculations

To calculate heat required from LPG usage figures:

Net heat output (kWh) = LPG (litres) \* 7 \* 95% heater efficiency for LPG heaters

To calculate size of biomass system required:

Average heat output required (kW) = Net heat output / number hours of use

So if LPG data is number of litres used in a month, one 30 day month is equal to 720 hours.

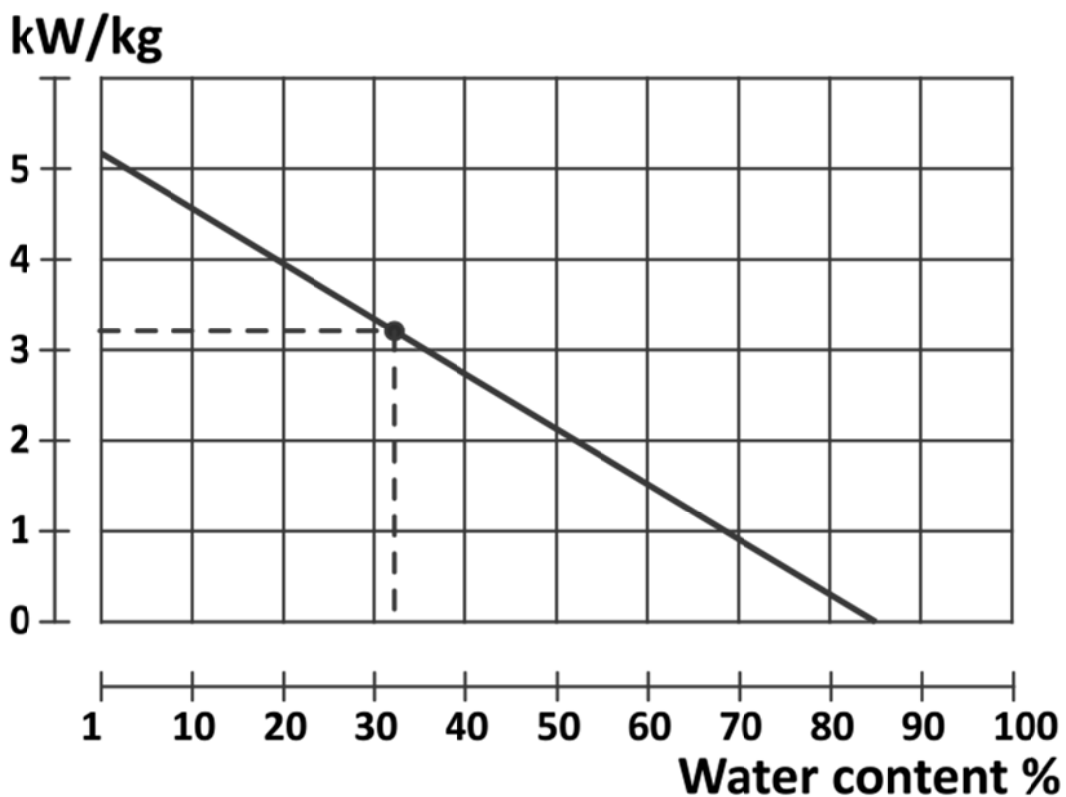
The system should then be sized above the average heat output to avoid running it constantly and to have a buffer for peak loads.

To calculate biomass required:

Moisture content of the biomass is critical in determining the heat output (refer to the graph below).

Generally use 3.5 kWh (heat) per kg of biomass. Biomass heaters are usually slightly less efficient than LPG (around 85% to 90%), so add 10% mass to account for this.

kg biomass required = Net heat output (kWh) / 3.5 + 10%



## Appendix 2: Providers and funding

Companies providing biofuel system services in Australia include:

- Enriva Pty Ltd; General Manager Sohum Gandhi, Neutral Bay 2089; [sohum@enriva.com.au](mailto:sohum@enriva.com.au); 02 8006 2868; [www.enriva.com.au](http://www.enriva.com.au)
- DRAGONNRG; Shaun Quayle; [shaun@dragonnrg.com.au](mailto:shaun@dragonnrg.com.au); Mobile: 0438 587791

The Federal Government is providing funding for rural research and development for profit until 2022, focussing on primary industries and trialling new technologies. The next funding round is yet to be announced. More information is available at <http://www.agriculture.gov.au/ag-farm-food/innovation/rural-research-development-for-profit>.

The Victorian Government's \$20 million New Energy Jobs Fund (NEJF) will support Victorian-based projects that create long-term sustainable jobs, increase the uptake of renewable energy generation, reduce greenhouse gas emissions and drive innovation in new energy technologies. Funding to support new energy technology projects will be available through three annual grant rounds. The third grant round is expected to open late 2017. <http://www.business.vic.gov.au/support-for-your-business/future-industries/new-energy-technologies>