BREAZE

Draft McCallum Linen Biomass Fuelled Steam Boiler Business Case

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A business case for the installation of a 2 MW wood chip fuelled steam boiler at McCallum Linen, Ballarat. Indicative installation costs and potential savings are presented.

McCallum Linen Wood Chip Fuelled Steam Boiler Business Case

Executive Summary
In June 2016, the Victorian Government committed to Victorian renewable energy generation targets of 25 per cent by 2020 and 40 per cent by 2025. Part of that commitment was a Renewable Energy Action Plan. This plan included support for community renewable energy projects through community power hubs. Ballarat Renewable Energy and Zero Emissions (BREAZE) were selected to become a Community Power Hub and develop funding proposals to use bioenergy. This proposal outlines a business case to use wood chips to replace natural gas at the McCallum Linen site in Coronet Street, Wendouree.

McCallum Linen is a laundry and linen hire service that uses a significant amount of natural gas for the production of steam used in the washing and ironing systems and for heat in four large dryers. Based on gas usage figures supplied by McCallum staff and the rated capacities of the steam boiler and dryers it appears that the steam boiler is averaging less than half its rated capacity of 200 hp or 1,962 kW. The four dryers have a plated output of 233 kW each. The site operates 7.5 hours per day, four days per week with the boiler system being started earlier to ensure heat output is available when staff arrive for work. See attachment 6 for detailed energy use.

This business case proposes installing a 2,000 kW (2 MW) wood chip fuelled steam boiler to replace the current gas fired steam boiler and provide sufficient heat to replace most or all of the natural gas used in the dryers. The total heat output of the proposed boiler is 3,109,204 kWh of which around 1,399,142 kWh would supply the steam and hot water needs of the site. The remaining 1,710,062 kWh would offset gas use by the dryers by preheating the intake air. Maximising the use of the boiler output would ensure the best return on investment.

The estimated installed cost of the 2,000 kW steam boiler system is $880,596.00 with a simple payback of 7.1 years. It could be less if natural gas prices rise. The NPV after 20 years is expected to be $ 671,448 with a simple return on investment of 14.1%. A reduction in greenhouse gas emissions of up to 560 tonnes for the site would be achieved if all the natural gas use was replaced.

The existing natural gas boiler and dryer system would be retained as backup and to cover peak loads. Last financial year McCallum Linen spent just over $179,000 on natural gas and this is expected to be reduced to less than $5,000 per year if this system is installed.

The Ballarat City Planning Department has been contacted and advised that a Planning Permit will be required at a cost of around $1,400 but a Building Permit may not be needed depending on the type of system housing used. A containerised system should be exempt but the construction of a shed would not. The approximate cost of a building permit would be $1,200.

The EPA has advised that as the proposed system sizes are below the output threshold under their 1559.1- Energy from Waste Guidelines they will not need their approval.

Detailed costings, draft wood chip supply contract, Operation Health and Safety Plan, system supplier quotations and hospital energy use summary are attached.

Note: all prices quoted are exclusive of GST.

Figure 1: McCallum Linen, Wendouree

Proposal summary (Value proposition)

In June 2016, the Victorian Government committed to Victorian renewable energy generation targets of 25 per cent by 2020 and 40 per cent by 2025. Part of that commitment was a Renewable Energy Action Plan. This plan included support for community renewable energy projects through community power hubs. Ballarat Renewable Energy and Zero Emissions (BREAZE) were selected to become a Community Power Hub and develop funding proposals to use bioenergy. This proposal outlines a business case to use wood chips to replace natural gas at the

McCallum Linen site in Coronet Street, Wendouree. By switching to a renewable energy source, McCallum Linen may be eligible for a Gas Efficiency Grant from Sustainability Victoria of up to $50,000.

McCallum Linen is a laundry and linen hire service that uses a significant amount of natural gas for the production of steam used in the washing and ironing systems and for heat in four large dryers. Based on gas usage figures supplied by McCallum staff and the rated capacities of the steam boiler and dryers it appears that the steam boiler is averaging less than half its rated capacity of 200 hp or 1,962 kW. The four dryers have a plated output of 233 kW each. The site operates 7.5 hours per day, four days per week with the boiler system being started earlier to ensure heat output is available when staff arrive for work. See attachment 6 for detailed energy use.

Figure 2: Dryers and large washer

This business case proposes installing a 2,000 kW (2 MW) wood chip fuelled steam boiler to replace the current gas fired steam boiler and provide sufficient heat to replace most or all of the natural gas used in the dryers. The total heat output of the proposed boiler is 3,109,204 kWh of which around 1,399,142 kWh would supply the steam and hot water needs of the site. The remaining 1,710,062 kWh would offset gas use by the dryers by preheating the intake air. The use of steam to heat industrial clothes dryers is common and they are available in Australia, see: https://www.richardjay.com.au/dryers/adc-ad-202

The operating temperature of boiler is 100° C and typical maximum temperature for tumble clothes dryers is below 90° C so the use of heat exchangers should provide sufficient heat. Maximising the use of the boiler output would ensure the best return on investment.

The estimated installed cost of the 2,000 kW steam boiler system is $880,596.00 with a simple payback of 7.1 years. It could be less if natural gas prices rise. The NPV after 20 years is expected to be $ 671,448 with a simple return on investment of 14.1%. A reduction in greenhouse gas emissions of up to 560 tonnes for the site would be achieved if all the natural gas use was replaced.

The existing natural gas boiler and dryer system would be retained as backup and to cover peak loads. Last financial year McCallum Linen spent just over $179,000 on natural gas and this is expected to be reduced to less than $5,000 per year if this system is installed.
The value of the expected greenhouse gas reduction is zero at present as Australia does not currently have a price on carbon however the Emissions Reduction Fund (ERF) does provide an indicative price through the auction of Australian Carbon Credit Units (ACCUs). According to the latest review of the ERF by the Australian Climate Change Authority, the average price paid for ACCU's was $11.83/tonne. Using this figure as a nominal value for emission reductions then the projected savings would be worth $6,625 however there is uncertainty on the future value of emission reductions so this value has not been included.

Note: all prices quoted are exclusive of GST.

Fuel costs used are for shredded and screened timber waste from KKC Recycling which is located nearby at 3 Hammer Court. Initial discussions with the manager of KKC Recycling indicated they could supply wood chips at a delivered price of $50/tonne. Having the fuel supplier so close will minimise fuel transport costs and onsite storage requirements. The suggested location for the system is the area at the rear of the building as indicated in the satellite picture of the site in figure 4. The systems will be housed in shipping containers with a 6m container for fuel and a 6m container for the boiler system. Given the closeness of the fuel supplier, a larger container would not be needed. A total area of around 50m2 including the fuel store filling system will be needed.

Concerns have been raised about the future availability of wood chips in the region however a 2009 report prepared for the Central Highlands Agribusiness Forum (CHAF) by SED Consulting suggested there was over 70,000 tonnes of timber harvesting residue and 11,000 tonnes of timber processing residue available annually within 50 km of Ballarat. The current Australian Biomass for Bioenergy Assessment (ABBA) project lists 39,736 tonnes of timber harvesting residue, 31,130 tonnes of timber processing residue, and 23,542 tonnes of wood waste available per annum in the local area. The proposed biomass boiler system will use less than 1,000 tonnes per annum so there is ample local resource of biomass available and if necessary the boiler could be successfully operated on straw briquettes or other agricultural residues such as olive pits and almond shells.

Safety and comfort of McCallum Linen staff will also be ensured with the systems fully containerised and emissions well below EPA recommendations. The installation will be an example for other businesses and provide an ongoing reduction in the laundry operating costs.

Figure 3: Proposed steam boiler system location

Proposal development

This proposal arose out of the desire of McCallum Linen to reduce their operating costs. BREAZE approached the laundry to help them realise this goal through the Community Power Hub process. A potential fuel source was identified nearby at KKC Recycling. This company recycles waste timber and produces a shredded product suitable for boiler fuel.

The selection of a containerised system allows for a more flexible installation process with minimal disruption to laundry operation. It also gives McCallum Linen the option to easily remove or relocate the system in future if required. Due to a lack of biomass steam system suppliers in Australia, tender options are limited and this will be an issue for the project as well as future potential users will need to consider.

The Ballarat City planning department has been contacted advised that a Planning Permit will be required at an estimated cost of $1,400. A Building Permit may be required for any building other than a containerised system. The approximate cost of a building permit would be $1,200. The EPA has advised that as the proposed system sizes are below the output threshold under their 1559.1- Energy from Waste Guidelines they will not need their approval.

Figure 4: Satellite picture of McCallum Linen **(Courtesy Google Maps)**

Technical changes required

The output of the steam boiler would be connected to the existing steam pipe work connecting the existing gas boiler to the washer. This steam piping would need to be extended to the dryers and fan forced, finned heat exchangers installed at each dryer air intake. The plumbing will be roof mounted and cause minimal disruption to laundry operations. The existing gas boiler will only operate if the biomass system is off line and for one day every 3 months for maintenance purposes. The biomass boiler will be web linked and has an automatic notification system to alert maintenance staff of any problems. Maintenance contractors can access the boiler system remotely, assess any problem and advise McCallum Linen staff accordingly.

The biomass system and fuel storage containers will be located at the rear of the site on the east side of the building. There is sufficient space to allow easy access for fuel delivery vehicles. Fuel deliveries will generally require the attendance of a McCallum Linen staff member to access the fuel quality and to operate the fuel store filling system.

Cost/Benefit analysis of the Biomass Steam Boiler

Item	Value	Assumptions and accuracy
Purchase and delivery of a containerized boiler system and fuel storage	$765,596	Granpal price base on initial quotation
System delivery, site works and plant construction	$50,000	Dragon NRG price base on initial estimate
Electricity connection	$15,000	Darren O'Hagan price base on initial estimate
Heat delivery system	$50,000	Poole Plumbing price based on initial estimate
Total System Cost (ex. GST)	**$880,596**	

Biomass Steam Boiler financial and other benefits

Item	Value	Assumptions and accuracy
Laundry heating cost*	- $124,540	Estimated net energy cost reduction based on outputs with proposed fuels ±5% accuracy. Includes an annual system maintenance cost of $17,612.
Reputation	Not included in this estimate	The resulting reduction in energy and greenhouse gas emissions by the laundry will ensure McCallum Linen is leading in the area of sustainability.
Total Financial Benefit (ex. GST)	**$124,540**	

*Based on current natural gas prices. These prices are likely to rise in future but this forward value has not been included in the calculations.

Total costs = $880,596   Quantifiable benefits = $124,540   NPV after 20 years = $671,448

Approximate simple payback on the project is 7.1 years without inclusion of co-benefits such as energy security and company reputation.

Project risks

A risk assessment has been conducted in accordance with internal procedures. A summary of key risks and how they will be managed is described below.

Risk	Mitigation strategy
Safety during installation	Risk management plan will be in place and standard operating procedures will be followed,
Impact on laundry operations	The biomass steam system will be stand alone and not connected to the existing steam system until the installation is almost complete. Disruption to normal operation while the final connects are being made is expected to be minimal.
Savings not achieved	Based on case studies from similar installations overseas there is a high level of certainty that the savings will be achieved. The financial saving is likely to be higher in future due to likely increases in natural gas prices.
Local wood chip fuel becomes unavailable	The proposed biomass steam system is able to use a range other fuels including wood pellets. There are a number of potential fuel sources in the Ballarat area which would still be cheaper than natural gas.

Next steps

The McCallum Linen management and BREAZE will review this document and decide which technology is the most appropriate. Applications for funding can then be sort. Once funding has been obtained a formal tender process based on the specifications and outputs suggested by this report can be undertaken. Discussions with KKC Recycling or other fuel supplier should be commenced as soon as project funding is obtained to ensure a wood chip supply is in place when the proposed system is installed.

Attachments

Detailed costings, draft Operational Health and Safety Plan, draft Supply Contract, response from EPA, quotation provided by system suppliers and laundry energy use summary are attached.

Attachment 1

Breakdown of Installation Costs

Indicative Budget for McCallum Linen 2 MW Steam Only Plant

ITEM	CAPITAL COST	INCOME	EXPENDITURE
2000 kW Granpal biomass steam boiler	$765,596.00		
System delivery, site works and plant construction	$50,000.00		
Electricity connection	$15,000.00		
Heat delivery system including dry heat exchangers.	$50,000.00		
Operating Hours - 1,800 p.a.			
Plant foot print up to 100 m2			
Fuel - 888 tonnes of wood chips @ $50/tonne			$44,400.00
Plant & Equipment Maintenance (2% of capital)			$17,611.92
Heating replacement value - 3,109,204 kWh @ $0.06/kWh		$186,552.00	
TOTALS	**$880,596.00**	**$186,552.00**	**$62,011.92**
Potential annual profit if the indicated amount of heat is used.	**$122,152.00**	**Return On Investment - %**	**14.1**

Attachment 2

Draft McCallum Linen Biomass Boiler Operation Health and Safety Plan

This document provides an overview of the most common risks involved with the main activities in a biomass system, namely: ′ fuel delivery, ′ fuel storage and handling, ′ boiler operations and combustion. It is only a draft and should be reviewed once the biomass heating system has been installed

Fuel delivery

Fuel for the boiler system will be delivered by a truck which will have to manoeuvre on site and then tip into a mechanical conveyor. This will involve reversing trucks in a restricted space that is shared with other activities, e.g. car park, laundry delivery area and pedestrian access. A full risk assessment must be carried out to identify the risks posed by the delivery procedures and should include the following considerations: the most appropriate time for receiving deliveries, ′ whether pedestrians might be present in the delivery area, the requirement for a reversing assistant. The delivery site should be delineated prior to the delivery and laundry staff on site to co-ordinate safe access of the truck. Access to fuel reception and storage areas should be controlled to prevent injury to operatives or pedestrians. Temporary and or permanent barriers may be used to control access as appropriate.

Tipping

The access area to a fuel store filling trough should have clear sight lines and consideration should be given to the discharge of fuel by tipping as this procedure may well cause a significant change in the vehicle's centre of gravity reducing stability. Operatives should not be permitted to stand in the tipping zone at the rear of the vehicle in order to assist or control the tipping action, by using a rod, for example. If rear gates or doors must be activated manually then this must be achieved from a safe position.

Biomass fuel storage

The biomass fuel storage is included in the boiler system container. It includes the storage filling and fuel feed systems with a number of health and safety implications. The fuel store is a confined space and is therefore potentially hazardous. Any fuel store maintenance or repair should be kept to a minimum. It is hazardous because it is effectively a confined space connected to a combustion chamber where carbon dioxide (CO^2) and carbon monoxide (CO) are produced. A procedure for entering and working in the confined space will be required and a 'permit to work' authorisation is advisable. Except in the case of an annual inspection or maintenance, entry to the fuel storage will generally be due to plant failure. Even if a detailed procedure has been prepared, the nature of the failure may mean that the method cannot be followed in its entirety. If this is discovered upon entry, staff should exit the store and re-evaluate the plan from a safe position. As a result of this, as an absolute minimum the boiler and fans connected to the store should be switched off and left for as long as is required to ensure full gas dispersion before entry is attempted. Two people must be present before entry. If any fumes can be seen or if there is reason to believe any fume back may be occurring (e.g. there is a smell) then entry should not occur until 30 minutes after this has dissipated.

Fuel store access doors and hatches should not be opened without making sure that the level of fuel is below the opening. Fuel stores can contain slip and/or fall hazards and care should be taken when moving about inside the storage. Laundry staff and other maintenance personnel need to know the condition of air within a fuel store and a CO alarm, either visual or audible should be installed. Mechanical fuel extraction equipment is inherently dangerous but this can be mitigated partly through electrical isolation. The boiler and related equipment must be isolated and the isolating switches 'locked off' before entering a fuel store. The equipment should be confirmed as isolated by testing it before any work is undertaken. The boiler system maintenance procedure should identify the method of isolation and verification. Equipment should not be turned back on until the maintenance has been carried out and the operative is a safe a distance away from mechanical parts.

In the event of boiler failure due to fuel shortage, there is often pressure on maintenance staff to enter bunkers to shovel fuel, or generally take short-cuts to restart the fuel feed to the boiler and restore heating to the building. Failure of fuel feed systems can result in combustion gases leaking back into the fuel store or other confined/poorly ventilated space. Therefore, in such instances, the hazard from CO or other hazardous gases may be increased.

Fuel bridging or arching occurs when a void is created under biomass fuel which gets stuck in the storage (e.g. by the creation of fuel "bridges" within the store). This can be very dangerous, as if people enter the store and walk on the fuel, they can fall through the apparent surface of the fuel into this void and the mechanical extraction equipment below. Operatives should not be allowed to investigate without undertaking a thorough risk assessment. Agitating the fuel from the outside is the best remedy. Isolation of the fuel extraction equipment should be assured.

Fuel storage fire

Fires can start for various reasons, burn-back from the boiler is the most likely cause and this problem has been effectively addressed by duplicate anti-burn back technology. Ignition from a hot source within the fuel storage such as electrical component or cigarette can be avoided by good design and protocols (no smoking!). In case of fire in a fuel store McCallum Linen staff should: Immediately call the fire brigade, Switch off boiler and ventilation systems, Carefully close hatches and openings, Await fire brigade, Inform management, Follow the instructions of the fire brigade.

Whilst local fire brigades should be trained to deal with fires, it is suggested that laundry staff should highlight the potential risk of structural failures of wood chip bunkers (due to increased density and thus greater force loadings on bunker walls) or CO emission when fuel stores are flooded with water to extinguish fires.

Biomass boiler and combustion

A CO monitor is required in the boiler house and this should be placed at head height on a wall near the boiler, visible from where an operative might be expected to stand and review the plant. It is not recommended that a CO monitor is fitted immediately above the boiler itself or above a source of potential leaks of flue gas. It is important that the general level of CO within the working environment is measured and that the monitor is not tripped by, for example, the opening of a boiler inspection port. CO monitors in such locations can cause alarms to be considered as routine and then ignored.

Boiler Maintenance

The boiler should be extinguished at least 24 hours before any maintenance work is undertaken. Due to the presence of metal and moisture inside boilers, any electrical supplies (e.g. lighting or tools) should be low-voltage (24 V). The water jacket of the boiler should be vented regularly to ensure that air and other gases do not build up inside the boiler as this can cause corrosion. Staff should be aware that the vented water may be hot. Biomass fuel has a high volatile content, which is released during the combustion process as a mixture of gases including: ′ carbon monoxide (CO), ′ methane (CH_4), hydrogen (H_2), explosive. These gases usually burn during normal operation but excessive build up and uncontrolled combustion can cause a fire side explosion. This can happen in circumstances such as; uncontrolled draft, excessive charging, delayed ignition, accidental or uncontrolled admittance of air to the combustion space. In order to avoid the consequentially severe explosion risks, it is vital that the manufacturer's operating instructions are adhered to at all times. Inappropriate manual intervention, for example by opening boiler doors or flue hatches when the boiler is operational, should always be avoided as this may lead to an explosive mixture being created in the combustion space.

Anti-burn back

The boiler is fitted with duplicate anti-burn back devices that eliminate the risk of fire reaching the fuel storage. These consist of a water quench system and rotary fuel valve. Laundry staff should ensure that the water supply for the quench system is connected and working. Regular inspections of the flexibly tipped rotary valves (which are designed to prevent burn-back) are required as abrasives in fuel can wear them down, degrading the seal.

Soot and ash handling

Soot and deposits removed from the boiler walls during cleaning, should always be stored outside in a metal container. Boiler and chimney soot are well known carcinogens due to high levels of polycyclic aromatic hydrocarbons (PAHs) and must be disposed of appropriately. Ash can contain glowing embers. It should only be handled in metal containers, and should be stored outside if possible. Completely combusted grate ash from clean biomass has a low level of PAH (in contrast to soot) and thus presents a lower risk. All fly ash, poorly combusted grate ash or ash from contaminated wood, presents a health hazard and should be disposed of as hazardous waste. However, the grate ash removed from a biomass boiler may still contain plentiful volatile content to cause rapid ignition when sufficient combustion air is available. Therefore care should be taken in when opening of the ash-hopper lid as the rush of air this causes can re-ignite the volatile content. It is not possible to eliminate all dust (mainly in the form of fly ash) in a biomass boiler house, and fly-ash is particularly pervasive. This fine particulate emission is likely to contain volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs), even from clean wood. Handling ash, sweeping the boiler house and doing associated tasks require staff training and the use of appropriate personal protection equipment (PPE), including full overalls, a rated dust mask and eye protection. Cleaning boilers is a particularly dirty task and staff must be aware of the risks. Maintenance staff should use a disposable respirator of class FFP2 (EN 149) or re-usable cartridge P2 (EN 143). A vacuum cleaner fitted with

HEPA filter would also be appropriate.   Ensure adequate ventilation of the boiler room when undertaking cleaning of the boiler.
Ash containers and ash removal must be undertaken in accordance with Manual Handling guidelines.

Flue and chimney

The flue should be checked and cleaned annually by a professional chimney sweep. Waste must be removed to a licensed landfill site as in theory the boiler operator is responsible for waste produced on their site. The flue must be cleaned through its whole length from the back of the boiler to the top of the flue. After cleaning, all components must be re-secured, e.g. all bolts on inspection plates. ′ A detailed visual inspection of the flue draft stabiliser should be carried out annually (draft stabilisers can suffer cracking through repeated mechanical action). ′ Lagging must be replaced where it has been removed to aid cleaning. ′ Corrosion from condensation should be checked annually. ′ Any problems should be fixed or reported and noted in the logbook.   Tar fires can occur when tar builds up in the chimney and flue ductwork from poor fuel and prolonged low fire operation. This tar usually burns off incrementally, but if it ignites this can cause the chimney to glow bright red. Regular flue maintenance is the best way to avoid chimney fires from tar. In case of a chimney fire The following actions should be taken: Stop the boiler firing by switching off at the main isolator, Call the fire brigade, If you perceive no risk to yourself and the fire is relatively recent, close the flue draft stabilisers and (ideally) cover combustion fan air inlets, Await fire brigade and inform management. Follow the instructions of the fire brigade and ensure (politely!) that the fire brigade understands the risks associated with fires in chimneys. It is best to seal with foam.

A ‘logbook’ should located in the boiler house and be maintained, recording, among other things, operational data, safety checks and maintenance activities. A copy of the boiler operation and maintenance manual should also be available to laundry staff and any other maintenance personnel.

Attachment 3

GUIDANCE NOTES

These guidance notes are intended to assist with the completion of the specimen supply contract for biomass by weight or volume. Neither the specimen contract nor the notes are intended to be prescriptive, and consideration must be given to site specific issues and the supplier/end user relationship. Both parties are advised to seek legal advice before entering into a legally binding contract. For additional background information on biomass fuels, storage, handling and a range of other relevant information the Carbon Trust's guide to biomass heating is available for download via the website: www.carbontrust.co.uk/biomass

Preamble.
This section is normally straightforward. However, the end user may not necessarily own the site or the installation – they may be operating it on behalf of a client (the owner), in which case the owner of the site needs defining separately in this part of the contract.

1. Contract.
The supplier and end user may mutually agree that clause 1.2 is overly restrictive – it may be necessary in terms of quality control, yet restricts the end user from sourcing alternatives should there be any doubt about the security of supply from a single supplier. Alternatively, the end user may choose a biomass co-operative (such as South West Wood Fuels) in which case, whilst only one supplier provides biomass to the end user, it will have been sourced from multiple suppliers earlier in the supply chain.

2. Biomass specification.
The appropriate biomass specification will depend on the fuel type (see Section 6), and to some extent on the performance specification of the boiler. Standards are vital for biomass to become a commodity fuel which end users can buy with confidence.
The European Committee for Standardization (CEN) formed a technical committee (CEN/TC 335 – Solid biofuels) to develop standards to describe all forms of solid biofuels within Europe, including wood chips, wood pellets and briquettes, logs, sawdust and straw bales. The standards allow all relevant properties of the fuel to be described, as well as the physical and chemical characteristics of the fuel, methodologies for sampling and assessment of moisture content, etc. Whilst some of these standards are still in draft form, they are becoming more widely used in the UK, and are readily available from several sources, including the Biomass Energy Centre (www.biomassenergycentre.org.uk).
Alternatively, the Austrian Standards Institute (*Osterreichisches Normungsinstitut*, referred to as ONORM) Standard M7 133 or the German Institute for Standardization (*Deutsches Institut fur Normung*) DIN 66 165 tend to be *de facto* across Europe and are widely used in the UK.

Ultimately, the end user should seek advice from the boiler manufacturer so as not to compromise any warranties, then select the most appropriate biomass specification in line with the manufacturer's recommendations.

3. Duration of contract.

The supplier and end user may agree an appropriate supply contract period of between 1 and 5 years. It is suggested that a sensible period of notice for either contract extension or termination would be three months, but this can be varied by agreement between the supplier and end user as required.

4. Quantity.

This contract template allows for supply by either volume or weight subject to the end user and supplier agreeing their preferences.

Whilst the energy content of wood by weight varies very little between different timber species, the density varies significantly. Therefore, if the end user is purchasing biomass by weight, the species of timber should not matter (although clearly the moisture content of the biomass will). However, if purchasing biomass by volume, the energy content will be dependent upon the timber species; for example, the typical calorific value of softwood chips at 30% moisture content is 0.70 MWh/m^3, compared to 1.02 MWh/m^3 for hardwood chip at 30% MC. In addition, the bulk density will vary considerably; resulting in a highly variable volume expansion from 1m^3 of solid wood to anywhere between 2 and 5.5 times the original volume when chipped.

Foresters tend to work in volume. Arguably though, purchase by weight is less problematic provided that the moisture content is specified and agreed in advance (based on the boiler specification), and that the supply complies with that agreed moisture content.

It is important from the supplier's perspective that a prescribed quantity (by weight or volume) is agreed contractually, whilst making provision for the end user to request additional biomass as required (but with reasonable notice).

5. Price.

It is generally accepted that fresh felled wood of most species weighs about 1 tonne per solid cubic metre, but as the wood becomes air dry it loses between one quarter and one half of its weight. Appendix 1 illustrates how this varies between species. However, the volume increases when wood is chipped. As a general rule of thumb, 1 tonne of woodchip will be equivalent to 4 cubic metres of chip. However, this conversion must be used with caution, as it does not take account of varying moisture content.

The final price (for either weight or volume) will depend on numerous factors, including the biomass quality, local market conditions, availability, and distance of travel. End users are recommended to appraise the local market to determine benchmark prices before negotiating the final price with the selected supplier.

The price should then be indexed by setting an initial price based upon the full costs of supplying the biomass to the site. The initial price then changes over time by periodically applying agreed indexation. However, the issue of an appropriate index for biomass is a complex one. Whilst it is important that biomass costs continue to be competitive vis-à-vis fossil fuel prices in order to maintain economic viability for the end user, biomass suppliers also need to be able to make a profit margin sufficient to maintain the economic viability of their business. The rising cost of fossil fuels will invariably have a knock-on effect to the price of biomass (i.e. with respect to harvesting, processing and transportation costs, all of which are processes reliant upon fossil fuels).

There are a number of different forms of indexation which could be applied:

• A price index for a major fuel such as the index for a heavy fuel oil (or gas) for [medium] sized manufacturing companies produced by the Department for Business, Enterprise and Regulatory Reform as contained in the Quarterly Energy Prices (e.g. Table 3.1.1: Percentage price movements between Q2 2007 and Q2 2008 for heavy fuel oil (HFO), electricity and gas, by size of consumer, for manufacturing industry) which can be found at http://www.berr.gov.uk/files/file47741.pdf;

• A general index as an agreed proportion of the Retail Price Index (RPI), except that if haulage costs (a critical cost factor for biomass fuel) increase by more than twice RPI in one 12 month period, the fuel supplier has the right to re-open discussions on prices;

• The price could simply increase at an agreed rate per annum e.g. 2% or 5%.

The most appropriate indexation should ultimately be mutually agreed between the supplier and the end user.

6. Fuel sources.

The source of biomass will depend to some extent upon availability in the local area. The contract is designed to be able to support the supply of a wide range of biomass fuels, including straw, cord wood, wood chip, wood pellet, short rotation coppice (SRC) such as poplar and willow, grass and non-woody energy crops such as Miscanthus (*miscanthus giganteus*), Switchgrass (*Panicum virgatum*), Reed canary grass (*Phalaris arundinacea*), Rye (*Secale cereale*), Giant reed (*Arundo donax*), and Hemp (*Cannabis sativa).*

7. Delivery of biomass.

Conditions for delivery of fuel will be site dependent, but need to fully take account of the health and safety risks to pedestrians, vehicles and property on the end user site. It is important that the supplier conducts a site survey well in advance, and identifies all risks and hazards on site before negotiating with the end user the most appropriate days and times of delivery. For example, if the installation is at a school, it may be considered more appropriate that delivery times to site are outside of normal school hours, in order to minimise the risk to pupils. Equally, the attendance during deliveries of an end user representative (e.g. Maintenance Operative, Site Supervisor) may be necessary for both health & safety and security reasons. Weekend deliveries may be acceptable or preferable at certain sites, depending on security policies and access arrangements.

7.4 In terms of notice periods for deliveries, the supplier may need 3-7 days in order to plan the delivery.

7.5 If the end user is remote and has no-one on site, responsibility for determining fuel levels may be assigned by prior agreement to the supplier.

8. Sampling.

Current relevant standards for sampling include CEN Technical Specification 14778-1, *Solid Biofuels – Sampling – Part 1: Methods for Sampling* and/or CEN Technical Specification 14778-2, *Solid Biofuels – Sampling – Part 2: Methods for sampling particulate material transported in lorries*.

Both specifications may be considered unnecessarily complex for certain sites, however. Part 2 is most relevant to a large capacity plant receiving multiple lorry deliveries per day.
Where moisture content is the critical factor, CEN Technical Specification 14774-2:2004 Solid biofuels - *Methods for the determination of moisture content - Oven dry method - Part 2: Total moisture - Simplified method* may be considered the most appropriate methodology.

9. Terms of payment.
The date of invoicing may depend upon the end user's financial accounting periods, whilst payment terms will depend upon the supplier's standard terms and conditions of sale. Both must be agreed in advance to avoid any dispute at a later date.

10. Other terms and conditions.
The level of the supplier's public liability insurance may depend on the end user's standard requirements. This must be agreed in advance to avoid any dispute at a later date. It is important that the limit on liability at Clause 10.2 and 10.4 is agreed at an appropriate figure. This should be representative of the end user's possible total loss but market practice is typically that such a sum does not exceed the maximum value of the contract to the supplier (i.e. the value of the total volume of fuel to be supplied over the course of the contract).

Appendix 1 – Fuel Specifications

The wood chip shall be: G50 with the maximum dimension being less than 120mm and cross section area less than 5cm2, moisture content less than 30%, ash content A2 and fines/contamination less than 5% (refer to standards tables below).

Wood Chips Classification: ONORM M7 133			
Description	**G30 Size**	**G50 Size**	**G100 Size**
Edge Length Single - Max	85mm	120mm	250mm
Pieces Cross Section - Max	3cm2	5cm2	10cm2
Retained in coarse sieve	Max. 20%	Max. 20%	Max. 20%
Coarse sieve mesh	16 x 16mm	31.5 x 31.5mm	63 x 63mm

Retained in medium sieve	60 to 100%	60 to 100%	60 to 100%
Main Quantity nominal length	30mm	50mm	100mm
Medium sieve mesh	2.8 x 2.8mm	5.6 x 5.6mm	11.2 x 11.2mm
Passing medium sieve	Max. 20%	Max. 20%	Max. 20%
Fine sieve mesh	1 x 1mm	1 x 1mm	1 x 1mm
Passing fine sieve	Max. 4%	Max. 4%	Max. 4%

Moisture Content		**Ash Content**	
Class	**Class Limits**	**Class**	**Class Limits**
W20	< 19.99%	A1	< 1%
W30	20 – 29.99%	A2	1 – 1.5%
W35	30 – 34.99%		
W40	35 – 39.99%		
W50	40 – 49.99%		

Contamination

The origin wood must also be free from general contamination such as:-

slate, stones, metal, rubber, plastic & other unidentified foreign bodies, heavy metal compounds as a result of treatment (e.g. Copper Chrome Arsenate(CCA) identified by green colour), halogenated organic compounds , e.g. Lindane (identified by yellow colour), Creosote (identified by dark brown stain and smell), painted wood, MDF, hardboard and fibreboard.

Attachment 4

McCallum Linen Steam System

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Total Gas Use – MJ	1,000,375	1,030,750	1,007,500	984,250	961,000	937,750	914,500	891,125	874,500	849,125	828,063	914,188	**11,193,125**
Gas Cost - $	$16,006	$16,492	$16,120	$15,748	$15,376	$15,004	$14,632	$14,258	$13,992	$13,586	$13,249	$14,627	**$179,090**
Heating kWh per Month	277,882	286,320	279,861	273,403	266,945	260,486	254,028	247,535	242,917	235,868	230,018	253,941	**3,109,204**
Work Days per Month	17	19	17	18	18	15	17	16	19	14	19	18	**207**
Operating Hours per Month	153	171	153	162	162	135	153	144	171	126	171	162	**1,863**
Total Average Heating kW per Hour	2,043	1,884	2,058	1,899	1,854	2,171	1,868	1,934	1,598	2,106	1,513	1,763	
Dryer Use - kW per Hour	932	932	932	932	932	932	932	932	932	932	932	932	**11,184**
Net boiler Demand - kW per Hour	1,111	952	1,126	967	922	1,239	936	1,002	666	1,174	581	831	**8,985**
Boiler kWh per month	277,882	286,320	279,861	273,403	266,945	260,486	254,028	247,535	242,917	235,868	230,018	253,941	**3,109,204**
Wood Chips - Tonnes	79.4	81.8	80.0	78.1	76.3	74.4	72.6	70.7	69.4	67.4	65.7	72.6	**888**

Notes: Information on gas usage, gas cost and laundry operating hours provided by McCallum Linen staff. Dryer gas usage based on plated output figures. Boiler usage based on balance of gas consumption not used by dryers. Wood chip usage based on a nominal energy content of 3.5 kWh per kg.